

**AI, UAVs, HYPERSONICS, AND AUTONOMOUS
SYSTEMS: EMERGING TECHNOLOGIES AND
EURO-ATLANTIC SECURITY**

HEARING

BEFORE THE

**COMMISSION ON SECURITY AND
COOPERATION IN EUROPE**

ONE HUNDRED SIXTEENTH CONGRESS

SECOND SESSION

—————
JANUARY 22, 2020
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Printed for the use of the
Commission on Security and Cooperation in Europe

[CSCE 116-2-1]



Available via www.csce.gov

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U.S. GOVERNMENT PUBLISHING OFFICE

WASHINGTON : 2021

39-690PDF

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January 22, 2020

COMMISSION ON SECURITY AND COOPERATION IN EUROPE
WASHINGTON, DC

The field hearing was held at 9:15 a.m. in Nedderman Hall, University of Texas at Arlington, Arlington, Texas, Hon. Marc Veasey, Commissioner, Commission on Security and Cooperation in Europe, presiding.

Commissioner present: Hon. Marc Veasey, Commissioner, Commission on Security and Cooperation in Europe.

Members of Congress present: Hon. Colin Allred, Representative from the 32nd District of Texas; and Hon. Ron Wright, Representative from the 6th District of Texas.

Witnesses present: Kelley M. Saylor, Analyst in Advanced Technology and Global Security, U.S. Congressional Research Service; Dr. William Inboden, Executive Director at the Clements Center for National Security and Associate Professor at the LBJ School, University of Texas-Austin; and Chris Jenks, Director of the Criminal Clinic and Associate Professor of Law, Southern Methodist University.

HON. MARC VEASEY, COMMISSIONER, COMMISSION ON SECURITY AND COOPERATION IN EUROPE

Mr. VEASEY. Good morning. It's my distinct pleasure to welcome everyone to this field hearing on the Commission on Security and Cooperation in Europe, which is informally referred to as the U.S. Helsinki Commission. I have the honor of serving as a commissioner. And the chairman of the committee is Alcee Hastings of Florida. And I want to thank Congressman Hastings for asking me to convene this hearing today at UTA. Some of you may be less familiar with the Helsinki Commission than our usual audience in Washington, DC, and I'd like to start off by telling you a little bit about the commission.

Forty-four years ago President Gerald Ford joined 35 other heads of state—including long-standing American adversaries—to sign one of the most significant international agreements of the 20th century, the final act of the Conference on Security and Cooperation in Europe, better known as the Helsinki Accords. The accords

committed the United States, Europe, and the Soviet Union to respect human rights, to manage the spread of dangerous weapons, to foster economic opportunity, and to ending the territorial disputes in Europe that had already twice plunged the world into war.

Our commission was created to uphold exactly these commitments, and since its inception it has provided a crucial voice for defending freedom, opportunity, and human rights throughout the United States and the Organization for Security and Cooperation in Europe, also known as the OSCE, where these commitments are negotiated to this day. Composed of Members of Congress from both parties and chosen from the House and Senate, the Helsinki Commission represents our democracy's commitment to preserving and advancing the peace, freedom, and prosperity across the world that previous generations of Americans sacrificed so much to be able to achieve. That is why I'm honored to have been appointed to serve on the Helsinki Commission, because the world has changed dramatically since it was established, but the need to defend the principles of peace and security and freedom and opportunity and human rights is greater than ever.

Ladies and gentlemen, let me now offer a few thoughts on the purpose of the event and why we're actually having the event here in Texas. The subject matter for today's hearing relates to the impact of emerging technologies on Euro-Atlantic security. And I'm looking forward to learning a great deal from our witnesses today on this subject. New threats that we are concerned with range from hypersonic weapons, to drones, to autonomous weapon platforms, artificial intelligence, directed energy, and others. These technologies have the potential to unlock some very important capabilities to ensure the defense of our homeland and support our allies and friends abroad. However, these same technologies are under development by some of our strategic competitors—Russia chief among them—and so I'll look forward to hearing from our experts and their views on how potential adversaries are looking to use some of these same technologies to threaten us and our allies around the world.

Finally, I will also look forward to our witnesses' views on how we should approach our international engagement on these technologies, including through diplomatic efforts and understanding what national and legal regimes apply or are under consideration. In particular, today's discussion should help us better consider whether the OSCE and its affiliated security institutions can offer a space to establish norms for emerging technologies. So that's what we want to get out of today's hearing.

But why are we having it here at UTA rather than D.C., where the Helsinki Commission and other committees normally meet? The answer to that question could not be more clear to those of us that are here in this room. But for the benefit of those who may be watching this on livestream or reading the transcript, I asked Chairman Hastings for the privilege of convening this hearing here precisely because of the unique confluence of technical know-how and academic expertise, and defense industrial presence we have right here in north Texas.

The spirit of innovation and expertise alongside cutting-edge industry and an innovative private sector is why the Army decided

to establish the headquarters of its Futures Command in Austin in 2018. In fact, after this hearing we're going to be spending some time over in Fort Worth at Lockheed Martin Aeronautics to be briefed on the capabilities and technological advances provided by the F-35 Lightning II aircraft, and how well it provides increased opportunities for interservice and international cooperation. I'll also be visiting the production line where the F-35 is assembled and getting a firsthand look at our fifth gen fighters.

And so we are here because of all the expertise available to us. But we're also here away from Washington because of how essential it is that Americans throughout our Nation have an opportunity to engage in policy discussions paramount to our shared values in the transatlantic space. This hearing offers a connection outside the Beltway to America's international commitments as a participating State of the OSCE. We should all have a stake in meeting commitments to our local and international communities.

And with that—with all of that being said, I now want to turn to my fellow Texans. To my right here we have Colin Allred, who represents the 32d Congressional District in Dallas County. And to my left we have Congressman Ron Wright of the 6th Congressional District. We're actually in his district, so thank you for hosting us. And he represents the 6th Congressional District, that represents Ellis counties and Tarrant counties. And I now want to yield to them so they can make some opening remarks.

Colin.

**HON. COLIN ALLRED, REPRESENTATIVE FROM THE 32d
DISTRICT OF TEXAS**

Mr. ALLRED. Well, thank you, Mark and Ron, for being here. And to our panel, thank you for taking your time out. I'd like to also thank the Helsinki Commission for holding this hearing here in north Texas.

The emerging technologies discussed in this forum can both enhance our security and further endanger our future. Although there are positive aspects to some of these technologies that could reduce the number of lives lost in armed conflict, there are, of course, ethical and legal dilemmas that they also present. And as we look to develop these technologies, I think the United States must balance both security readiness and maintaining our values as a Nation. That's why I'm looking forward to hearing from our witnesses today on these important topics.

I'm a member of the Foreign Affairs Committee and can say that obviously we are in a moment in which there is conflict popping up around the world, and in which we have a complicated threat stream that we're trying to look to. But as we turn to the great power competition that we've seen emerging now as the focus of our own foreign policy and of our strategic opponents, I think it's important that we look at these emerging technologies and how this is going to impact it.

I think as was said in some of the testimony that I read and that may be presented today, you know, advancing technology is as old as humankind, especially in warfare. This is something that we have done from the very beginning, finding better and more efficient ways to conduct warfare. And it has always presented ethical

dilemmas. Maybe never so much so as now, though. And I think that's something that we should consider, and that this is an area where the United States has to lead in. We're the only country that can lead in this regard. And we are, of course, I think, going to have to take the dual approach of pursuing our own technology advances while also pursuing international agreements to find a way forward.

So thank you all for being here. Appreciate you. And I look forward to getting into the testimony and having a lively discussion.

Mr. VEASEY. Thank you. Thank you very much, Representative Allred.

And now I'm going to pass the mic to Representative Wright.

**HON. RON WRIGHT, REPRESENTATIVE FROM THE 6th
DISTRICT OF TEXAS**

Mr. WRIGHT. Thank you. And I want to thank Congressman Veasey for having this hearing here and inviting me. I want to thank the panel for coming today.

One of the things that Congressman Veasey did not tell you is another reason to have it here is this is the land of the lucid, because it's not in Washington. And anytime you can have a hearing outside of Washington, it's a good thing.

Many years ago—by the way, I'm old enough that I actually remember the Helsinki Accords, probably one of the few people in the room that do—but many years ago, it was in the 1970s, and I'll never forget this. I was with my grandfather, and we were watching TV at his house. And there was this news report about—and it was an environmental report. It was mainly about smog and how bad automobiles had become in terms of their contribution to smog in concentrated areas. That was before we really started cleaning up, you know, how—catalytic converters and all those things that we added to cars to clean them up.

And he looked at me and he said: You know, we didn't have that problem with horses. And although he was joking, his point was well-taken. And that is that technology is always a double-edged sword. And if you have a cellphone, that cellphone is a double-edged sword. Nothing has interrupted my life like a cellphone has. And technology's a wonderful thing, but there's always that downside to it. And what we're looking at here today is—you know, we have just a plethora of emerging technologies, all of which could be used to benefit mankind tremendously.

I think—you know, I would like to think that within my lifetime biotechnology will solve the problem of famine. That's just one—medical science—I mean, I could—there's a long list of technologies that are emerging that are going to make a tremendous difference to the quality of life of everybody on this planet. But there's also that downside. And that is that bad characters can use that same technology and weaponize it in ways that would really hurt and possibly even destroy humanity. This is a very important hearing. Congressman Veasey, thank you for holding it.

Mr. VEASEY. Absolutely. Congressman Wright, thank you very much.

And before I finish with my remarks, I just want to share a personal story that you may find humorous. So Friday night Ron and

I, Congressman Wright and I, were both here at UTA for the MLK banquet that they had on Friday night. And as Members of Congress, particularly when we're back in our district, we're very busy. We're always at, like, different events.

And were it not for the wonderful staff and all of our staffs represented here today that help us, from everything including keeping our schedules, we really wouldn't know how to get from one place to the other. I usually literally look at my schedule the night before to know what I'm doing that next day to try to keep up with everything. And so it's not unusual that you forget or don't recall that you've agreed to go to a certain event.

And so if you could have saw Congressman Wright's face on Friday night at the banquet when I told him: Ron, thank you for agreeing to come to Helsinki. And he looked at me like, When did I agree to go to Finland with you? [Laughter.] And if you could have just saw his face. It was—it was—

Mr. WRIGHT. My heart stopped.

Mr. VEASEY. Yes. It was—it was classic. But again, I want to thank both of these gentlemen for taking time out of their busy schedule to be a part of this.

Now let me express my gratitude to the experts who have taken time out of their busy schedules to also be with us today to provide their testimony for the record. I'd like to very briefly introduce them. And I think that you'll see that they represent a clear demonstration of the incredibly high caliber of locally sourced national security expertise we have right here in Texas.

First, we're going to hear from Kelley Sayler, who is an analyst in advanced technology and global security at the U.S. Congressional Research Service. Kelley, thank you very much for being here. For those who may not know, the CRS is a great resource to all of us that are Members of Congress. We really depend on them to provide us expertise on almost any subject matter that comes before us as members. Ms. Sayler has an extensive experience working on these issues both in and out of the government, including service in the Office of Security and Defense. And I'll also note her strong Texas connections. She received her master's degree from Baylor University and also took some classes here at UTA. So, Ms. Sayler, thank you very much for being here.

Our next speaker is going to be Dr. William Inboden, who serves as the executive director of the William Powers, Jr. chair at the William P. Clements, Jr. Center for National Security at the University of Texas at Austin. Among Dr. Inboden's many other roles, he serves as associate professor at the LBJ School of Public Affairs, distinguished scholar at the Robert S. Strauss Center for International Security and Law, and editor-in-chief of the Texas National Security Review. He has served as a senior director of strategic planning on the National Security Council at the White House and in the Department of State's policy planning staff, as well as serving as a staff member in both the U.S. Senate and the House of Representatives. Thank you very much for being here today, sir.

Our third witness will be Professor Chris Jenks, who is the director of the Criminal Clinic and associate professor of law at the Dedman School of Law at SMU university in Dallas. And as you

can see, Chris is even wearing his SMU colors. Thank you for representing your colors here today. As a noted expert on the Law of Armed Conflict and lethal autonomous weapons, Professor Jenks has served more than 20 years in the U.S. Army, first as an infantry officer in Germany, Kuwait, and as a NATO peacekeeper in Bosnia, and later as judge advocate. He also served details at the Department of State and at the Department of Justice and was recently called to serve as special assistant to the Department of Defense general counsel.

And as a last note before I turn the floor over to the witnesses, I'd like to offer thanks to the University of Texas at Arlington. Thank you very much, Dean, for helping us coordinate this, and being a part of this day. We really, really do appreciate that. And just really Nedderman Hall, because this being the engineering department, and so much of the technology that happens here on a daily basis. I couldn't think of a more fitting place for us to have this program today.

And let me inform witnesses that their full statements will be entered in the record. And I've asked them to summarize their testimony for the purpose of our discussion today. You now have the floor. And we'll start with Ms. Sayler.

KELLEY M. SAYLER, ANALYST IN ADVANCED TECHNOLOGY AND GLOBAL SECURITY, U.S. CONGRESSIONAL RESEARCH SERVICE

Ms. SAYLER. Thank you to Representative Veasey, Representative Allred, Representative Wright, and the Helsinki Commission for the opportunity to provide an overview of emerging military technologies and their potential implications for international security. I will focus my remarks today on three specific emerging military technologies: Artificial intelligence, lethal autonomous weapons, and hypersonic weapons.

Although the U.S. Government has no official definition of artificial intelligence, AI generally refers to a computer system capable of human-level cognition. AI is currently being incorporated into a number of military applications by both the United States and U.S. competitors, including but not limited to intelligence, surveillance, and reconnaissance; logistics; cyber operations; command and control; and semi-autonomous and autonomous vehicles.

These technologies are intended to either augment or replace human operators, freeing the operators for more complex and cognitively demanding work. In addition, AI-enabled systems could both react significantly faster than systems that rely upon operator input and cope with an exponential increase in the amount of data available for analysis. AI could also enable new concepts of operations, such as swarming, in which unmanned vehicles autonomously coordinate to achieve a task. Swarming could confer a warfighting advantage by overwhelming adversary defensive systems.

The Department of Defense reportedly maintains over 600 active AI projects and is particularly focused on developing AI applications for predictive maintenance, humanitarian aid and disaster relief, cyberspace, and robotic automation. China is the United States' most ambitious competitor in the international AI market.

China has pursued language and facial recognition technologies and is developing various types of unmanned vehicles. It is also actively pursuing swarm technologies. In addition, reports indicate that the Chinese are developing a suite of AI tools for cyber operations.

Russian AI development lags behind that of the United States and China. Nonetheless, the Russian military has been researching a number of AI applications, with a heavy emphasis on semi-autonomous and autonomous military vehicles. Russia is also developing swarming capabilities and is exploring innovative uses of AI for remoting sensing and electronic warfare. In the event of a conflict, these capabilities could reduce our ability to effectively communicate and navigate on the battlefield.

A related technology is lethal autonomous weapons, also known as LAWS. Although there is no internationally agreed upon definition of LAWS, the Defense Department has identified LAWS as a class of weapon systems that is capable of independently selecting and engaging targets without manual human control of the system. This capability would enable the system to operate in communications-degraded or -denied environments where traditional systems may not be able to operate.

Some analysts have noted that LAWS could additionally allow weapons to strike military objectives more accurately and with less risk of collateral damage or civilian casualties. Others, including approximately 25 countries and 100 nongovernmental organizations, have called for a preemptive ban on LAWS due to ethical concerns such as a perceived lack of accountability for use and a perceived inability to comply with the proportionality and distinction requirements of the laws of war. The United States is not known to be currently developing LAWS, and neither China nor Russia has publicly stated that it is developing LAWS.

Hypersonic weapons, which fly at speeds of at least Mach 5—that's five times the speed of sound—and maneuver throughout their flight, are in development in a number of countries, including in the United States, Russia, and China. Currently no defense against hypersonic weapons exists, and experts disagree on the affordability, technological feasibility, and utility of hypersonic missile defense options. The Department of Defense currently has a number of hypersonic development programs; however, the United States is unlikely to field an operational hypersonic weapon before 2022.

Russia is pursuing two nuclear-capable hypersonic weapons—the Avangard and Zircon. Russia claims that Avangard became operational in December 2019 while the Zircon could become operational as early as 2023.

China has tested the DF-ZF hypersonic weapon at least nine times since 2014. Although unconfirmed by U.S. intelligence agencies, some analysts believe the DF-ZF will be operational as early as this year. China also successfully tested Starry Sky-2, a hypersonic vehicle prototype, in August 2018. And some reports indicate that that system could be operational by 2025.

The implications of these and other emerging technologies for international security are difficult if not impossible to predict. They will be a function of many factors, including the rate of techno-

logical advancement in both the United States and competitor nations, the manner in which emerging technologies are combined and integrated into existing military forces, the interactions between various emerging technologies, and the extent to which national policies and international law enable or inhibit their development, integration, and use.

Nonetheless, many emerging technologies exhibit characteristics that could potentially impact the future character of war. For example, developments in technologies such as artificial intelligence, big data analytics, and lethal autonomous weapons could diminish or remove the need for a human operator. This could, in turn, increase combat efficiency and accelerate the pace of combat, potentially with destabilizing consequences. Emerging technologies could also potentially shift the offense-defense balance. For example, some analysts have suggested that swarms of coordinated, unmanned vehicles could overwhelm adversary defensive systems or U.S. defense systems, providing a greater advantage to the attacker, while directed-energy weapons that provide a low-cost means of neutralizing such attacks could favor the defender.

Thank you, again, for inviting me here today. And I very much look forward to your questions.

DR. WILLIAM INBODEN, EXECUTIVE DIRECTOR AT THE CLEMENTS CENTER FOR NATIONAL SECURITY AND ASSOCIATE PROFESSOR AT THE LBJ SCHOOL, UNIVERSITY OF TEXAS-AUSTIN

Dr. INBODEN. Congressman Veasey, Congressman Allred, Congressman Wright, Helsinki Commission, and of course our UT Arlington leadership and student hosts, thank you also for including me in today's hearing. I want to say, as a parenthetical, it's especially encouraging to see bipartisan leadership here committed on these national security issues during our time of considerable division in our country across party lines. It's a great reminder of the bipartisan commitment that some wonderful leaders in Congress have to keeping our country strong and safe. So thank you. Your very presence here today shows that.

On April 27th, 2007, Estonian citizens found their country under attack. External threats were all too familiar to this tiny Baltic State, which had been invaded and occupied for most of the 20th century by Nazi Germany and then by the Soviet Union. But this attack was different. It wasn't tanks and troops rolling across the border, or airplanes dropping bombs from the sky, but computer signals traveling at the speed of light through internet cables. In short order, the cyberattacks disrupted or shut down entirely Estonia's banking system, government, major media outlets, and political parties. These attacks continued in waves for 3 weeks. Though not a bomb was dropped, or shot was fired, nor did a single enemy soldier set foot in the country, the effects were crippling and brought the country to a standstill.

For Estonia, the effect was almost the same of being invaded, occupied, and controlled by an outside power. That outside power was Russia. Though 13 years after the onslaught on Estonia many operational details are still unknown—which is, of course, itself a hallmark of cyber warfare—what is not disputed is that the Kremlin

was the originating, authorizing, and orchestrating power behind the attacks. As the historian Robert Service writes, “the Kremlin’s purpose was not only to knock out the Estonian network of communications but also to show the world what it could do—as well as to allow its disruptive specialists to conduct a real-life test of what became known as hybrid warfare. Without setting foot outside the Russian capital they could do enormous harm abroad.”

In that spirit, and for purposes of this hearing, from our vantage point 13 years later, I think we should look back on Russia’s cyberattack on Estonia and see it for what it was: the first wave in what would become a cascade of Russian aggression and hybrid warfare that included weaponizing new technologies—the very technologies we’re looking at today. The Estonia attacks were followed by Russia’s invasion of Georgia in 2008, by its seizure of Crimea and invasion of Ukraine in 2014, its military intervention in Syria in 2015, and even, I would argue, its assault on our democratic processes in the 2016 election cycle—an assault which continues today.

And I begin with these observations because, though Russia isn’t mentioned by name in the title of today’s hearing, Russia is the OSCE member State most implicated in the themes and questions we’re addressing today and developing and implementing these new weapons systems.

I should also mention, parenthetically, I’m glad that Ms. Sayler’s testimony mentioned China. I was talking with Congressman Allred beforehand. We could do a whole ‘nother hearing on China. And I think China’s advances in this area are even more significant. I was focusing on Russia because they are an OSCE member State, but also because, unlike China, Russia is actually employing these on the battlefield right now. China may have every intention of doing so, and we need to watch that space carefully. But Russia’s actually operationalizing this.

So anytime we make a strategic assessment of emerging technologies, I think we should ask ourselves what is new, and what is not? I want to mention three aspects of these new weapons technologies which are not new. The first is lethality. Yes, these can be lethal, but ever since nuclear weapons we’ve had, you know, the most totalizing form of lethality that the world has known—in addition to chemical and biological.

The second which isn’t new is range. These emerging technologies don’t necessarily have unprecedented levels of range and reach. Existing weapons systems could already project force globally, and for over a half century we’ve had reach into outer space.

The third which is not new is speed. Again, these emerging technologies have varying dimensions of speed, but they don’t necessarily represent a qualitative leap in rapidity. Ballistic missiles already fly at several times the speed of sound, as hypersonics do. The internet already offered communications at the speed of light.

So what is new? I think there’s three aspects of these emerging technologies which are new, at least in a strategic sense. The first is deniability. Given various factors involving the distance of human operators, the operational complexity of cutouts and false surrogates, and the literal autonomy of some of these systems, oftentimes it’s very easy to deny who actually was the main actor be-

hind it. You know, to put it more colloquially, a lot of time they're not going to have a return address. And that makes deterrence and retaliation more difficult and can be strategically destabilizing.

The second is controllability. This is the corollary of deniability. These new weapons systems can be controlled remotely with greater precision, from greater distance, with greater anonymity, and in greater safety for the operators than any previous weapons by an order of magnitude. It means that kinetic action could be taking place in an OSCE participant State, but controlled by various actors 10,000 miles away.

And the third is inhumanity. And I don't mean this in the melodramatic sense, but the very literal sense of removing the human actor in ways we've never before seen before. The emerging domain of AI and autonomous weapons brings us a new paradigm that may completely remove the human actor and quite literally be inhumane. A great analyst on these is Paul Scharre of the Center for New American Security. I know Kelley's worked with him before. And he put it this way in his really excellent new book, "An Army of None": "Do we control our creations or do they control us?"

So how then, on the very specifics of our hearing today, should the OSCE think about these emerging technologies? Here's my main takeaway. If you remember nothing else from today, remember this next sentence: The importance of these emerging technologies cannot be evaluated aside from the nature of the states that use them. It's not the fact of the new technologies that matters most, but who will use them and for what purposes.

To put it a little more provocatively, I doubt that many if any of us here worry too much about the United Kingdom and France possessing nuclear weapons, even though they both have for 77 years. Whereas many of us do continue to worry about Russia's nuclear arsenal. And there's a reason—there's a reason for that. And this is, I think, the core strategic insight of the original Helsinki process, the commission that brings us here today, because it connected respect for human rights and civil liberties with European and transatlantic security. And that continues to be the animating spirit of the OSCE.

So bringing it back to Putin and Russia, his authoritarian rule squelches and silences any dissent, and empowers him to act with aggression based only on his whims or designs. Because he lacks popular legitimacy—and because he fears his own citizens—he resorts to a perverse and toxic combination of cultivating grievances, fueling paranoia, and projecting strength against adversaries, real or perceived. So such a ruler would naturally seek to acquire—and in his case to use—the most advanced, sophisticated, and lethal weapons systems that he can.

So what should be done? I think the best framework to address these emerging technologies lies in the commitments and values of the Helsinki Final Act. Again, the accords, the agreements that the CSCE continues to monitor and implement today. Open, free, and secure societies are best equipped to explore, debate, wrestle with and ultimately resolve these hard questions. In contrast, authoritarian states, by their nature, brook little dissent, encourage little transparency or debate, and concentrate power in the hands of dictators that generally make decisions on the employment of arms

based on expediency and utility, rather than morality or conscience. So in practical terms, any strategy to address Russia's growing advantage in this weaponry needs to include pressing Russia to honor its OSCE commitments on human rights and freedoms.

Finally, how might these technologies be managed and perhaps limited by international agreements? Well, I'm going to conclude with a hope, a caution, and a recommendation. The first is a hope. International agreements are possible. They have been forged at times in the past on controlling new weapons technologies, whether sawtooth bayonets, dum-dum bullets, chemical and biological weapons, blinding lasers, or even the entire class of nuclear weapons abolished by the 1987 INF Treaty, competing states have been able to come together, forge agreements, and honor and fulfill them. So that's the hope.

The caution: An arms control agreement is only as strong as its weakest signatory, and its verification regime. While Russia would need to be part of any effective arms control accords on emerging weapons technologies, Russia also historically has a bad habit of treaty violations. These include its violations in its previous incarnation as the Soviet Union or now as Russia of the ABM treaty, the Biological Weapons Convention, and the INF Treaty, not to mention its serial violations of its OSCE commitments. So we should temper our expectations or hopes of just how much can be accomplished with Russia in this realm in the near term.

And finally, the recommendation. I do think the U.S. and our like-minded OSCE participant States should take a page from the cold war playbook and combine strength with diplomacy. Diplomatic success proceeds from military power and allied unity. To begin, the U.S. and other OSCE democracies should move forward in developing our own capabilities on emerging weapons technologies, specifically those featured today. Unilateral disarmament is not a luxury that we can indulge.

But as with the NATO dual track decision of 1979 to respond to the Soviet deployment of intermediate-range nuclear missiles in Europe by, in turn, on the one hand, deploying American intermediate-range nuclear missiles, Pershing IIs and ground-launched cruise missiles, and also pursuing diplomatic negotiations was a key decision NATO made and the Reagan Administration implemented thereafter of buildup, but also negotiate at the same time. We need to build up to negotiate. I think from a position of strength we can better encourage Russia and other potentially recalcitrant states, such as China, of the advantages of setting shared rules for the control, use, and limitation of these weapons.

Thank you for your time and I look forward to our discussion.

CHRIS JENKS, DIRECTOR OF THE CRIMINAL CLINIC AND ASSOCIATE PROFESSOR OF LAW, SOUTHERN METHODIST UNIVERSITY

Mr. JENKS. Congressman Veasey, Congressman Allred, Congressman Wright, I want to thank the Helsinki Commission and UTA for hosting this hearing and bringing attention to artificial intelligence, unmanned aerial vehicles, hypersonic, and autonomous systems. These topics are a problematic combination of critically

important and commonly misunderstood. It is vital to transatlantic security that the United States and our allies reach consensus on how we think about these topics so we can identify where and how we wish to develop and operationalize emerging technologies, but also to identify norms and whether to limit the export of certain technologies to mitigate the risk of these capabilities ending up in the hands of bad actors.

Some of today's topics are not being meaningfully discussed in multilateral fora. And the one topic which is the subject of such discussions, autonomous weapons, is frankly validating why entities like the OSCE may want to consider adding emerging technologies as a focus area. Autonomous weapons have been the subject of several years of discussions within the United Nations. The wonderfully named Convention on Certain Conventional Weapons, or CCW, has intermittently met in Geneva beginning in 2014. There are 125 states parties to the CCW, so roughly two-thirds of the countries in the world have signed on, including the U.S., Russia, China, and all of our European allies. The purpose of the CCW is to ban or restrict the use of specific types of weapons that are considered to cause unnecessary or unjustifiable suffering to combatants, or to affect civilians indiscriminately.

But referring to autonomy and autonomous weapons is to refer to a technological descriptor, not a specific type of weapon. As a result, the international community has spent many confusing and frustrating hours in Geneva talking past each other because of the different understandings of autonomy. That is but one reason why the OSCE should consider also taking up this issue. Because we're talking about a technological descriptor, there are just as many, and frankly more, civilian applications which will leverage autonomy than there will be military. And these civilian applications will be increasingly important for economic growth and prosperity which, of course, also bears on security.

Another reason why the OSCE should take up emerging technologies is to help inform the public. Within the CCW autonomous weapons discussions there is a small but exceedingly vocal coalition of nongovernmental organizations which seek to regulate or ban autonomous weapons. They have been effective at inciting what I call moral panic, employing evocative science-fiction imagery of uncontrollable robotic weapons indiscriminately roaming the streets and shooting at everything from a toddler to a teddy bear. I don't want you to think that I'm being hyperbolic. They literally produced images of a robotics weapons system and a child carrying a teddy bear.

While that sounds, and frankly is, absurd, one of the results of their efforts is that autonomy and artificial intelligence are now four-letter words. What do I mean? Well, some countries are avoiding acknowledging that they either already have fielded or are developing autonomous weapons systems—as if the word “autonomy” was now recognized as either politically incorrect or a profane word we were just made aware of. When I speak of autonomous weapons, similar to Ms. Sayler, I use the widely accepted definition of a system which is capable of selecting and engaging targets without human intervention. So we are talking about weapons systems which determine what to shoot at, and then shoot at that target.

We should be clear that such systems are not far off in some vague technological timeline future. They are here, they have been here. The U.S. and many other countries, including our European allies, have fielded weapon systems with an autonomous mode. This goes back to the early 1980s. The systems are largely defensive, and anti-materiel. They shoot down incoming missiles, or planes, or boats which are attacking at close range. With technological advances comes the possibility of weapons systems able to perform new and different functions than in the past.

I'm not saying this doesn't raise concerns. It does. But it also raises the prospects, as Congressman Allred alluded to, of limiting war's harmful effects, of using lethal force with greater discrimination, limiting civilian casualties but also better protecting our servicemembers. In my view, there can be no question that the U.S. and our European allies must continue to leverage emerging technology and weapons systems. We would be derelict in our duty if we didn't. But we need to halt the demonization of technology in the context of weapons.

So I'll end by expressing my hope that you continue and expand these discussions both here in the U.S. and also in and with our European allies.

Thank you for your time. I look forward to your questions.

Mr. VEASEY. Thank you very much. And I want to thank the panelists for those opening remarks. I'm going to open up with questions, and then I'm going to ask the members if they would like to ask the panelists questions as well. And if we have time, toward the end of the program we're going to open it up for questions from the audience. And so please be thinking about forming your own questions to ask these distinguished panelists.

The first question that I have is on these new technologies. And I wanted to ask you particularly about how these emerging technologies have reinforced our ability to protect our own security and that of our allies and partners abroad. And I want to give you a specific example—addressing the A2/AD challenge by Russia and China.

As you know, Russia—and it was talked about earlier in opening comments that you made—Russia actively threatens our NATO allies through its deployment of what are called anti-access/area denial—A2/AD—capabilities in Kaliningrad and in Crimea, among other locations. These capabilities are designed to make it impossible for the U.S. to operate freely in the Baltic and Black Sea regions in the event of a conflict. China is similarly deploying capabilities designed to impact our ability to operate in the South China Sea.

To what extent are these technologies we are discussing today relevant to addressing this particular challenge? And in particular, how could the United States' use hypersonic weapons and/or AI to defeat the capabilities of an adversary trying to deny us access to a certain geographic area? And we'll ask Ms. Sayler to open up with comments on that.

Ms. SAYLER. So I think the National Defense Strategy actually states very explicitly—there's a callout for emerging technologies, a recognition that these will, quote, "ensure we will be able to fight and win the wars of the future." And so I think there was a rec-

ognition by the Pentagon that these would be critical in applications such as anti-access/area denial situations in Russia and China.

When we're talking about emerging technologies, I think it's very important to keep in mind that the technologies are not ends in and of themselves. So they are tools in the hands of a commander. And what I mean by that is that it's not just that we get the right technologies, it's that we also ensure that they are integrated into our military forces, that our military forces are trained on how to use them, and that we have the appropriate concepts of operation to ensure that they're actually effective on the battlefield.

And so hypersonic weapons, we don't have—publicly available anyway, operational concepts. It's difficult to evaluate how they might be used in the event of a conflict. But theoretically they offer maneuverability that you could potentially use if you have the appropriate sensor architecture to target road mobile missile launchers, that we know that both Russia and China, strategic competitors, are investing in, as well as other fleeting targets—for example, in a terrorist-type situation. With artificial intelligence you're also increasing the speed with which you can execute decision-making. Again, that depends on how it's integrated into the system. But in theory that would enable you to be making decisions faster than your adversary. And that obviously gives you a distinct advantage.

Mr. VEASEY. Mr. Inboden, do you have any comments on that?

Dr. INBODEN. Just to add to that, at the strategic level a real concern I have is the growing cooperation between Russia and China in this realm. Whether it's technology sharing, joint military operations, or even shared strategic concepts on anti-access/area denial. So China started pioneering this in the South China Sea. Russia saw that and sort of took a page out of Beijing's playbook in Kaliningrad.

The other thing I'd say is this is not so much about the United States trying to poke our nose into other people's business where we don't have an interest. We have treaty allies who are very directly threatened and implicated by this. You know, Poland in the Baltics, you know, around Kaliningrad, of course, the Philippines in the South China Sea, and then our commitments—not formal treaty—but commitments to Taiwan and others. So our legally and morally bound allies want us there. And when adversaries are saying we can't be there because of these new technologies, that's a real problem.

On the plus side, I hope that for regaining access sometimes it might be a matter of just disabling their command and control and communications without even having to fire a shot. So sometimes we can leap ahead of them if they've been able to try to deny access to an area. So I'm being a little more optimistic there, but it's not all a losing proposition.

Mr. VEASEY. I wanted to talk a little bit about the U.S., and are we falling behind in hypersonics. You know, Vladimir Putin claims that Russia is now the world's leader in developing and deploying operational hypersonics. Some analysts suggest that China is also potentially ahead of the United States in this domain. To what extent is this case? And what impact could it have on international

security? And I think you have to keep in mind Putin—especially with him being a former KGB guy, he’s always trying to spin things. He’s always trying to see if he can win a propaganda war in saying things like that. But to what extent should we really be concerned about this?

Ms. SAYLER. So I think when we’re evaluating whether or not the United States is falling behind in hypersonic weapons, it depends on the metric. So by a timeline, Russia has stated that it has already fielded a hypersonic weapon. China is likely to field on this year. The United States is not going to field one for probably two or three more years. But it’s not an apples to apples comparison because we’re developing different types of systems. And the systems that the United States is pursuing are actually more technologically sophisticated because, for example, we’re not pursuing nuclear armed weapons. And so they need to be actually more precise than some of our strategic competitor systems.

With that said, there is a broad range of opinion sort of on what the effect will be if these systems are deployed by U.S. competitors. So on one hand some analysts believe that these could be destabilizing because they’re very unpredictable in how they operate, and you could have uncertainty with regard to the object that’s being targeted, and that could in turn lead to unintended escalation of a conflict or other sort of destabilizing actions.

On the other hand, there are analysts that believe that these technologies will be bound by the same principles of deterrence as our already existing missiles, and that therefore they are unlikely to have a profound consequence. And those analysts also point out that the United States missile defenses already are vulnerable in particular circumstances. For example, if an adversary were to deploy a missile salvo, and therefore their ability to launch a hypersonic weapon doesn’t really change things particularly. So that’s sort of the range of opinion on that issue.

Mr. VEASEY. My last question before I turn it over to colleagues, is the ethical, the human rights considerations. You know, some of the things under consideration—a lot of it is very sobering, especially when you start talking about lasers that blind people, as I think Dr. Inboden mentioned in his opening comments. You know, gene-editing babies, those are things that I think should concern all of us. What are the implications of emerging technologies for ethics and human rights? And are certain technologies more concerning than others to you? And what, if anything, governs our development of our own deployment of these technologies? And I’ll open it up to anyone that’s on the panel.

Ms. SAYLER. So I think with regard to ethics and human rights, again, it depends specifically on the country that’s developing. What measures do they have in place? What does their weapons review process look like? When we talk about lethal autonomous weapons, again, full range of opinion. The U.S. Government has stated publicly that it believes that a ban on such systems would be preemptive and premature at this time, because potentially they could enable us to adhere even better to the law of armed conflict, that they would be more precise, that they would not have collateral damage or civilian casualties that other weapons systems might have. There’s an alternative view that suggests that these

weapons would be inherently indiscriminate. And so I think it depends on how countries are evaluating their systems, and essentially ensuring that they can perform as anticipated when they're deploying them. And that's a country-by-country sort of issue.

Dr. INBODEN. A couple thoughts to add to that. I'm in agreement with everything Ms. Saylor said. The first is essentially what she said, there are some upsides to these new technologies in the realm of ethics and morality. So for example, UAVs, you know it can be very controversial, drones, but in addition to the extra protection they provide for American forces their precision really helps fulfill two of the cardinal tenets of just war theory, law of armed conflict, of discrimination and proportionality. The first, discrimination, being you don't kill civilians, you just kill the bad guys, the enemy combatants. And with its precision targeting, you know, the bad guy can be right there, and a civilian right next to him or her, and we can just take him—take him out.

The second, of course, is proportionality. Don't use any more force than you actually need. Don't use a 500-pound bomb if a bullet will do. And again, just putting a, you know, six-or eight-pound warhead on a—on a missile from a UAV can sometimes kill just the right number of the bad people without excessive civilian casualties.

So there are some positive sides of this. Another one, getting a little more into the realm of sci-fi, is that sometime it might even be—we might even have the capabilities to disable an enemy weapon system without having to kill any of them. But, you know, just make it stop in its proverbial tracks there.

I come back to the principles of the Helsinki Accords, Helsinki's commitments to religious freedom, to allowing religious communities to bring voices of spirituality and conscience into these debates ensures that free societies, while doing whatever they need on the weaponry and materiel fronts, are also bringing in voices of conscience and morality to shape these debates. And that's my bigger worry with the Russias and Chinas of the world, is they're making these decisions based only on military strength and expediency, while they're squelching the different, you know, clergy and religious citizens who may be able to bring the voice of conscience in. So that's why I go back to that core Helsinki insight of all these things need to be considered together.

Mr. JENKS. In terms of the implications, I think there's certainly at least the potential for some real positive, but also some negative, implications. When I think of the potential positive implications—I mean, it's certainly an ethical or a human rights win if we're limiting civilian casualties, limiting collateral damage. I think there is a risk with some of these emerging technologies that they might lower the threshold for using force, because you're now able to use force in a way where your servicemembers are not going to be at risk. And when you add into that, as Mr. Inboden talked about, deniability, I think that's a risk.

One of the things I find interesting in the ethics discussion is increasingly people talking about human dignity and being killed by a machine. And I struggle to understand the difference in a human killing a human or a machine, frankly, killing a human. When I served in Iraq and we had a number of wounded U.S.

servicemembers, I never encountered a wounded U.S. servicemember who felt better about having been shot by a person as opposed to an autonomous system. So I think we even have an ethical obligation to pursue some of these systems if we're able to use them more discriminately.

In terms of potentially worrisome technologies, I think kind of below the radar a lot of the focus is on armed forces, but domestic security services. If you think about crowd control and privacy concerns—and if I now tell you that both on the air and on the ground there are robotic systems that are able to surveil or maybe even use—take riot kind of control measures, and to do so autonomously, you can see how in the hands of different country security services that don't have the constitutional obligations and responsibilities that we do, you could see that getting very problematic from a human rights or privacy perspective.

Mr. VEASEY. And I think also too one thing that has to be taken into consideration that I would ask the audience to think about also is that once you start limiting these things for military use, what sort of impact is that going to have on civilian applications, right? I mean, a lot of the things that we rely on for everyday use today—whether it's GPS, or whether it's, you know, drones—I know that cities now want to be able to use drones and what have you to be able to monitor things like traffic and high-speed pursuits, and what have you. So there are a lot of things that the military uses for defense purposes that we also want to be able to benefit from for everyday civilian use too. And you know, by denying some of these things what sort of impact will it—will it have on us being able to have these advances, particularly when other, you know, other countries are trying to develop them.

So with that, I'm going to turn it over to Congressman Wright.

Mr. WRIGHT. Thank you very much. I think all of you know that Alfred Nobel invented dynamite. Now, this is the same Alfred Nobel for which the Nobel Prizes are named. And the story goes that when he developed dynamite he thought he had invented the end of war because it was such a horribly destructive device. And of course, we saw that that was wrong. And the experience of the 20th century at least was that if a technology could be developed then that technology would be weaponized. And if it could be weaponized, it would be used.

Now for the last—since the 1980s, and the different arms accords and agreements that we've had, the use of nuclear weapons, at least by governments, has not been as great a factor as it was when I was growing up in the 1950s and 1960s. But that concern still—is still there, that if there is a technology that can be developed, it would likely, by bad actors, be weaponized and possibly used.

And so you get into the ethical and moral questions y'all were just discussing. And I remember the neutron bomb, and the moral absurdity of having a bomb that would kill people but leave the buildings intact. That was a moral—and a worldwide outrage, because it was morally absurd. Why would it matter if the building survived, if all the people were dead?

So you get into those kind of questions. My first question to you, though, is all these emerging technologies that can be weaponized,

what frightens you the most? And I want all three of you to answer that.

Mr. JENKS. I think I would just reiterate, for me—I mean, and different people have different fears or concerns. The idea of a kind of constant surveillance state that would be emboldened by autonomous—by autonomy, and the idea that there could be drones in the air. And you know what that drone does? It follows you everywhere. And if you turn this into microdrones and swarms of them, the idea that—I mean, I think a lot of people misunderstand that everywhere you are in Manhattan, you're on a camera. And everywhere you are in parts of London, you're under a camera. Now, just expand that level of surveillance, and I think the privacy—the privacy concerns. So that's—for me, that's the concern that comes to my mind.

Mr. WRIGHT. Makes your computer easier to use.

Dr. INBODEN. I would share all the concerns that Chris said there. I just spent a few weeks in China this summer and just, you know, the constant surveillance, the knowing that—

Mr. WRIGHT. The facial recognition.

Dr. INBODEN. Yes, the facial recognition, that kind of stuff. You know, under a Leninist police state. The other one that does scare me, though, is the possibility I alluded to earlier in the inhumanity part, is the potential development of a completely autonomous weapons system where human controls are totally out of the picture. I mean, the only time in history we've really seen something remotely close to this was the doomsday machine that the Soviet Union started building in the 1980s. Their fear was that if the U.S. were to decapitate all the Soviet leadership in a preemptive nuclear strike, the machine would then take over and ensure that all the Soviet missiles were counter-launched, even though there's no one actually giving the order.

And even the Soviets decided, wait, this is a bridge too far, because, you know, what if the machine goes haywire and we're actually here, but we can't—we can't turn it off and stop it? But that concept in the 21st century is truly horrifying. And that goes back to the question of, you know, do we control our creations, or do they control us?

Ms. SAYLER. I would hesitate to say that any specific technology is inherently bad. I think it really comes back to how it's being used and what regimes are in place to ensure that there is ethical use, that human rights considerations are taken into account. And that's really a question of policy. Many of these technologies do potentially pose operational risk or significant concerns for human rights and ethics. But I don't think that's an issue of something that's inherent in the technology.

Mr. WRIGHT. My next question has to do with how we engage, entice, and monitor nations that we think are bad actors and are engaged in the development of these technologies. We know that New START [Strategic Arms Reduction Treaty] is about to expire. I serve on Foreign Affairs with Colin. And we had a hearing not too long ago on that very issue, and the desire for the president to open that up to China.

Well, China doesn't have a whole lot of interest in any kind of arms control. But that is a vehicle by which certain things could

be added if we can do it without destroying the agreement itself. And that was the chief concern that came up in the hearing, is if we start adding things it would destroy the agreement itself and we would have no START.

So my question is, how do we entice—because one of the reasons you even enter into an arms agreement is it gives you the ability—it gives us the ability—to see inside that country in ways we wouldn't be able to otherwise. So if it's not something like New START, how do we entice and get people, get nations like China and Russia—China especially. Russia is a menace, but China in the long term is a much greater threat—how do we entice them to the table and get them to agree before all of this happens, before all of this gets to a mature state? Because it's much harder to do then.

Dr. INBODEN. Great question. I'm going to answer it by going back to one of your previous questions, looking at the nuclear era. And this is where we can take some encouragement from history. In the late 1960s there were only six nuclear powers in the world—the five U.N. permanent Security Council members and Israel. And they were—that is now undeclared. But—[inaudible]—Israel has nukes, okay? And in 1968 President Johnson, the namesake of the school that I teach at, led the way in drafting and ratifying the Nonproliferation Treaty. And at the time, the widespread fear was over the next 20 years the number of nuclear powers in the world would go from about 6 to about 36. Every expectation was there was going to be a cascade of proliferation over the next 20 years.

And yet, here we are, over 50 years after the NPT, and there are only three more nuclear powers in the world since then—India, Pakistan, and North Korea. There's only nine now.

Now, there's concern with those, especially with North Korea. But how and why did that work? And I think there's three reasons that maybe can be applied to the other—to control of the other technologies we're worried about today. The first is the treaty monitoring and dialog channels itself, right? I mean, even if—I was earlier skeptical of the Soviet Union/Russia's record on this. They do break a lot of them. But having those monitoring channels, having those dialog ones, it at least limits the—and sometimes prevents the violations.

The second, though, is something that's fallen into disrepute these days, and I wish we had more respect for, America's alliance structure. Why did Taiwan and South Korea and Japan give up their aspirations for nuclear weapons? Because they had the protection of the American nuclear umbrella, because they trusted our alliance commitments to them. And so I think the United States continuing to be committed to our allies is actually a strong counterproliferation measure which is often forgotten.

The third goes back to my other point about strategic strength. Maintaining our defenses, maintaining a cutting-edge military ourselves strengthens our hand at the negotiating table. That needs to be compliant with the diplomacy, especially in these arms control agreements.

Mr. VEASEY. That's interesting, two of you mentioned about being under constant surveillance earlier, because just, you know, in our everyday lives, with the issue of data privacy—something

that that we deal with on the Energy and Commerce Committee—I feel like we’re already kind of under constant surveillance anyway.

In addition to Dean Crouch we’ve also now been joined by President Karbhari that’s here. I want to recognize him. Thank you, sir. Thank you, President of UTA. We really appreciate you giving us this space—the generous use of the space. It’s been a great presentation so far. So thank you very much. We appreciate it sir. Thank you.

Now I’m going to turn it over to Congressman Allred.

Mr. ALLRED. Thank you, Mr. Chairman, for the day. I want to thank my colleagues for their great questions. I think we’ve covered a lot of ground here.

But, Dr. Inboden, I wanted to drill down on the inherent tension—and I agree with your point on this about pursuing a dual track approach. And I want to say I agree both because of the historic comparisons, and also because I think we can’t unilaterally disarm, pursuing these technologies while also trying to use international agreements to place them in a—

[AUDIO BREAK]

Dr. INBODEN. [In progress following audio break]—for example. Sometimes you just want to say, we’re not going to—we’re not going to play in that realm. Similar to President Reagan’s decisions to start reducing the nuclear arsenal as an example to the Soviets, would be another there.

And on your larger point, the strategic question that, you know, leaders almost always face when you’re looking at an adversary is: Are we in an escalation spiral or a deterrence cycle here? If it’s an escalation spiral, where every step we take to get stronger they’re going to take—you know, then it—then it can get into an out-of-control arms race.

So the key is how can we shift that to a deterrence cycle where us taking a step to get stronger persuades them we don’t want to go into that realm? And the way to do that is, you know, partly by the building up, but also by diplomacy, by talking about the importance of human rights and civil liberties commitments, as these—as these mutual strengths. So it’s never one clear, only go in this direction and not the other one as well. So they’re hard questions and I appreciate you bringing it up.

Mr. ALLRED. Well, I think it is going to be—the dynamic is going to be difficult because of that. But I don’t think that means that we shouldn’t pursue it. And I agree that we’ve been able to form some of these agreements at times with adversaries when—that were—in times that were more difficult than we have now in terms of our interactions with them. We’re not in a cold war setting, but we were and we were able to sign these agreements. So I’m hopeful that we will continue to lead, and lead through our alliances, as you said. I think that this all has to be multilateral. None of this, in my opinion, should be bilateral. This is not just about the United States and Russia, the United States and China. This would be a worldwide issue.

And to that point, Professor Jenks, I wanted to talk about lethal autonomous weapons systems and proliferation, because I share

the idea that the existence of a weapon itself is not necessarily an evil, but that it does depend on who possesses it and how it's used. I might have a few more concerns than you do about the existence of entirely autonomous weapons systems, because I think that removing that human element does take out a discretion step that I think is dangerous in terms of escalation.

But—and this is for you as well, Ms. Sayler—we've seen that Chinese weapons manufacturers such as Xi'an, I don't know if I'm pronouncing that correctly, have indicated that they might export these weapons systems to the UAE, Saudi Arabia, and Pakistan. I have in my mind, of course, concerns between Russia sharing this technology with Iran, China with North Korea. The proliferation of these systems, to me, has a real slippery slope here. And so as we look at policies such as considering a preemptive ban—which I recognize has limitations—what approach should we take, or do you think we can take, to try to prevent these weapon systems from getting out? Because the deterrence part of this is that we have equal skin in the game in terms of if you use it, we also have the ability to use it. That's not always the case with some of these rogue states, or even nonstate actors.

Mr. JENKS. No, thank you, Congressman. That's an important—it's an important question. One of the unfortunate downsides of the circular discussions that have been ongoing in Geneva is it's taken up all the time and the space. And so we're not having other important conversations. Specifically as to your question on export controls, I would tell you there's an alarming lack of any meaningful discussion about what and how export controls would look like for things like artificial intelligence, autonomy, and cyber issues. Because we're talking now about lines of code, and how are we going to regulate and control that? And no doubt very challenging, but we're not even having those conversations.

So I think we need to move past this what's autonomy, what's artificial intelligence. And that's why I wonder if discussions at a smaller level, maybe within the OSCE, than these broad forum discussions, like 125 countries that range the full spectrum including the Vatican and Costa Rica, which does not have an armed forces. So the discussions that that group is going to have are hard to kind of channel toward a productive outcome. But I think starting the discussion about export control regimes on artificial intelligence and autonomy is critically important. And it is not occurring at all.

Ms. SAYLER. I think one of the challenges with lethal autonomous weapons, when we think about traditional arms control regime we often say trust but verify. And as Mr. Jenks alluded to, this is a real challenge when it comes to a weapons system in which what is making it a lethal autonomous weapon is in the software.

And so you could have the same system—the same hardware of the system, that could be—that could, for example, have a semi-autonomous mode, an autonomous mode, a fully autonomous lethal mode. And it's really a question of software. And so in order to verify that, you would have to have countries exchanging software code, which then gets into proprietary information, state secrets, classified information. So that's the challenge that you're facing. Not to say it's not feasible, but—

Mr. VEASEY. Now I want to open it up for questions from the audience. I want to let everyone know that we do have a hard stop at 10:30, so we won't be able to get that many questions in. I'll ask the panelists to try to keep their answers as brief as possible. But I did want everyone out there to have a chance to ask a question. Anyone in the audience have a question?

Yes, sir.

QUESTIONER. Hello. I'm at UT Arlington political science and journalism major.

I just recently got back from working at the Library of Congress Kluge Center, where we focused on a lot of different issues regarding China and export controls. So the U.S.-China Commission just recently published its 2019 report, alluding to the fact that several Chinese labs sponsored by the government might be sending students—posing as students to our graduate schools and our other schools, starting as, like, a history major, and then randomly switching to quantum computing.

So, one, how do you foresee a future in which we defend the academic freedom of our students and the choice that they make when they come to study, but also our state secrets and our government-sponsored labs? I know there's a clearance process, of course, that goes into that, but how do we prevent those state secrets and lines of code from being whisked away to our strategic rivals?

Mr. VEASEY. You know, I'll give a couple of thoughts on that. The panelists or the other members may have some thoughts. The first one is that, you know, for our defense contractors that we have here in north Texas and across the country, you have to be a U.S. citizen to actually work at a defense contracting plant. You can't be—you can't be on a green card or H1-B. You have to be a U.S. citizen. The second thing is that everyone in the intelligence community is very well aware that the Chinese do send students over here to spy on us, and to get the expertise that they need in order to help advance the Chinese Government. To the extent that even a lot of our technology companies understand that. And when they're trying to get the H1-B visas, and what have you, for people to come and work at their different companies, that they put protections in place knowing that they were probably sent to a large tech firm, for instance, to be able to bring that technology back to China.

Mr. ALLRED. I just wanted to very briefly weigh in and say I was actually having this conversation with some representatives from UTD yesterday. And Congressman Veasey's absolutely right. This is a very real thing. This is not something that's been made up. It's a threat to us. But at the same time, we have to balance that with the needs of our research institutions and understand what they are good at and what they are not good at. The research institutions themselves are not going to be good at performing the functions of the FBI, or the CIA, or trying to ferret out, you know, nefarious actors. That's not what their purpose is, and I think it also hurts the goal of their research, and also the goal of the scientific community—which is to gather information, have it peer reviewed, and have it available for discussion. But there are steps that we get to which the classification levels increase, in which the scrutiny

has to increase. And that's where I think we can apply some of that.

Dr. INBODEN. If I could just add, in full agreement with Congressman Allred and Congressman Veasey, this is a very big issue we're dealing with at UT Austin as well. And it's a UT systemwide issue. And this is a very difficult balance because, on the one hand, one reason why the American higher education system is the envy of the world and draws so much international talent is because of its excellence, its quality, based on principles of transparency, and openness, and free inquiry, and academic freedom. However, unfortunately the Chinese Government has been exploiting that. And we've seen some, you know, significant cases of abuse and espionage. And there're more that hasn't been uncovered yet.

So I think Congressman Allred's exactly right. We need better partnerships between FBI, CIA, counterintelligence, and our universities to at least be alert to these things. But we also need to remember, I can't stress this enough, that America's rivalry and competition right now is with the Chinese Government and the Chinese Communist Party, not the people of China. The people of China can be some of our best friends and allies in this. They—for the most part, they want more freedoms and better lives for themselves. They feel friendship toward America. They like our—they like our culture. They are not the enemy. But rather, they have a government with more nefarious designs. So keeping that distinction clear is really important.

QUESTIONER. Hi. I'm Victoria LaBarre. I go to UTA. I'm an electrical engineer and I focus in robotics. So the AI part was actually really interesting for me.

Just because we're on ethical questions, with the part of the thing that's coming out with AI is, like, the more you make it autonomous when it goes wrong, like who do you blame? And just kind of the background with that is part of my research in machine learning is trying to make decisions when there is no base truth, because the problem with a system that you're going against one of the laws of robotics, where instead of, like, you can't injure a human, now we're telling you specifically please shoot one. The problem with this is, like, how does that autonomous system make that decision based off of no input at all? And does that lead into some biases?

Ms. SAYLER. The issue of accountability is hotly debated at the U.N. CCW, which is where the discussions of autonomous weapons take place. So the nongovernmental organization advocacy community essentially believes that there cannot be accountability. The U.S. Government and other delegations have essentially stated that the same accountability measures that apply to other weapons systems will apply to lethal autonomous weapons. So you have, you know, product liability, liability for defense contractors. It's incumbent on the commander who deploys the system to survey the operating environment and make sure that the weapon's use would comply with the Law of Armed Conflict.

There are issues of bias and, you know, spoofing, and all kinds of concerns with regard to deploying these weapons. And so that's sort of getting back to the weapons review process. You would need to know that the weapon would perform as anticipated in a real-

istic operating environment. And that's something that's actually written into the U.S. policy on lethal autonomous weapons. But many countries—in fact, most countries—do not have policies for these systems. And so the concern would be that they might not be taking some of those factors that you raised into account.

Mr. JENKS. And I think part of what you're likely to see is the development of autonomous systems in inverse relationship to the potential of if something goes awry that there will be civilian casualties. So that's why you're going to see the greatest development initially subsurface. If something goes wrong 200 meters below the surface of the water, that may go back for a whale, a friendly sub, a bad sub. High altitudes, I'd say middle of the ocean, and frankly the last domain where you're going to see autonomous weapons systems is going to be the really challenging ground, urban environment. And we may—you know, we may never get there. But we will—frankly, are already working toward those other systems—again, subsurface, surface of the water, and high altitude.

Mr. VEASEY. Well, I know we have a couple more questions, and I want to apologize, because we do have to stop at 10:30. We promised we would let the panelists and the Members of Congress be able to leave at 10:30. But if you have a question and you want to ask some of the panelists on the way out, we think that they'd probably be happy to answer your questions. But I want to, again, thank Dr. Karbhari and the staff at UTA for allowing us to the space, and thank our distinguished panelists that were here. I thank my colleagues for taking time out of their schedule to come and be a part of this meeting of the U.S. Helsinki Commission on our cooperation that we have with our transatlantic partners. I think that these topics and many others that are discussed really, now probably more than ever, need to be something that the American public takes a closer look at.

So thank you very much. [Applause.]

[Whereupon, at 10:32 a.m., the field hearing ended.]

APPENDIX

PREPARED STATEMENTS

PREPARED STATEMENT OF HON. MARC VEASEY

Good morning to everybody. It is my distinct pleasure to welcome you all to this field hearing of the Commission on Security and Cooperation in Europe (CSCE), which is informally referred to as the U.S. Helsinki Commission.

I have the honor of serving as a Commissioner, under the leadership of Congressman Alcee Hastings of Florida, and I would like to thank Chairman Hastings for asking me to convene this hearing today.

Because some of you may be less familiar with the Helsinki Commission than our usual audience in Washington, DC, I'd like to start by telling you a bit about our Commission.

Forty-four years ago, President Gerald Ford joined 35 other heads of state, including longstanding American adversaries, to sign one of the most significant international agreements of the 20th Century—the Final Act of the Conference on Security and Cooperation in Europe, better known as the Helsinki Accords.

The accords committed the United States, Europe, and the Soviet Union to respect human rights, to manage the spread of dangerous weapons, to foster economic opportunity, and to ending the territorial disputes in Europe that had already twice plunged the world into war.

Our Commission was created to uphold exactly these commitments, and since its inception, it has provided a crucial voice for defending freedom, opportunity, and human rights through the engagement of the United States in the Organization for Security and Cooperation in Europe—also known as the OSCE—where these commitments are negotiated to this day.

Composed of Members of Congress from both parties and chosen from the House and Senate, the Helsinki Commission represents our democracy's commitment to preserving and advancing the peace, freedom, and prosperity across the world that previous generations of Americans sacrificed so much to achieve.

That is why I am honored to have been appointed to serve on the Helsinki Commission. The world has changed dramatically since it was established, but the need to defend the principles of peace and security, freedom, opportunity and human rights is greater than ever.

Ladies and gentlemen,

Let me now offer a few thoughts on the purpose of this event, and why we are having it here in Texas.

The subject matter for today's hearing relates to the impact of emerging technologies on Euro-Atlantic security, and I am looking forward to learning a great deal from our witnesses today on this subject.

New threats that we are concerned with range from hypersonic weapons, to drones, autonomous weapon platforms, artificial intelligence, directed energy, and others. These technologies have the

potential to unlock some important capabilities to ensure the defense of our homeland and support our Allies and friends abroad.

However, these very same technologies are also under development by some of our strategic competitors—Russia chief among them—and so I also look forward to hearing our experts' views on how our potential adversaries are looking to use some of these same technologies to threaten us and our Allies.

Finally, I will also look forward to our witnesses' views on how we should best approach our international engagement on these technologies, including through diplomatic efforts, and understanding what national and legal regimes apply or are under consideration. In particular, today's discussion should help us better consider whether the OSCE and its affiliated security institutions can offer a space to establish norms for emerging technologies.

So that's what we want to get out of today's event.

But why are we here, in Arlington, Texas, rather than in Washington D.C., where Congressional hearings typically take place?

The answer to that question could not be more clear to those of us here in this room, but for the benefit of those who may be watching this on livestream or reading our transcript: I asked Chairman Hastings for the privilege of convening this hearing here precisely because of the unique confluence of technical know-how, academic expertise, and defense-industrial presence right here in Texas.

This spirit of innovation and expertise, alongside cutting edge industry and an innovative private sector, is why the Army decided to establish the headquarters of its Futures Command in Austin, Texas, in 2018.

In fact, after this hearing, I'll be spending some time this afternoon visiting Lockheed Martin Aeronautics, to be briefed on the increased capabilities and technological advances provided by the F-35 Lightning II aircraft, as well as how it provides increased opportunities for inter-service and international cooperation. I'll also be visiting the production line where the F-35 is assembled and getting a first-hand look at this 5th generation fighter jet.

So we are here because of all the expertise available to us. But we are also here, away from Washington, because of how essential it is that Americans throughout our nation have an opportunity to engage in policy discussions paramount to our shared values in the transatlantic space. This hearing offers a connection outside of the Beltway to America's international commitments as a participating state of the OSCE. We all should have a stake in meeting commitments to our local and international communities.

With all that being said, let me express my gratitude to the experts who have taken time out of their busy schedules to be with us today to provide their testimony for the record. I'd like to very briefly introduce them now, and I think you will quickly see that they represent a clear demonstration of the incredibly high caliber of locally-sourced national security expertise we have available to us here in Texas.

- We will first hear from Kelley Sayler, who is an Analyst in Advanced Technology and Global Security at the U.S. Congressional Research Service. For those who may not know, the CRS is a tremendous resource to all of us in Congress who depend

on their expertise on almost any issue that comes before us. Ms. Sayler has extensive experience working on these issues both in and out of government, including service in the Office of the Secretary of Defense. I also note her strong Texas connection: she received her Master's degree from Baylor University. Ms. Sayler, thank you for being here.

- Our next speaker will be Dr. William Inboden, who serves as the Executive Director and William Powers, Jr. Chair at the William P. Clements, Jr. Center for National Security at University of Texas-Austin. Among Dr. Inboden's many other roles, he also serves as Associate Professor at the LBJ School of Public Affairs, Distinguished Scholar at the Robert S. Strauss Center for International Security and Law, and Editor-in-Chief of the Texas National Security Review. He has served as Senior Director for Strategic Planning on the National Security Council at the White House, and in the Department of State's Policy Planning Staff, as well as serving as a staff member in both the United States Senate and the House of Representatives.
- Our third witness today will be Professor Chris Jenks, Director of the Criminal Clinic and Associate Professor of Law at the Deadman School of Law at Southern Methodist University (SMU) in Dallas. A noted expert on the law of armed conflict and lethal autonomous weapons, Professor Jenks served more than 20 years in the US Army, first as an Infantry Officer in Germany, Kuwait and as a NATO peacekeeper in Bosnia and later as a Judge Advocate. He has also served details at the Department of State and at the Department of Justice, and was recently called to serve as Special Assistant to the Department of Defense General Counsel.

As a last note before giving our witnesses the floor, I'd like to offer the Commission's thanks to the University of Texas, Arlington, for allowing us to use this great facility; what better place to talk about technology and its implications than right here in Nedderman Hall, home to the University's engineering departments?

Let me inform the witnesses that their full statements will be entered into the record; I have asked them to summarize their testimony for the purposes of our discussion today.

PREPARED STATEMENT OF KELLEY M. SAYLER



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TESTIMONY

Statement of

Kelley M. Saylor

Analyst in Advanced Technology and Global Security

Before

United States Commission on Security and Cooperation in Europe

Hearing on

**“AI, UAVS, Hypersonics, and Autonomous
Systems: Emerging Technologies and Euro-
Atlantic Security”**

January 22, 2020

Congressional Research Service

7-5700

www.crs.gov

<Product Code>

Thank you Representative Veasey and the U.S. Commission on Security and Cooperation in Europe for the opportunity to provide an overview of emerging military technologies and their potential implications for international security. My name is Kelley Sayler, and I am an analyst in advanced technology and global security with the Congressional Research Service.

As noted by the 2018 National Defense Strategy, U.S. national security will likely be “affected by rapid technological advancements and the changing character of war...New technologies include advanced computing, ‘big data’ analytics, artificial intelligence, autonomy, robotics, directed energy, hypersonics, and biotechnology—the very technologies that ensure we will be able to fight and win the wars of the future.”¹ While the United States is the leader in developing many of these technologies, China and Russia—our key strategic competitors—are also making steady progress in developing advanced military technologies. As these technologies are integrated into military forces and deployed, they could hold significant implications for the future of international security.

Artificial Intelligence

Although the U.S. government has no official definition of artificial intelligence (AI), AI generally refers to a computer system capable of human-level cognition. AI is further divided into two categories: narrow AI and general AI. Narrow AI systems can perform only the specific task that they were trained to perform, while general AI systems would be capable of performing a broad range of tasks, including those for which they were not specifically trained. General AI systems do not yet—and may never—exist.

Narrow AI is currently being incorporated into a number of military applications by both the United States and U.S. competitors, including but not limited to intelligence, surveillance, and reconnaissance; logistics; cyber operations; command and control; and semi-autonomous and autonomous vehicles. These technologies are intended to either augment or replace human operators, freeing the operators for more complex and cognitively demanding work. In addition, AI-enabled systems could both react significantly faster than systems that rely upon operator input and cope with an exponential increase in the amount of data available for analysis. AI could also enable new concepts of operations, such as swarming (i.e., cooperative behavior in which unmanned vehicles autonomously coordinate to achieve a task) that could confer a warfighting advantage by overwhelming adversary defensive systems.

Finally, recent news reports and analyses have highlighted the role of AI in enabling increasingly realistic photo, audio, and video digital forgeries, popularly known as “deep fakes.” Adversaries could potentially deploy this AI capability as part of their information operations in a “gray zone” conflict.² Deep fake technology could be used against the United States and its allies to generate false news reports, influence public discourse, erode public trust, and attempt to blackmail diplomats. Some have suggested that AI could be used to create full digital “patterns-of-life,” in which an individual’s digital footprint is mapped against other personal information, such as spending habits and job history, to create comprehensive behavioral profiles of servicemembers, suspected intelligence officers, government officials, and private citizens. Similar to deep fakes, this information could be used for targeted influence operations or blackmail.

United States

The Department of Defense’s (DOD) unclassified investments in AI have grown from just over \$600 million in FY2016 to \$927 million in FY2020, with the Department reportedly maintaining over 600

¹ Department of Defense, “Summary of the 2018 National Defense Strategy of The United States of America,” 2018, p. 3, <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>.

² “Gray zone” conflicts are those that occur below the threshold of formally-declared war.

active AI projects.³ Pursuant to the FY2019 NDAA, DOD established the Joint Artificial Intelligence Center (JAIC, pronounced “jake”) to coordinate DOD projects of over \$15 million.⁴ The JAIC has identified its priority national mission initiatives for AI as predictive maintenance,⁵ humanitarian aid and disaster relief, cyberspace, and automation. The FY2019 NDAA additionally directed DOD to publish a strategic roadmap for AI development and fielding, as well as guidance on “appropriate ethical, legal, and other policies for the Department governing the development and use of artificial intelligence enabled systems and technologies in operational situations.”⁶

The FY2019 NDAA also established a National Security Commission on Artificial Intelligence to conduct a comprehensive assessment of militarily relevant AI technologies and provide recommendations for strengthening U.S. competitiveness.⁷ The commission’s interim report to Congress identifies five key lines of effort for U.S. AI competitiveness: (1) investing in research and development, (2) applying AI to national security missions, (3) training and recruiting AI talent, (4) protecting and building upon U.S. technology advantages, and (5) marshalling global AI cooperation. The commission’s final report, which is to provide recommendations for implementing these lines of effort, is to be available in October 2020.

Russia

Russian president Vladimir Putin has stated that “whoever becomes the leader in [AI] will become the ruler of the world.”⁸ At present, however, Russian AI development lags significantly behind that of the United States and China. As part of Russia’s effort to close this gap, Russia has released a national strategy that outlines 5- and 10-year benchmarks for improving the country’s AI expertise, educational programs, datasets, infrastructure, and legal regulatory system.⁹ Russia has also indicated it will continue to pursue its 2008 defense modernization agenda, with the aim of robotizing 30% of its military equipment by 2025.¹⁰

³ Office of the Under Secretary of Defense (Comptroller)/Chief Financial Officer, Defense Budget Overview: United States Department of Defense Fiscal Year 2020 Budget Request, March 2019, p. 9; and Brendan McCord, “Eye on AI,” August 28, 2019, transcript available at <https://static1.squarespace.com/static/5b75ac0285ede1b470f58ae2/t/5d6aa8edb91b0c0001c7a05f/1567>.

⁴ P.L. 115-232, Section 2, Division A, Title II, §1051.

⁵ Predictive maintenance uses AI “to predict the failure of critical parts, automate diagnostics, and plan maintenance based on data and equipment condition.” Department of Defense, “Summary of the 2018 Department of Defense Artificial Intelligence Strategy,” February 12, 2019, p. 11, <https://media.defense.gov/2019/Feb/12/2002088963/-1/-1/SUMMARY-OF-DOD-AI-STRATEGY.PDF>.

⁶ P.L. 115-232, Section 2, Division A, Title II, §238. In support of this mandate, the Defense Innovation Board, an independent federal advisory committee to the Secretary of Defense, has drafted recommendations for the ethical use of artificial intelligence. See Defense Innovation Board, “AI Principles: Recommendations on the Ethical Use of Artificial Intelligence by the Department of Defense,” October 31, 2019, https://media.defense.gov/2019/Oct/31/2002204458/-1/-1/0/DIB_AI_PRINCIPLES_PRIMARY_DOCUMENT.PDF.

⁷ P.L. 115-232, Section 2, Division A, Title X, §1051. The Commission’s Interim Report, which assesses the challenges and opportunities of militarily relevant AI technologies, is available at <https://drive.google.com/file/d/153OrxnuGEjsUvixWsfYauslwNeCEkvUb/view>.

⁸ “Whoever leads in AI will rule the world”: Putin to Russian children on Knowledge Day,” *RT.com*, September 1, 2017, <https://www.rt.com/news/401731-ai-rule-world-putin/>.

⁹ Office of the President of the Russian Federation, “Decree of the President of the Russian Federation on the Development of Artificial Intelligence in the Russian Federation” (Center for Security and Emerging Technology, Trans.), October 10, 2019, <https://cset.georgetown.edu/wp-content/uploads/Decree-of-the-President-of-the-Russian-Federation-on-the-Development-of-Artificial-Intelligence-in-the-Russian-Federation-.pdf>.

¹⁰ Tom Simonite, “For Superpowers, Artificial Intelligence Fuels New Global Arms Race,” *Wired*, August 8, 2017.

The Russian military has been researching a number of AI applications, with a heavy emphasis on semiautonomous and autonomous military vehicles. Russia has also reportedly built a combat module for unmanned ground vehicles that is capable of autonomous target identification—and, potentially, target engagement—and plans to develop a suite of AI-enabled autonomous systems.¹¹ In addition, the Russian military plans to incorporate AI into unmanned aerial, naval, and undersea vehicles and is currently developing swarming capabilities.¹² These technologies could reduce both cost and manpower requirements. Russia is also exploring innovative uses of AI for remoting sensing and electronic warfare, which could in turn reduce an adversary's ability to effectively communicate and navigate on the battlefield.¹³ Finally, Russia has made extensive use of AI technologies for domestic propaganda and surveillance, as well as for information operations directed against the United States and U.S. allies.¹⁴

Despite Russia's aspirations, analysts argue that it may be difficult for Russia to make significant progress in AI development. In 2017, Russian military spending dropped by 20% in constant dollars, with subsequent cuts in 2018.¹⁵ In addition, many analysts note that Russian academics have produced few research papers on AI and that the Russian technology industry has yet to produce AI applications that are on par with those produced by the United States and China.¹⁶ Others analysts counter that such factors may be irrelevant, arguing that while Russia has never been a leader in internet technology, it has still managed to become a notably disruptive force in cyberspace.¹⁷

China

China is the United States' most ambitious competitor in the international AI market. China's 2017 "Next Generation AI Development Plan" describes AI as a "strategic technology" that has become a "focus of international competition."¹⁸ Recent Chinese achievements in the field demonstrate China's potential to realize its goals for AI development. In particular, China has pursued language and facial recognition technologies—many of which it plans to integrate into the country's domestic surveillance network and social credit system. This system aims to monitor and "grade" every Chinese citizen by 2021 based on social behavior.¹⁹ China is also developing various types of air, land, sea, and undersea autonomous

¹¹ Tristan Greene, "Russia is Developing AI Missiles to Dominate the New Arms Race," *The Next Web*, July 27, 2017, <https://thenextweb.com/artificial-intelligence/2017/07/27/russia-is-developing-ai-missiles-to-dominate-the-new-arms-race/>; and Kyle Mizokami, "Kalashnikov Will Make an A.I.-Powered Killer Robot," *Popular Mechanics*, July 19, 2017, <https://www.popularmechanics.com/military/weapons/news/a27393/kalashnikov-to-make-ai-directed-machine-guns/>.

¹² Samuel Bendett, "Red Robots Rising: Behind the Rapid Development of Russian Unmanned Military Systems," *The Strategy Bridge*, December 12, 2017.

¹³ Jill Dougherty and Molly Jay, "Russia Tries to Get Smart about Artificial Intelligence"; *The Wilson Quarterly*, Spring 2018; and Margarita Konaev and Samuel Bendett, "Russian AI-Enabled Combat: Coming to a City Near You?," *War on the Rocks*, July 31, 2019, <https://warontherocks.com/2019/07/russian-ai-enabled-combat-coming-to-a-city-near-you/>.

¹⁴ Alina Polyakova, "Weapons of the Weak: Russia and AI-driven Asymmetric Warfare," Brookings Institution, November 15, 2018, <https://www.brookings.edu/research/weapons-of-the-weak-russia-and-ai-driven-asymmetric-warfare/>; and Chris Meserole and Alina Polyakova, "Disinformation Wars," *Foreign Policy*, May 25, 2018, <https://foreignpolicy.com/2018/05/25/disinformation-wars/>.

¹⁵ "Military expenditure by country, in constant (2017) US\$ m., 1988-2018," Stockholm International Peace Research Institute, <https://www.sipri.org/sites/default/files/Data%20for%20all%20countries%20from%201988%E2%80%932018%20in%20constant%20%282017%29%20USD%20%28pdf%29.pdf>.

¹⁶ Leon Bershidsky, "Take Elon Musk Seriously on the Russian AI Threat," *Bloomberg*, September 5, 2017, <https://www.bloomberg.com/view/articles/2017-09-05/take-elon-musk-seriously-on-the-russian-ai-threat>; and Polyakova, "Weapons of the Weak."

¹⁷ Gregory C. Allen, "Putin and Musk Are Right: Whoever Masters AI Will Run the World," *CNN*, September 5, 2017.

¹⁸ China State Council, "A Next Generation Artificial Intelligence Development Plan," p. 2.

¹⁹ "Beijing to Judge Every Resident Based on Behavior by End of 2020," *Bloomberg*, November 21, 2018, <https://www.bloomberg.com/news/articles/2018-11-21/beijing-to-judge-every-resident-based-on-behavior-by-end-of-2020>. It should be noted that Chinese technology companies such as ZTE Corp are working with other authoritarian regimes to develop

military vehicles and is actively pursuing swarm technologies, which could be used to overwhelm adversary missile defense interceptors. In addition, open-source publications indicate that the Chinese are developing a suite of AI tools for cyber operations.²⁰

China's management of its AI ecosystem stands in stark contrast to that of the United States.²¹ In general, few boundaries exist among Chinese commercial companies, university research laboratories, the military, and the central government; China's National Intelligence Law requires companies and individuals to "support, assist, and cooperate with national intelligence work."²² As a result, the Chinese government has a direct means of guiding military AI development priorities and accessing technology that was ostensibly developed for civilian purposes.

International Institutions

A number of international institutions have examined issues surrounding AI, including the Group of Seven (G7), the Asia-Pacific Economic Cooperation (APEC), and the Organisation for Economic Co-operation and Development (OECD), which developed the first intergovernmental set of principles for AI. These principles are intended to "promote AI that is innovative and trustworthy and that respects human rights and democratic values."²³ The United States is one of 42 countries—including the OECD's 36 member countries, Argentina, Brazil, Colombia, Costa Rica, Peru, and Romania—to have adopted the OECD AI Principles. These principles serve as the foundation for the Group of Twenty (G20)'s June 2019 Ministerial Statement on human-centered AI.²⁴ In addition, the OECD established the AI Policy Observatory in 2019 to develop policy options that will "help countries encourage, nurture, and monitor the responsible development of trustworthy AI systems for the benefit of society."

Lethal Autonomous Weapon Systems

Although there is no internationally agreed upon definition of Lethal Autonomous Weapon Systems (LAWS), the U.S. Department of Defense has defined LAWS as a class of weapon systems that is capable of independently identifying a target and employing an onboard weapon system to engage and destroy the target without manual human control. LAWS require computer algorithms and sensor suites to classify an object as hostile, make an engagement decision, and guide a weapon to the target. This capability would enable the system to operate in communications-degraded or -denied environments where traditional systems may not be able to operate. Some analysts have noted that LAWS could additionally "allow weapons to strike military objectives more accurately and with less risk of collateral damage" or civilian casualties.²⁵ Others, including approximately 25 countries and 100 nongovernmental organizations, have

similar social-control systems. See, for example, Angus Berwick, "How ZTE helps Venezuela create China-style social control," *Reuters*, November 14, 2018, <https://www.reuters.com/investigates/special-report/venezuela-zte/>.

²⁰ Elsa Kania, *Battlefield Singularity: Artificial Intelligence, Military Revolution, and China's Future Military Power*, Center for a New American Security, November 28, 2017, p. 27.

²¹ *Ibid.*, p. 6.

²² Arjun Kharpal, "Huawei says it would never hand data to China's government. Experts say it wouldn't have a choice," *CNBC*, March 5, 2019.

²³ Organisation for Economic Co-operation and Development, "OECD Principles on AI," June 2019, <https://www.oecd.org/going-digital/ai/principles/>.

²⁴ "G20 Ministerial Statement on Trade and Digital Economy," June 9, 2019, available at <https://www.mofa.go.jp/files/000486596.pdf>.

called for a preemptive ban on LAWS due to ethical concerns such as a perceived lack of accountability for use and a perceived inability to comply with the proportionality and distinction requirements of the laws of war. Although LAWS generally do not yet exist, some analysts have classified Israel's Harpy anti-radar loitering munition as a LAWS.²⁶

United States

The United States is not known to be currently developing LAWS. However, Department of Defense Directive (DODD) 3000.09 establishes department guidelines for the development and fielding of LAWS to ensure that they comply with "the law of war, applicable treaties, weapon system safety rules, and applicable rules of engagement."

Russia

Russia has not publicly stated that it is developing LAWS; however, Russian weapons manufacturer Kalashnikov has reportedly built a combat module for unmanned ground vehicles that is capable of autonomous target identification and, potentially, target engagement.²⁷

China

According to U.S. Secretary of Defense Mark Esper, Chinese weapons manufacturers, such as Ziyang, have advertised LAWS.²⁸ In addition, some reports indicate that China has exported—or is in negotiations to export—systems that are capable of autonomous target selection and engagement to the United Arab Emirates, Saudi Arabia, and Pakistan.²⁹

International Institutions

Since 2014, the United States has participated in international discussions of LAWS under the auspices of the United Nations Convention on Certain Conventional Weapons (UN CCW). The UN CCW has considered proposals by states parties to issue political declarations about LAWS, as well as proposals to regulate or ban them. At the UN CCW, the United States and Russia have opposed a preemptive ban on LAWS, while China has supported a ban on the use—but not development—of LAWS, which it defines as weapon systems that are inherently indiscriminate and thus in violation of the law of war.

Hypersonic Weapons

Hypersonic weapons—which fly at speeds of at least Mach 5—are in development in a number of countries, including the United States, Russia, and China. There are two categories of hypersonic weapons:

- **Hypersonic glide vehicles** are launched from a rocket before gliding to a target.
- **Hypersonic cruise missiles** are powered by high-speed engines throughout the duration of their flight.

²⁶ Defense Innovation Board, "AI Principles: Recommendations on the Ethical Use of Artificial Intelligence by the Department of Defense, Supporting Documents," p. 12.

²⁷ Kyle Mizokami, "Kalashnikov Will Make an A.I.-Powered Killer Robot," *Popular Mechanics*, July 19, 2017.

²⁸ Patrick Tucker, "SecDef: China is Exporting Killer Robots to the Mideast," *Defense One*, November 5, 2019.

²⁹ Gregory C. Allen, *Understanding China's AI Strategy: Clues to Chinese Strategic Thinking on Artificial Intelligence and National Security*, Center for a New American Security, February 2019, p. 6.

In contrast to ballistic missiles, hypersonic weapons do not follow a ballistic trajectory and can maneuver en route to their destination, making defense against them difficult.³⁰ Currently, no such defense against hypersonic weapons exists, and experts disagree on the affordability, technological feasibility, and utility of hypersonic missile defense options. These options could include interceptor missiles, hypervelocity projectiles, laser guns, and electronic attack systems.

United States

The Pentagon's FY2020 budget request for all hypersonic-related research is \$2.6 billion, including \$157.4 million for hypersonic defense programs. The Department of Defense (DOD) is currently developing hypersonic weapons under the Navy's Conventional Prompt Strike program, which is intended to provide the U.S. military with the ability to strike hardened or time-sensitive targets with conventional warheads, as well as through several Air Force, Army, and DARPA programs.³¹ Analysts who support these development efforts argue that hypersonic weapons could enhance deterrence, as well as provide the U.S. military with an ability to defeat capabilities such as advanced air and missile defense systems that form the foundation of U.S. competitors' anti-access/area denial strategies.³² Others have argued that hypersonic weapons confer little to no additional warfighting advantage.

The United States is unlikely to field an operational hypersonic weapons before 2022; however, in contrast to Russia and China, the United States is not currently developing hypersonic weapons for potential use with a nuclear warhead. As a result, U.S. hypersonic weapons will likely require greater accuracy and will be more technically challenging to develop than nuclear-armed Russian and Chinese systems.

Russia

Although Russia has conducted research on hypersonic weapons technology since the 1980s, it accelerated its efforts in response to U.S. missile defense deployments in both the United States and Europe, and in response to the U.S. withdrawal from the Anti-Ballistic Missile Treaty in 2001.³³ Detailing Russia's concerns, President Putin stated that "the US is permitting constant, uncontrolled growth of the number of anti-ballistic missiles, improving their quality, and creating new missile launching areas. If we do not do something, eventually this will result in the complete devaluation of Russia's nuclear potential. Meaning that all of our missiles could simply be intercepted."³⁴ Russia thus seeks hypersonic weapons, which can maneuver as they approach their targets, as an assured means of penetrating U.S. missile defenses and restoring its sense of strategic stability.³⁵

³⁰ While ballistic missiles do travel at hypersonic speeds, they are not classified as "hypersonic weapons," which both fly at hypersonic speeds and can maneuver throughout their course of flight.

³¹ For a full history of U.S. hypersonic weapons programs, see CRS Report R41464, *Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues*, by Amy F. Woolf.

³² Roger Zakheim and Tom Karako, "China's Hypersonic Missile Advances and U.S. Defense Responses," Remarks at the Hudson Institute, March 19, 2019. See also Department of Defense Fiscal Year (FY) 2020 Budget Estimates, Army Justification Book of Research, Development, Test and Evaluation, Volume II, Budget Activity 4, p. 580.

³³ United Nations Office of Disarmament Affairs, *Hypersonic Weapons: A Challenge and Opportunity for Strategic Arms Control*, February 2019, <https://www.un.org/disarmament/publications/more/hypersonic-weapons-a-challenge-and-opportunity-for-strategic-arms-control/>.

³⁴ Vladimir Putin, "Presidential Address to the Federal Assembly," March 1, 2018, <http://en.kremlin.ru/events/president/news/56957>.

³⁵ In this instance, "strategic stability" refers to a "bilateral nuclear relationship of mutual vulnerability." See Tong Zhao, "Conventional Challenges to Strategic Stability: Chinese Perceptions of Hypersonic Technology and the Security Dilemma," Carnegie-Tsinghua Center for Global Policy, July 23, 2018, <https://carnegietsinghua.org/2018/07/23/conventional-challenges-to->

Russia is pursuing two nuclear-capable hypersonic weapons—the Avangard and the 3M22 Tsirkon (or Zircon). Avangard is a hypersonic glide vehicle launched from an intercontinental ballistic missile (ICBM), giving it “effectively ‘unlimited’ range.”³⁶ Russia claims that Avangard became operational on December 27, 2019; however, this claim has not been verified by U.S. intelligence reports and has been met with skepticism by some U.S. officials.³⁷ Tsirkon, a ship-launched hypersonic cruise missile, may become operational as early as 2023.³⁸

China

According to Tong Zhao, a fellow at the Carnegie-Tsinghua Center for Global Policy, “most experts argue that the most important reason to prioritize hypersonic technology development [in China] is the necessity to counter specific security threats from increasingly sophisticated U.S. military technology, including [hypersonic weapons].”³⁹ In particular, China’s pursuit of hypersonic weapons, like Russia’s, reflects a concern that U.S. hypersonic weapons could enable the United States to conduct a preemptive, decapitating strike on China’s nuclear arsenal and supporting infrastructure. U.S. missile defense deployments could then limit China’s ability to conduct a retaliatory strike against the United States.⁴⁰

China has tested the DF-ZF hypersonic glide vehicle at least nine times since 2014. U.S. defense officials have reportedly identified the range of the DF-ZF as approximately 1,200 miles and have stated that the missile may be capable of performing “extreme maneuvers” during flight.⁴¹ Although unconfirmed by intelligence agencies, some analysts project the DF-ZF will be operational as early as 2020.⁴² China also successfully tested Starry Sky-2, a nuclear-capable hypersonic vehicle prototype, in August 2018.⁴³ Some reports indicate that the Starry Sky-2 could be operational by 2025.⁴⁴ U.S. officials have declined to comment on the program.⁴⁵

strategic-stability-chinese-perceptions-of-hypersonic-technology-and-security-dilemma-pub-76894.

³⁶ Steve Trimble, “A Hypersonic Sputnik?,” *Aviation Week*, January 14-27, 2019, p. 20.

³⁷ Amanda Macias, “US intelligence reports: Russia’s new hypersonic weapon will likely be ready for war by 2020,” *CNBC*, May 15, 2018.

³⁸ “Russian Navy to accept latest Tsirkon hypersonic missile for service in 2023—source,” *TASS*, March 20, 2019.

³⁹ Tong Zhao, “Conventional Challenges to Strategic Stability: Chinese Perceptions of Hypersonic Technology and the Security Dilemma.”

⁴⁰ Tong Zhao, “Conventional Challenges to Strategic Stability”; and Lora Saalman, “China’s Calculus on Hypersonic Glide,” August 15, 2017, Stockholm International Peace Research Institute, <https://www.sipri.org/commentary/topical-background/2017/chinas-calculus-hypersonic-glide>.

⁴¹ “Gliding missiles that fly faster than Mach 5 are coming,” *The Economist*, April 6, 2019, <https://www.economist.com/science-and-technology/2019/04/06/gliding-missiles-that-fly-faster-than-mach-5-are-coming>; and Franz-Stefan Gady, “China Tests New Weapon Capable of Breaching US Missile Defense Systems,” *The Diplomat*, April 28, 2016, <https://thediplomat.com/2016/04/china-tests-new-weapon-capable-of-breaching-u-s-missile-defense-systems/>.

⁴² *U.S.-China Economic and Security Review Commission 2015 Annual Report*, p. 20, https://www.uscc.gov/sites/default/files/annual_reports/2015%20Annual%20Report%20to%20Congress.PDF.

⁴³ Jessie Yeung, “China claims to have successfully tested its first hypersonic aircraft,” *CNN*, August 7, 2018, <https://www.cnn.com/2018/08/07/china/china-hypersonic-aircraft-intl/index.html>. See also *U.S.-China Economic and Security Review Commission 2018 Annual Report*, p. 220, https://www.uscc.gov/sites/default/files/annual_reports/2018%20Annual%20Report%20to%20Congress.pdf.

⁴⁴ *U.S.-China Economic and Security Review Commission Report 2015*, p. 20.

⁴⁵ Bill Gertz, “China Reveals Test of New Hypersonic Missile,” *The Washington Free Beacon*, August 10, 2018, <https://freebeacon.com/national-security/chinas-reveals-test-new-hypersonic-missile/>.

International Institutions

There is currently no international regime dedicated to overseeing the development of hypersonic weapons. Although the New START Treaty, a strategic offensive arms treaty between the United States and Russia, does not specifically cover hypersonic weapons, it does cover intercontinental ballistic missiles, which could be used to launch hypersonic glide vehicles.⁴⁶ Furthermore, Article V of the treaty states that “when a Party believes that a new kind of strategic offensive arm is emerging, that Party shall have the right to raise the question of such a strategic offensive arm for consideration in the Bilateral Consultative Commission (BCC).” Accordingly, some legal experts hold that it would be possible to negotiate to include hypersonic weapons in the New START limits.⁴⁷ However, because New START is due to expire in 2021, unless extended through 2026, this solution may be temporary.⁴⁸ In addition, it would not cover hypersonic weapons developed in countries other than the United States and Russia.

Directed-Energy Weapons

DOD defines directed-energy (DE) weapons as those using concentrated electromagnetic energy, rather than kinetic energy, to “incapacitate, damage, disable, or destroy enemy equipment, facilities, and/or personnel.” DE weapons—often colloquially referred to as “lasers”—could be used by ground forces in counter rocket, artillery, and mortar (C-RAM) or short-range air defense (SHORAD) missions. They could offer low costs per shot and nearly limitless magazines that, in contrast to existing conventional systems, could enable an efficient and effective means of defending against missile salvos and swarms of unmanned vehicles. Theoretically, DE weapons could also provide options for boost-phase missile intercept, given their speed-of-light travel time; however, as in the case of hypersonic missile defense, experts disagree on the affordability, technological feasibility, and utility of this application.

High-powered microwave weapons, a subset of DE weapons, could be used as a nonkinetic means of disabling electronics, communications systems, and improvised explosive devices in the event of a conflict, or as a nonlethal “heat ray” system for crowd control.

United States

In 2014, the U.S. Navy fielded the first—and, to date, only—operational DE weapon, the Laser Weapon System (LaWS), aboard the USS Ponce. LaWs was a 30-kilowatt laser prototype that “was capable of blinding enemy forces as a warning, shooting down drones, disabling boats, or damaging helicopters.”⁴⁹ The Navy plans to deploy its 60-kilowatt laser, HELIOS, aboard the USS Preble in 2021. The U.S. military has previously developed the Active Denial System, a high-powered microwave weapon used for crowd control; however, the system was recalled—likely due to ethical and operational considerations.

The Army, Navy, Air Force, and DARPA each have DE development programs underway, with the Pentagon requesting \$235 million for directed-energy weapons and directed-energy defensive capabilities

⁴⁶ For example, Russia’s Avangard hypersonic glide vehicle is reportedly launched by an intercontinental ballistic missile. See Rachel S. Cohen, “Hypersonic Weapons: Strategic Asset or Tactical Tool?”

⁴⁷ James Acton notes: “during [New START] negotiations, Russia argued that boost-glide weapons might constitute ‘a new kind of strategic offensive arm,’ in which case they would trigger bilateral discussions about whether and how they would be regulated by the treaty—a position [then] rejected by the United States.” James M. Acton, *Silver Bullet?: Asking the Right Questions about Conventional Prompt Global Strike*, Carnegie Endowment for International Peace, 2013, p. 139, <https://carnegieendowment.org/files/cpgs.pdf>.

⁴⁸ CRS Report R41219, *The New START Treaty: Central Limits and Key Provisions*, by Amy F. Woolf.

⁴⁹ Kyle Mizokami, “The U.S. Army Plans To Field the Most Powerful Laser Weapon Yet,” *Popular Mechanics*, August 7, 2019.

in FY 2020. These programs are intended to scale up power levels from around 150 kilowatts, as is currently feasible, to around 300 kilowatts, a level at which cruise missiles could be intercepted.⁵⁰

Russia

Russia claims to have fielded the Peresvet ground-based DE weapon system in December 2018. Although little is publicly known about Peresvet, including its power level, the weapon can reportedly disrupt Global Positioning System (GPS) and communications signals and may be able to perform an anti-satellite mission.⁵¹

China

China has reportedly developed a 30 kilowatt road-mobile DE system, LW-30, designed to engage unmanned aerial vehicles and precision-guided weapons.⁵² China claims the system is comparable to Russia's Peresvet. Reports indicate that China is also developing an airborne DE weapon pod.⁵³

According to the Defense Intelligence Agency, China is additionally pursuing DE weapons

to disrupt, degrade, or damage satellites and their sensors and possibly already has a limited capability to employ laser systems against satellite sensors. China likely will field a ground-based laser weapon that can counter low-orbit space-based sensors by 2020, and by the mid-to-late 2020s, it may field higher power systems that extend the threat to the structures of non-optical satellites.⁵⁴

International Institutions

As a discussion paper for the UN Convention on Certain Conventional Weapons notes, DE weapons, "are not authoritatively defined under international law, nor are they currently on the agenda of any existing multilateral mechanism."⁵⁵ Certain applications of DE weapons are, however, prohibited. For example, Protocol IV of the CCW "Protocol on Blinding Lasers," prohibits "excessively injurious" applications of DE weapons, including the use of DE weapons to permanently blind enemy combatants.

Biotechnology

Biotechnology leverages life sciences for technological applications. A number of developments in biotechnology hold potential implications for international security. As a 2018 Government Accountability Office report notes, the Departments of Defense, State, and Homeland Security, and the Office of the Director of National Intelligence, all assess that biotechnologies, such as the low-cost gene-editing tool CRISPR, have the potential to "alter genes or create DNA to modify plants, animals, and humans. Such biotechnologies could be used to enhance [or degrade] the performance of military personnel. The proliferation of synthetic biology—used to create genetic code that does not exist in nature—may increase the number of actors that can create chemical and biological weapons." In addition,

⁵⁰ Sydney J. Freedberg Jr., "Lasers to Kill Cruise Missiles Sought by Navy, Air Force, Army," *Breaking Defense*, October 29, 2019.

⁵¹ Defense Intelligence Agency, *Challenges to Security in Space*, February 2019, p. 23, https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space_Threat_V14_020119_sm.pdf.

⁵² Nikolai Novichkov, "Airshow China 2018: CASIC's LW-30 laser weapon system breaks cover," *Jane's Defence Weekly*, November 9, 2018.

⁵³ Andrew Tate, "China aiming to procure airborne laser-based weapon pod," *Jane's Defence Weekly*, January 8, 2020.

⁵⁴ Defense Intelligence Agency, *Challenges to Security in Space*, p. 20.

⁵⁵ "Directed Energy Weapons: Discussion paper for the Convention on Certain Conventional Weapons (CCW)," Article 36, November 2017.

biotechnology could be used to create adaptive camouflage, cloaking devices, or lighter and stronger body armor.⁵⁶ U.S. competitors may be less restrained in both researching and applying biotechnology, particularly as it relates to human performance modification and biological weapons.⁵⁷

United States

There is no coordinating body for biotechnology research within the U.S. government, nor is there a DOD-specific biotechnology research strategy.⁵⁸ However, pursuant to Section 1086 of the FY 2017 NDAA,⁵⁹ the Trump Administration released the *National Biodefense Strategy*, which outlines “how the United States Government will manage its activities more effectively to assess, prevent, detect, prepare for, respond to, and recover from biological threats, coordinating its biodefense efforts with those of international partners, industry, academia, non-governmental entities, and the private sector.”⁶⁰

U.S. biotechnology programs with national security applications are primarily centered on improving military “readiness, resilience, and recovery.” DARPA, for example, has a number of biotechnology programs devoted to battlefield medicine, diagnostics, and prognostics. It is also exploring options for mitigating the effects of traumatic brain injury, treating neuropsychiatric illnesses such as depression and post-traumatic stress, and protecting against infectious diseases and bio-engineered threats to the U.S. food supply. In addition, DARPA’s Safe Genes program seeks “to [protect] servicemembers from accidental or intentional misuse of genome editing technologies.”⁶¹ Biotechnology research also continues at the service laboratories, which recently completed a \$45 million, three-year joint research initiative in synthetic biology.⁶² Overall U.S. government spending on biotechnology is difficult to track; however, a report prepared for the U.S.-China Economic and Security Review Commission notes that “the largest contributors to life science spending were the Department of Health and Human Services (HHS) (\$25.1 billion), US Department of Agriculture (USDA) (\$1.8 billion), Department of Defense (\$0.8 billion), and National Science Foundation (NSF) (\$0.7 billion).”⁶³

Russia

The Russian biotechnology sector lags behind that of the United States and China. According to one recent study, Russia imports more than 80 percent of its biotechnology products.⁶⁴ In recognition of this deficiency, Russia released BIO2020, the country’s whole-of-government strategy for developing a

⁵⁶ Patrick Tucker, “The US Army Is Making Synthetic Biology a Priority,” *Defense One*, July 1, 2019.

⁵⁷ Daniel R. Coats, Director of National Intelligence, “Statement for the Record: Worldwide Threat Assessment of the US Intelligence Community,” U.S. Senate Committee on Armed Services, March 6, 2018.

⁵⁸ Diane Dieuliis, “Biotechnology for the Battlefield: In Need of a Strategy,” *War on the Rocks*, November 27, 2018. There is, however, a coordinated framework for biotechnology regulation. See “Modernizing the Regulatory System for Biotechnology Products: Final Version of the 2017 Update to the Coordinated Framework for the Regulation of Biotechnology,” January 2017, https://www.epa.gov/sites/production/files/2017-01/documents/2017_coordinated_framework_update.pdf.

⁵⁹ P.L. 114-328, Section 2, Division A, Title X, §1086.

⁶⁰ The White House, *National Biodefense Strategy*, 2018, <https://www.whitehouse.gov/wp-content/uploads/2018/09/National-Biodefense-Strategy.pdf>.

⁶¹ See Defense Advanced Research Projects Agency, “Our Research: Biological Technologies Office,” <https://www.darpa.mil/our-research/?Filter=&oFilter=1>.

⁶² Marisa Alia-Novobilski, “Tri-Service effort leverages synthetic biology expertise to address future warfighter needs,” Wright-Patterson AFB, September 27, 2017.

⁶³ “China’s Biotechnology Development: The Role of US and Other Foreign Engagement,” Prepared for the U.S.-China Economic and Security Review Commission, February 14, 2019, p. 42.

⁶⁴ Anna Grebenyuk and Nikolai Ravin, “The long-term development of Russian biotech sector,” *Emerald Insight*, September 11, 2017.

biotechnology sector worth approximately 1% of gross domestic product (GDP) by 2020 and for “creating the conditions” for a sector worth at least 3% of GDP by 2030.⁶⁵ BIO2020 identifies Russia’s priority areas for biotechnology research as biopharmaceutics and biomedicine, industrial biotechnology and bioenergetics, agricultural and food biotechnology, forest biotechnology, environmental protection biotechnology, and marine biotechnology. Little information is publicly available with regard to how Russia might employ such technologies within a military or national security context. However, the accusation that the country recently attempted to assassinate a former double agent for the United Kingdom using a Novichok nerve agent—in violation of the 1992 Chemical Weapons Convention—suggests that it may be similarly unrestrained with regard to the use of biological agents.⁶⁶ Furthermore, the Soviet Union is known to have maintained an extensive, long-standing biological weapons program, Biopreparat, in violation of the 1972 Biological Weapons Convention.⁶⁷

China

Motivated by an aging population and growing health care needs, China has been particularly interested in conducting biotechnology research. Biotechnology is cited as a key strategic priority within China’s Made in China 2025 initiative and is additionally highlighted within China’s current five-year development plan. This plan “stipulates that the biotechnology sector should exceed 4% of gross domestic product by 2020 and that there should be 10 to 20 life-science parks for biomedicine with an output surpassing 10 billion yuan (US\$1.5 billion).”⁶⁸ Some reports suggest that the Chinese government may be spending as much as \$600 million annually on biotechnology research; however, China’s biotechnology market remains less than a tenth of the size of the U.S. market.⁶⁹

In particular, China is aggressively pursuing biotechnologies for genetic testing and precision medicine. In 2016, Chinese scientists became the first to use the CRISPR gene-editing tool on humans. In 2018, a Chinese scientist produced—perhaps with the approval of the Chinese government—the first “gene-edited babies,” although amidst international outcry China later sentenced the scientist to three years in jail and termed his work “extremely abominable in nature.”⁷⁰ China additionally maintains one of the world’s largest repositories of genetic information, the National Genebank, which includes U.S. genetic data. Such information could be used to develop personalized disease treatment plans or, potentially, precision bioweapons.⁷¹

International Institutions

Only the weaponization of biotechnology is prohibited under international law.⁷² Some international institutions have demonstrated interest in considering the implications of biotechnology. For example, since 1983, ASEAN has maintained a sub-committee on biotechnology, which facilitates coordination on

⁶⁵ Russian Federation, “BIO2020: Summary of the State Coordination Program for the Development of Biotechnology in the Russian Federation,” 2012, [http://bio-economy.ru/upload/BIO2020%20\(eng\)%20-%20short.pdf](http://bio-economy.ru/upload/BIO2020%20(eng)%20-%20short.pdf).

⁶⁶ Mark Urban, “Salisbury attack ‘evidence’ of Russian weapon stockpile,” *BBC*, March 4, 2019.

⁶⁷ Lukas Trakimavičius “Is Russia Violating the Biological Weapons Convention?,” Atlantic Council, May 23, 2018, <https://www.atlanticcouncil.org/blogs/new-atlanticist/is-russia-violating-the-biological-weapons-convention/>.

⁶⁸ Shannon Ellis, “Biotech Booms in China,” *Nature*, January 17, 2018.

⁶⁹ “China’s Biotechnology Development: The Role of US and Other Foreign Engagement.”

⁷⁰ Michael Standaert, “‘Extremely abominable’: Chinese gene-editing scientist faces law,” *Al Jazeera*, November 26, 2018. See also, Elsa Kania, “Weaponizing Biotech: How China’s Military Is Preparing for a ‘New Domain of Warfare,’” *Defense One*, August 14, 2019.

⁷¹ David J. Lynch, “Biotechnology: the US-China dispute over genetic data,” *Financial Times*, July 31, 2017.

⁷² The United States, China, and Russia have ratified the 1972 Biological Weapons Convention, which is a legally binding treaty that bans the development and production of biological weapons.

regional biotechnology projects. Similarly, since 1993, the OECD has maintained an Internal Coordination Group for Biotechnology, which monitors developments in biotechnology and facilitates coordination among various sectors involved in biotechnology research (e.g., agriculture, science and technology, environment, industry).

In addition, the 1972 Biological Weapons Convention requires review conferences, which assess both the implementation of the treaty and ongoing developments in biotechnology, every five years. Annual meetings are held between review conferences to informally consider these topics as well as to address national bilateral and multilateral efforts to enhance biosecurity.

Potential Implications of Emerging Technologies for International Security

The implications of emerging technologies for international security and strategic stability are difficult—if not impossible—to predict, as they will be a function of many factors, including the rate of technological advancement in both the United States and competitor nations, the manner in which emerging technologies are integrated into existing military forces, the interactions between emerging technologies, and the extent to which national policies and international law enable or inhibit their development, integration, and use.

Nonetheless, many emerging technologies exhibit characteristics that could potentially impact the future character of war. For example, developments in technologies such as artificial intelligence, Big Data analytics, and lethal autonomous weapons could diminish or remove the need for a human operator. This could, in turn, increase combat efficiency and accelerate the pace of combat—potentially with destabilizing consequences.

Emerging technologies could also potentially shift the offense-defense balance. For example, some analysts have suggested that swarms of coordinated, unmanned vehicles could overwhelm defensive systems, providing a greater advantage to the attacker, while directed-energy weapons that provide a low-cost means of neutralizing such attacks, could favor the defender.

PREPARED STATEMENT OF DR. WILLIAM INBODEN

Testimony for CSCE Field Hearing on “AI, UAVs, Hypersonics and Autonomous Systems:
Emerging Technologies and Euro-Atlantic Security”

Arlington, Texas

January 22, 2020

By

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I.

Congressman Veasey, other Commissioners, and invited guests, thank you for including me in today’s hearing on this most important of topics.

On April 27, 2007, Estonian citizens found themselves and their country under attack. External threats were all too familiar to this tiny Baltic State, which had been invaded and occupied for most of the twentieth century by Nazi Germany and the Soviet Union. But this attack was different. It was not tanks and troops rolling across the border, or airplanes dropping bombs from the sky, but computer signals travelling at the speed of light through internet cables. In short order, the cyberattacks disrupted or shut down entirely Estonia’s banking system, government, major media outlets, and political parties. These attacks continued in waves for three weeks. Though not a bomb was dropped or shot was fired nor did a single enemy soldier set foot in the country, the effects were crippling and brought the country to a standstill. For Estonia the effect was almost the same of being invaded, occupied, and controlled by an outside power.

That outside power was Russia.

Vladimir Putin, with his endless pile of grievances, saw Estonia as a quadruple violator. He objected to Estonia joining NATO three years earlier, resented Estonia’s independence from the former Soviet Union in 1991 (when Estonia also became an OSCE participant), and still seethed over what he saw as Estonia’s betrayal of his father during the elder Putin’s military service in the Estonian territory during World War II. And most recently, in the proximate cause of the cyberattacks, Putin took umbrage at Estonia for moving a statue of a Red Army soldier from the center of Tallin to the outskirts. Putin saw the statue as a tribute to Russian valor in World War II; Estonians saw it as an ugly reminder of the Soviet Union’s occupation and tyranny over their country.

Though thirteen years after the onslaught on Estonia many operational details are still unknown (that in itself being one of the hallmarks of cyber warfare), what is not disputed is that the Kremlin was the originating, authorizing, and orchestrating power behind the attacks. As the

historian Robert Service writes, “the Kremlin’s purpose was not only to knock out the Estonian network of communications but also to show the world what it could do – as well as to allow its disruptive specialists to conduct a real-life test of what became known as hybrid warfare. *Without setting foot outside the Russian capital they could do enormous harm abroad.*”¹

History, it has been said, is lived forward and understood backwards. In that spirit, and for purposes of this hearing, from our vantage point of thirteen years later we should look back on Russia’s cyberattack on Estonia and see it for what it was: the first wave in what would become a cascade of Russia aggression and hybrid warfare that included weaponizing new technologies. The Estonia attacks were followed by, inter alia, Russia’s invasion of Georgia in 2008, intervention in Syria in 2013, seizure of Crimea and assault on Ukraine in 2014. Perhaps we might add to this list Russia’s assault on our democratic processes in the 2016 election, an assault that continues today. Though the particulars of each act of aggression varied, each included the use of new technologies and escalating levels of sophistication, all for the purposes of projecting Russian power, securing Russian interests, and weakening Russia’s (perceived) adversaries.

Thus what began with the use of cyberwarfare against Estonia, became cyberattacks followed by land invasion and precision weapon employment in Georgia in 2008, and then with increasing sophistication the use of autonomous weapons and UAVs in the invasion of Ukraine in 2014 and the intervention in Syria in 2015.

I begin with these observations because, though Russia is not mentioned by name in the title of today’s hearing, Russia is the OSCE state most implicated in the themes and questions we are addressing today. Russia is the OSCE state most involved in researching and developing these new weapons systems, most involved in employing them, and arguably most resistant to current or new measures or agreements to control and limit their use. It also bears noting that, with the exception of Syria, all of the states toward which Russia engaged in this aggression are also OSCE participants.

The other OSCE participant state leading in the development of these technologies is the United States.

II.

Why does this matter? I am not an expert on technology or defense policy; my training, experience, and research focus sit at the intersection of history, strategy, and statecraft. The focus of my testimony is on the strategic and diplomatic implications of these emerging technologies.

History reminds us that technological innovation in weaponry is a near constant factor in warfare and statecraft. Past innovations such as the long bow, the crossbow, gunpowder, repeating arms, tanks, submarines, aircraft, jet propulsion, ballistic missiles, nuclear age, all brought various revolutions in warfare and force projection. If anything, innovation in weaponry

¹ Emphasis added. Robert Service, *Kremlin Winter: Russia and the Second Coming of Vladimir Putin* (London: Picador 2019), 263-264.

is a constant factor in history, as is the human propensity for violence. The details will change, but these questions will always bedevil us in some form or another.

Anytime we make a strategic assessment of emerging technologies, we should ask ourselves: What is new, and what is not?

I begin with that which is not new:

- **Lethality:** These emerging technologies do not have unprecedented levels of lethality. As grim as it is to contemplate, the “lethality threshold” was crossed decades ago with the development of chemical, biological, and thermonuclear weapons, all of which can cause mass casualties on a terrifying scale.
- **Range:** These emerging technologies do not have unprecedented levels of range and reach. Existing weapons systems already enable the projection of force globally, and for over a half century we have had reach into outer space as well.
- **Speed:** Though emerging technologies under consideration involve varying dimensions of speed, whether in information processing or projectile velocity, they do not represent a qualitative leap in rapidity. Ballistic missiles already fly at several times the speed of sound. The internet already offers communications at the speed of light. Though some aspects of these new weapons have elements of rapidity – such as the blend of speed, mobility, and precision guidance of hypersonics, the speed by itself is not new.

So what is new? I believe the following factors are distinctive and to a degree unprecedented; they are not exhaustive but rather illustrative of the new strategic dimensions wrought by these emerging technologies:

- **Deniability.** Given various factors including the distance of human operators, the operational complexity that can involve cut-outs and false surrogates, and the literal autonomy of some of these systems, many of them offer a new dimension of deniability and potential anonymity that previous generations of weapons systems did not. This in turn makes deterrence and retaliation more difficult, and can be strategically destabilizing.
- **Controllability.** This is a corollary of deniability; these new weapons systems can be controlled remotely with greater precision, from greater distance, with greater anonymity, and in greater safety for the operators, than any previous weapons by an order of magnitude. It means that kinetic action could be taking place in an OSCE participant state but controlled by various actors 10,000 miles away in multiple directions.
- **Inhumanity.** This is meant not in a melodramatic manner but in the very literal sense of removing the human actor in ways never before seen. The closest past parallel came when the Soviet Union experimented in the 1980s with the infamous “Dead Hand” of its Doomsday machine that would have put the Soviet nuclear arsenal under automated control to launch automatic retaliatory strikes even if the entire command and control system had been decapitated. But while UAVs at least for now have human controllers, the emerging domain of AI and autonomous weapons brings in a new paradigm that may completely

remove the human actor and thus be quite literally “inhumane.” Paul Scharre of the Center for New American Security puts it this way: “do we control our creations or do they control us?”²

III.

How, then, should the OSCE think about these emerging technologies?

I will state my central point up front: the importance of these emerging technologies cannot be evaluated aside from the nature of the states that use them.

It is not the fact of the new technologies that matters most, but who will use them and for what purposes. It is not the nature of these weapons that should primarily concern us. It is the nature of the regime that possesses and deploys them.

To put it more pointedly and perhaps provocatively, I doubt that many if any of us here today lose sleep over the fact that the United Kingdom and France (both OSCE participant states of course) possess nuclear weapons. Whereas many of us do continue to worry, with warrant, about Russia’s nuclear arsenal (and likewise the DPRK’s nuclear arsenal, though they are not an OSCE participant).

This, of course, was the core strategic insight of the original Helsinki process, connecting as it did respect for human rights and civil liberties with European and transatlantic security. It also continues to be the animating spirit of the OSCE.

For this reason Putin and Russia occupy a large part of my testimony. Of the OSCE participating states, Russia and the United States are by far the most active and advanced in researching, developing, and deploying these emerging technologies. All OSCE participant states must participate in addressing these trends, but the conversation and consideration should focus on where these new weapons are most prevalent and most frequently employed.

To understand why Russia has been and continues to be so active in this realm, one must start with Vladimir Putin and how he sees the world. As many Russia scholars and Putin biographers have observed, the Cold War exerted – and continues to exert – a profound influence on the Russian leader. It provided his formative professional experiences as a KGB officer, and now provides a ready set of historical insights, lessons, and grievances for his worldview and statecraft.

One of the Cold War lessons Putin obsesses over concerns how the American technological edge proved decisive in the arms race that contributed to the Soviet Union’s bankruptcy. It was not just that by the 1980s the US began outspending the Soviets in dollars to rubles for the military; it was that the US developed a qualitative edge in defense technology that meant no matter how much the Soviets spent, they could not keep pace with the new advances in American weapons systems – from stealth, to precision guidance, to submarine quieting, to the lofty ambitions of the Strategic Defense Initiative. This was in part why the Kremlin resorted to

² Paul Scharre, *Army of None: Autonomous Weapons and the Future of War* (New York: W. W. Norton 2018), 8.

stealing Western technology through a massive KGB espionage campaign. Even these purloined technologies, however, bumped up against the constraints of the Soviet system and its sclerotic economy. As Fiona Hill and Clifford Gaddy document in their biography of Putin, he and his KGB colleagues became frustrated “that the Soviet economic system was incapable of using the technology stolen from the West.” Putin is determined now not to let Russia fall into that same trap.³

In particular he does not want to see the traditional Western technology edge once again overmatch Russia as in the Cold War. Putin seeks to make technological advancement central to the Russian military-industrial complex, central to Russian military strategy and doctrine, and central to Russian power projection.

Cost matters too. As sophisticated as they are in technological terms, these new weapons are relatively cheap compared to the cost of training equipping maintaining large conventional forces. This appeals to Putin given Russia’s economic stagnation and limited financial resources, in light of its imbalanced economy and ongoing pressure from Western sanctions.

Additionally, Russian military doctrine and Putin’s strategic designs depend in part on integrating the use of these new technologies for employment in “grey zone” conflicts and hybrid warfare. UAVs can be used for everything from kinetic operations that kill adversaries, to monitoring contested spaces for information operations and political warfare. As Jeff Edmonds and Samuel Bendett of the Center for Naval Analyses have written, “with greater access to space-based information, unmanned aerial vehicles, airborne reconnaissance systems, command and control systems, and unparalleled developments in electronic warfare, the Russian military is equipped to detect, track, and influence developments across the battlefield.”⁴ Russia is using its interventions in Ukraine and Syria as battlefield laboratories for testing and refining these emerging weapons technologies.

Finally, Putin’s authoritarian rule squelches and silences any dissent, and empowers him to act with aggression based only on his whims, preferences, or designs. Because he lacks popular legitimacy – and because he fears his own citizens – he resorts to a perverse and toxic combination of cultivating grievances, fueling paranoia, and projecting strength against adversaries real or perceived. Such a ruler naturally seeks to acquire – and potentially to use – the most advanced, sophisticated, and lethal weapons systems that he can.

IV.

The best framework to address these emerging technologies lies in the commitments and values embodied by the Helsinki Final Act. Open, free, and secure societies are best equipped to explore, debate, wrestle with, and ultimately resolve these hard questions.

³ Fiona Hill and Clifford Gaddy, *Mr. Putin: Operative in the Kremlin* (Washington DC: Brookings Institution Press 2015), 143.

⁴ <https://thestategybridge.org/the-bridge/2019/2/26/russian-battlefield-awareness-and-information-dominance-improved-capabilities-and-future-challenges>

In particular, Principle VII's guarantee of freedom of thought, conscience, religion, or belief protects the rights and capabilities of religious believers, alone or in fellowship, to draw on transcendent insights and act as prophetic voices of conscience for their societies. They can apply moral and religious principles to the just use of force, restraint on the use of force, and how human dignity can be either protected or exploited by emerging weapons technologies. It similarly empowers other dissenting voices, religious or secular, to raise hard questions, interrogate received dogmas, and engage in the creative thinking necessary to ensure that these new technologies – with their awesome power to create and to destroy – serve and secure free societies.

Principle VII's affirmation of “the effective exercise of civil, political, economic, social, cultural and other rights and freedoms, all of which derive from the inherent dignity of the human person and are essential for his free and full development” creates further space for open societies to address the challenges presented by emerging weapons technologies. Placing the human person – rather than the state, the ruler, the technology, or any other such alternatives – at the center of the Helsinki process provides a foundation for exploring how best to manage these new weapons systems. It answers the hard question posed by Scharre, and affirms that we need to control our creations.

In contrast, authoritarian states by their nature brook little dissent, encourage little transparency and debate, and concentrate power in the hands of dictators or ruling cliques that generally make decisions on the development and employment of arms based on expediency and utility more than morality or conscience.

In practical terms, any strategy to address Russia's growing advantage in this weaponry needs to include pressing Russia to honor its OSCE commitments on human rights and freedoms.

V.

Finally, how might these technologies be managed and perhaps limited by international agreements?

This question is even more complex than many other arms control questions because many of these emerging technologies have important civilian applications. In the private sector the technology itself will continue to be developed, refined, and used. In many cases in these civilian contexts it will contribute to economic growth, prosperity, and human flourishing. The question is whether the weaponization, the lethal use of it by militaries, can (or even should) be controlled?

On this question, I conclude with a hope, a caution, and a recommendation

- A hope: International agreements are possible. They have been forged at times in the past on controlling new weapons technologies. Whether sawtooth bayonets, dum-dum bullets, chemical and biological weapons, blinding lasers, or even the entire class of nuclear weapons abolished by the 1987 INF treaty, competing states have been able to come together, forge agreements, and honor and fulfill them.

- A caution: An arms control agreement is only as strong as its weakest signatory, and its verification regime. While Russia would need to be part of any effective arms control accords on emerging weapons technologies, Russia also historically has a bad habit of treaty violations. These include its violations (either in its previous incarnation as the Soviet Union or now as Russia) of the ABM treaty, the Biological Weapons Convention, and the INF treaty, not to mention its serial violations of its OSCE commitments. We should temper our expectations and hopes of just how much can be accomplished with Russia in this realm.
- A recommendation: The United States and like-minded OSCE participant states should take a page from the Cold War playbook and combine strength with diplomacy. Diplomatic success proceeds from military power and allied unity. To begin, the United States and other OSCE democracies should move forward in developing our own capabilities on emerging weapons technologies, specifically those featured today: AI, UAVs, Hypersonics, and Autonomous Systems. Unilateral disarmament is not a luxury we can indulge. But, as with the NATO “dual track” decision of 1979 to respond to the Soviet deployment of Intermediate Range Nuclear Missiles in Europe by deploying US Pershing IIs and Ground Launched Cruise Missiles and also pursuing diplomatic negotiations with the Soviets, today we are in a similar strategic predicament. We need to build-up to negotiate. From a position of strength we can better encourage Russia and other potentially recalcitrant states of the advantages of setting shared rules for the control, use, and limitation of these weapons.

Thank you for your time and interest, and I look forward to your comments and questions, and our discussion.

PREPARED STATEMENT OF CHRIS JENKS

I want to thank the U.S. Commission on Security and Cooperation in Europe and in particular Congressman Veasey and his staff for the opportunity to discuss emerging technologies and euro-Atlantic security.

My statement seeks to highlight the significance of artificial intelligence (AI) and autonomy to our national and collective trans-Atlantic security. I served in the U.S. military in Germany and Korea and on operational deployments to Bosnia, Kuwait, and Iraq and I've researched and written on emerging military technologies. I am familiar with the current security challenges facing the United States and our allies and I can unequivocally state that developing and operationalizing AI and autonomous systems is a legal and moral imperative. As I will later explain, more accurate wording would be to *continue* to develop and operationalize as depending on how one parses the definitions, we have fielded such systems for decades.

I will briefly summarize the definitional and taxonomical challenges AI and autonomy pose before providing the Commission my assessment of how the U.S. is doing at present and then suggest where and how we need to change. To preview my bottom line, our current approach to AI and autonomy is appropriate but considerably more thinking on how the U.S. will conduct military operations in the future is needed. With that thinking will come changes, changes which may need to be Congressionally directed.

In terms of how we think of AI and autonomy, there are widely varied approaches but no consensus on what either term means or even their relationship to the other. This in turn leads to two important points. The first is that many tech discussions are reduced to a veritable tower of Babel. The second is that under a number of definitions or understandings, the U.S. has fielded systems which use AI and/or perform functions autonomously for decades. In terms of AI, President Reagan's 1983 Strategic Defense Initiative incorporated aspects of what was then thought to be AI, notably expert systems AI which was developed in the 70s. The Defense Satellite Communication System and the Navy's submarine force, to name just two more contemporary programs, rely in part of AI as well as machine learning. In terms of autonomous systems, the Army's Patriot Missile and the Navy's Close in Weapons System or CIWS, incorporate autonomy into functions, including the selection and engagement of targets. And we fielded the Patriot starting in 1981 and the CIWS since 1980.

Shifting to an assessment of how the United States is doing in terms of AI and autonomy strategy and development, the current U.S. approach is appropriate. Between the Defense Advanced Research Projects Agency, the relatively new Joint AI Center and each of the military services, research, testing and fielding of systems is ongoing. While enabling personnel to exercise appropriate levels of human judgment, these developments may improve the military's efficacy while strengthen the implementation of the law of armed conduct. This may include reducing the risk of civilian casualties and the armed forces, facilitating the investigation or reporting of incidents involving violations, enhancing the ability to

implement corrective actions and automatically generating and disseminating information on unexploded ordnance.

While the United States has a moral duty to continue to develop systems which limit the effects of armed conflict, there may well be a legal duty. Certainly for our European allies who are States Parties to Additional Protocol I of the 1949 Geneva Conventions there is an obligation that "in the conduct of military operations, constant care shall be taken to spare the civilian population, civilians and civilian objects." Thus if autonomous vehicles achieved a degree of sophistication and safety such that they were less likely to crash into civilians and civilian property than human operated vehicles, a country employing such vehicles might be required to use them during military operations as a result of the constant care obligation.

At the same time the U.S. Department of Defense developed and released a policy on autonomy in weapons systems and the Defense Innovation Board and the recently established National Security Commission on Artificial Intelligence are working with both government and non-governmental organizations and industry to develop recommendations.

Also appropriate is the United States participation in the ongoing United Nations meetings on autonomous weapons. The working papers and interventions from the U.S. delegation have significantly advanced those ongoing discussions. At the same time, it is also appropriate that the United States has resisted fear mongering NGO attempts at sweeping regulation or even a ban. At a minimum it is premature to consider sweeping regulation when there is nothing close to consensus on what is even meant by AI and autonomy. And as I previously mentioned, depending on how you define AI and autonomy, any number of systems fielded by the US and our allies for decades would be implicated.

In terms of where and how we need to change, minimal if any attention has been paid to demarcating scientific and arms control mechanisms and much more thinking on how the U.S. will conduct military operations in the future is needed. This later point is not so much a tech problem as it is a process problem.

The U.S. military is the personification of a hierarchical organization. Is such a structure capable of conducting the decentralized or distributed operations in general let alone in an environment in which communications are denied by the adversary? How will command and control, authorizations and delegations of authorization work? What about resolving dueling or competing authorities? While the Defense Department operates jointly, how effectively is DoD able to conduct joint military operations involving AI and autonomy without sharing a common backbone network?

By way of example, consider the hierarchical way in which an air tasking order or ATO is developed in a military operation. An ATO is the sole method by which air strikes are planned, executed and assessed and involves multiple levels of command and staff and varying timelines and authorities. Now imagine a future environment in which no level of command is able to effectively communicate with the other, there are AI enabled systems able to perform a number of the ATO functions and ground forces require air support.

Between military service cultures and organizational inertia, DoD is unlikely to make the significant changes required to effectively conduct the distributed, netcentric, military operations many experts believe will be required. The question then becomes what would force DoD to make those changes?

Changes to how the U.S. military is structured and operates do not come quickly or easily. Ultimately, I submit that the U.S. Congress may need to direct that change.

I suggest the Commission and the Congress consider the Goldwater-Nichols Act of 1986. The need for the Act arose during interservice rivalries in the Vietnam War, which later tragically manifested themselves in the 1980 failed attempt to rescue U.S. hostages in Iran and in the 1983 U.S. invasion of Grenada.

I believe emerging technologies may require Goldwater-Nichols 2.0, though preferably more quickly and without a precipitating armed conflict involving AI in which the U.S. fares less well than it could or should have.

Thank you for your attention and I welcome your questions.



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**Commission on Security and
Cooperation in Europe.**

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