WEAPONS OF MASS DESTRUCTION:

THE STATE OF GLOBAL GOVERNANCE AMID RISING THREATS & EMERGING OPPORTUNITIES

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COUNCIL ON STRATEGIC RISKS

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Cover Photo:
UN Security Council special ministerial meeting on Denuclearization of the Democratic People's Republic of Korea (DPRK) in New York City on April 28, 2017.
U.S. Department of State

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FOREWORD

As we enter the 2020s, there are worrisome signs that weapons of mass destruction (WMD) are reemerging to increasingly threaten international stability. The global security environment is changing, long-held progress in arms control is at risk, and WMD development and use are mounting concerns.

These trends require new and expanded efforts to strengthen norms and global governance regarding WMD. History can be instructive in this course. After all, the international community has been largely successful in prohibiting and ensuring the destruction of one category of WMD: chemical weapons.

Just over 100 years ago, World War I saw widespread use of chemical weapons with more than one million people affected and estimates of at least 90,000 people killed. From this, the international community banded together to attempt to stop the use of chemical and biological weapons in conflict. In the following decades the devastation of nuclear weapons use and testing further added momentum. The development of norms against WMD, defensive technologies, and countermeasures all contributed to efforts to lower the political utility of these weapons and raise their costs.

Over time, the international community developed strong governance mechanisms to work toward full disarmament of chemical, biological, and nuclear weapons. In implementing the Chemical Weapons Convention---work conducted by the Organisation for the Prohibition of Chemical Weapons---97% of declared stockpiles of these weapons have been destroyed. The primary focus of the OPCW is therefore shifting to preventing the reemergence of chemical weapons and their use, including by non-state actors.

The success of the Chemical Weapons Convention regime sets a good example for efforts toward the elimination of other WMD. The international community can draw on its lessons for nuclear disarmament and efforts to make bioweapons obsolete as tools of mass destruction. We must not lose sight of these end goals.

The history of chemical weapons shows what is possible regarding all WMD. Though it will continue to take time, nuclear and biological weapons are already on similar long arcs away from their pinnacles of prior decades---if those trajectories can be maintained and expanded upon. This report outlines where the world stands today in this regard, and notes the importance of looking to past successes in WMD reductions to inform the international community's next steps.

This is not to imply that further progress in reducing WMD threats will be easy. The international community must recommit to strengthening the relevant norms and institutions and creating new avenues for win-win collaboration. Unfortunately history shows us that the decline of WMD may not fully prevent their use. Verification and accountability mechanisms are therefore gaining even more importance, as are the science and technical approaches that underpin such efforts. As with chemical weapons, preventing the reemergence of all WMD as legitimate tools of coercion and terror will be imperative in the 21st Century.

OPCW Director-General Ahmet Üzümcü addresses the media on 11 October 2013 on the occasion of the organisation's winning of the Nobel Peace Prize. OPCW

For further progress, we must work together among all stakeholders: those in government, science, industry, civil society, and international organizations. Raising awareness regarding WMD threats and opportunities, especially among younger generations, will be critical to ensuring the continued integrity and credibility of international norms. This report makes the case for why this is so important to international security, and offers practical ideas for how we can work together to continue building on the strong history of progress against WMD threats.

Ambassador Ahmet Üzümcü
Director General of the Organisation for the Prohibition of Chemical Weapons (2010-2018)
Senior Advisor, Council on Strategic Risks

AUTHOR'S NOTE

Weapons of mass destruction remain a daunting international security challenge. These threats have long been growing more complex, and in recent years norms regarding their possession and use have been weakening.

As a core part of its mission of anticipating, analyzing and addressing core systemic risks to security in the 21st Century, the Council on Strategic Risks is working to characterize this new era of weapons of mass destruction threats and offer practical solutions to help mitigate them. This report, made possible by the generous support of the Global Challenges Foundation, contributes to that task.

Any errors and omissions are solely those of the author, who is grateful to all who provided advice and input regarding this report.

PART I: BACKGROUND

The world has entered a new era of weapons of mass destruction (WMD) challenges. Today it is well established that WMD risks are rising and evolving in ways that defy some of the threat-mitigating effects related treaties, institutions, and norms have long provided.

Nowhere is this more clear than in the continued use of chemical weapons and the blocking of attempts to hold perpetrators accountable. Chemical weapons are now used far too commonly and in a spectrum of ways, from their use in conflict to targeted assassination attempts and at both large and small scales.

Additionally, the world is at the start of a new nuclear arms race, with the demise of important arms control and nonproliferation agreements and increasingly robust nuclear weapons modernization and expansion plans by multiple countries. Nuclear weapons testing may also be returning: North Korea has conducted several tests in recent years, and some parties in the United States seek to end its more than two-decade-long halt to the practice.

Biological weapons threats are expanding and changing as well. The United States and other countries successfully worked for decades to eradicate bioweapons programs, many of which were Cold War legacies. However, some nations may still maintain large bioweapons programs (e.g., North Korea) and terrorists have long eyed them as a means of causing widespread destruction and fear.

Some of the changes that are driving these trends are clear. The international security environment is laden with complex tensions, many of which appear to be worsening. State and non-state actors are altering the character of conflict to better advance their interests within this landscape.

Technological change is another prominent contributor. Information availability and advances in additive manufacturing stand to alter the power of long-held export control regimes that limited the materials and knowledge needed in WMD programs. Technological and market changes in the biological sciences are particularly rapid, including: advances in synthetic biology and gene editing; significantly reduced costs in synthesis and sequencing; robotics and machine learning enabling more rapid and cheaper bioproduction; the explosion in data these advances are driving; and other trends. Countries and researchers are beginning to sponsor gain-of-function experiments that could make diseases more transmissible or virulent to humans, and the risk is growing of nation-states or rogue actors recreating previously-eradicated diseases like smallpox or developing novel bioweapons.

Globalization, social media, and the increasingly-rapid transmission of information and misinformation are tightly interrelated to these challenges---and should be components of potential solutions. After all, the Treaty on the Prohibition of Nuclear Weapons (a.k.a. ban treaty) movement advanced due in large part to social mobilization by civil society groups, and social media (YouTube in particular) has been used extensively by governments, individuals, and advocacy groups in spreading both true and false information on chemical weapons use.

Progress in mitigating WMD risks requires working toward a deeper understanding of these changes; and closely examining which elements of the global governance system have weakened, which have held strong, and where persistent and emerging gaps warrant attention. What led countries that formerly refrained from overt use of WMD to change their behavior, and what has succeeded in preventing even more extensive use? Moving forward, what will help or hinder progress?

Addressing deficiencies in current WMD governance and leveraging the strengths of the current international system are both urgent. With every single new nuclear weapon-related test, use of chemical weapons, public announcement of experiments to advance weaponizable biological capabilities, and end to another nuclear agreement, the world becomes less safe and long-held norms against WMD spread and use further break down.

Furthermore, there is an urgent need to treat WMD in a more integrated, multidisciplinary manner. Nuclear, chemical, and biological threats are too often governed in their own silos at the international level and within most countries. WMD threats are also frequently managed in ways that wall them off from potential risks and opportunities in related areas, such as cybersecurity, health, climate, artificial intelligence, and others.

This is a critical time to take stock of the current weakening of norms against WMD and the status of the global governance system that for decades helped reduce the odds of catastrophic destruction via WMD. Though this report is not exhaustive, it is meant to highlight important WMD trends and present ideas for strengthening governance regarding these devastating weapons.

As such, it begins by highlighting several strengths of current structures that contribute to global governance of WMD. It follows with overviews of several significant weaknesses of this system. Part IV further identifies numerous gaps that today hinder progress against WMD threats, including gaps inherent in the current system and those that are emerging due to technological and other changes. The report concludes with recommendations that can help countries, international organizations, and nongovernmental organizations contribute to strengthening global governance regarding WMD.

PART II:
STRENGTHS OF THE CURRENT SYSTEM

All international treaties and norm-building mechanisms contain strengths and weaknesses. Some are inherent to the arrangements in place, and others change over time. Despite the challenges outlined above, there remain many strengths in the current system that can be instructive regarding future progress against WMD threats. The following section highlights several of the most important of these strengths.

HISTORY OF WMD ELIMINATION AND REDUCTIONS

Though the world must act on the troubling signs that global governance of WMD is weakening, it is important to keep in context the monumental progress that has occurred over several decades toward reducing---and in many cases eliminating---WMD programs. The following are just a few examples from this history of progress against chemical, nuclear, and biological weapons programs.

CHEMICAL WEAPONS

Of the world's chemical weapons stockpiles declared since the Chemical Weapons Convention (CWC) entered into force, about 97% have been verifiably destroyed as of mid-2019. Syria stands as a critical recent example of this work. Although it did not fully stop the devastating use of these weapons against the Syrian people, the international effort to destroy over 1,300 tons of chemical weapons materials from the Syrian stockpile serves as a historic example of proactive WMD threat reduction and multilateral collaboration toward their elimination.

Until 2014, Syria held a vast chemical weapons enterprise that included sarin, VX, and other materials that could readily cause mass death and devastation. The international community grew increasingly concerned for the security of Syria's facilities and materials as civil war spread across the country beginning in 2011. With the proactive development of technical chemical weapons elimination options tailored for the Syrian stockpile by the United States[1]---and breakthrough diplomacy by the Organisation for the Prohibition of Chemical Weapons (OPCW), Russia, and the United States---the Syrian government agreed in 2013 to join the CWC and relinquish its declared stockpile.

At the time, most of Syria's chemical weapons stockpile was in the form of bulk liquid agents and precursors, rather than pre-filled into delivery devices. A team of contributors from numerous countries helped to transport these materials out of Syria, neutralize them on a maritime vessel outfitted with a specially-developed system, and safely dispose of the remaining waste in commercial facilities.[2] Additional work was conducted in-country to verify the destruction of filled munitions and facilities in Syria that contributed to producing these WMD.

Former Anthrax Weapons Production Facility, Stepnogorsk, Kazakhstan. This facility, now destroyed, had the capability to produce an estimated 300 metric tons of weaponized anthrax in eight months.
ANDY WEBER

Other examples offer rich histories of success in chemical weapons elimination. Over multiple iterations, interrupted at times by war and regime change, Libya successfully destroyed more than 27 metric tons of sulfur mustard, 517 filled artillery shells, eight 500-pound bombs, large quantities of chemical weapons precursors, and more than 3,500 unfilled munitions intended for use as chemical weapons.[3] Russia, the United States, Japan, South Korea, several European countries, and others have likewise made great strides toward eliminating global chemical weapons stockpiles---some of which still remained as legacies of the World Wars. All of these efforts hold important lessons for the future of WMD governance and threat reduction.

NUCLEAR WEAPONS

Despite the rising threat of this trend reversing and the qualitative improvements to nuclear weapons in recent decades, world nuclear weapon stockpiles have decreased markedly in size since the mid-1980s. This progress came largely as a result of unilateral decisions and bilateral agreements by the Soviet Union (and later Russia) and the United States. As the Federation of American Scientists notes, levels fell "from a peak of approximately 70,300 in 1986 to an estimated 13,890 in early-2019."[4] These reductions should continue to be celebrated in ways that reinforce the norms and treaty obligations behind reducing nuclear weapons threats.

BIOLOGICAL WEAPONS

Successes are perhaps more differentiated for biological weapons than other WMD given the nature of these threats and their unique history. Many countries that once had bioweapons programs ended them internally around their signing onto the Biological Weapons Convention (BWC). In Iraq's case, Saddam Hussein's regime worked to destroy and convert facilities and took other measures to hide evidence that its offensive bioweapons program continued after it had signed the BWC. Still, the full arc of the Iraq bioweapons case is an example of success in the international community working through the UN to conduct intrusive inspections to verifiably end WMD programs and deter cheating. In more recent years, bioweapons threat reduction has often come in the form of cooperative international efforts to build norms among science communities, improve the security of and consolidate facilities containing dangerous pathogens to help prevent their diversion, and other steps.

Kazakhstan offers important lessons in eliminating all types of WMD programs given the vast Cold War weapons legacy it inherited upon independence in 1991. The end of the Soviet-era bioweapons program on its soil stands as a particularly important case, as the town of Stepnogorsk was home to a facility designed to produce bioweapons at an industrial scale that could have killed millions of people. As I wrote in 2017 along with Andy Weber, a former U.S. official who played a key role in addressing this threat:

> "The Scientific Experimental and Production Base facilities in the once-secret closed city of Stepnogorsk, Kazakhstan…once employed hundreds of scientists to work on anthrax, staphylococcus toxin, and Ebola-based weapons, among other civilian and military activities…Across about 25 buildings, the site housed equipment built and proven for large-scale, wartime mobilization production of agents for biological weapons—more than 300 metric tons of anthrax in about 10 months. The site housed giant fermentors, centrifuges, explosive aerosol testing chambers, biocontainment systems, and countless other types of equipment."[5]

Kazakhstan explored options for converting the former bioweapons facilities for strictly civilian use, but after encountering numerous hurdles decided to instead fully dismantle its vast, inherited bioweapons infrastructure.

NEAR UNIVERSALITY OF KEY TREATIES

Though trends appear to show weakening of global governance and norms against WMD, the near universality of existing treaties remains an important strength: 191 are party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT),[6] 193 to the CWC (plus one nation, Israel, that has signed but not ratified it),[7] and 183 to the BWC.[8]

Ambassadors from the United Kingdom and several non-aligned states watch as Soviet Ambassador Anatoli Dobrynin signs the NPT. The near-universality of the NPT, CWC, and BWC are important strengths of current global governance of WMD threats.
Lyndon B. Johnson Presidential Library / the National Security Archive.

The near-universality of the core WMD-related treaties confers numerous benefits. It shows their critical role in the international legal basis for how WMD are variously banned and governed. The NPT, CWC, and BWC systems remain important channels for diplomacy and collaboration. The BWC and CWC in particular cover issues that transcend vast parts of the global economy, and the work conducted under their auspices can help balance security needs with the growth of these sectors. Additionally, the near-universality of nation-state participation in these treaty systems adds resilience to norms against WMD use and possession. Even though issues such as accountability and adherence (explored later) must be improved, these systems have proven that they can be built upon productively.

A LAYERED APPROACH

Another benefit to current global governance regarding WMD is that it involves a multifaceted, layered approach. Regional and otherwise narrowly-focused treaties, agreements, conventions, and cooperative ventures build on the core international treaties to help adapt to change and fill gaps.

One important example lies in nuclear weapon free zones, a series of regional treaties banning its member states from having nuclear weapons and, in most cases, strictly limiting the ability of other countries to move these weapons within the zone and controlling any presence of dangerous nuclear materials. These treaties cover much of the world's geography, including Latin America and the Caribbean, the South Pacific, Southeast Asia, Africa, and Central Asia.[9] All of these initiatives help strengthen norms against nuclear weapons possession and use.

Additional layers come in the form of export control systems enacted through national laws as well as a series of voluntary collaborations dedicated to multilateral unity regarding the movement of dangerous WMD-related technologies and materials. These include:

- the Australia Group, which aims to help participants sync their national controls over items that may be used in biological or chemical weapons;
- the Wassenaar Arrangement, focused on exports of conventional arms and dual-use goods and technologies;
- the Nuclear Suppliers Group, which sets guidelines for trade in nuclear-related goods and services;
- the Missile Technology Control Regime, which seeks to guide trade in technologies that can be used to develop WMD delivery systems;
- and many more.

Further building on these treaties and informal mechanisms are layers of measures taken by the UN, narrowly-focused conventions and agreements, and other vehicles. One prominent example is UN Security Council Resolution 1540, passed in 2004 to augment the legal requirements of member states to prevent proliferation of WMD and their delivery systems in particular to non-state actors; the UN and many members have further enhanced its implementation by fostering regional and public-private coordination.[10] Even the persistent statements member states make in the UN and other fora help in maintaining norms against WMD proliferation and use.

RISE OF TAILORED AD HOC MECHANISMS

Another significant strength to global governance of WMD has been the rise of ad hoc efforts to bolster the primary treaty systems and accelerate progress toward their goals. Many of these mechanisms have been in multilateral and minilateral formats, welcoming small- to medium-sized groups of countries (and often other actors) to join together in committing resources, driving action, and communicating their political commitment to reducing well-defined WMD risks. They build on the long history of coordinated export controls and other voluntary efforts and contribute to the layered approach described above, yet are distinct in that they are established to focus on implementing highly-specific goals in reducing WMD threats, often for a limited time period.

One important set of examples originated through the major international organizations: the ad hoc mechanisms established to address Syrian chemical weapons challenges. The UN Secretary General and the OPCW Director General established a Joint Mission that operated from October 2013 to September 2014 to oversee the destruction of Syria's declared chemical weapons stockpile. The OPCW followed with a Fact-Finding Mission launched to accrue facts related to the use of chemical weapons in Syria.

The UN Security Council also established a Joint Investigative Mechanism whose mandate ran from 2015 to 2017 to help identify the perpetrators of chemical weapons attacks in Syria.[11] The OPCW Director General at that time, Ahmet Üzümcü, later described that this mechanism "was partially successful because of deadlock at the Council over further action."[12] The OPCW has tried to fill the gap left when its mandate ended due to disagreement in the UN forum.

Other examples have been initiated by nation-states. Among them, the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction, launched by the G-8 in 2002, focuses on specific measures to reduce the risks of WMD terrorism. Its successes include contributing to the security of dangerous pathogens and helping to accelerate the destruction of the Russian chemical weapons stockpile.[13] The Proliferation Security Initiative, which aims to improve global coordination to counter proliferation and focuses heavily on interdiction of WMD and related components, enjoys the support of more than 100 nations. The Global Initiative to Combat Nuclear Terrorism continues countering-nuclear terrorism work among over 90 nations and international organizations. The Nuclear Security Summit process, which included dozens of countries, brought high-level political support to the implementation of pledges to secure and reduce stocks of the most dangerous nuclear materials and otherwise reduce nuclear terrorism risks. The Global Health Security Agenda similarly facilitates around 65 countries and international organizations to help one another achieve specific steps toward improving public health capacity (many of which also benefit efforts to lower biological weapons threats).[14]

The Nuclear Security Summit series showed that ad-hoc mechanisms can help foster important cooperation and accelerate progress against WMD risks. Its leaders had to wrestle with numerous issues outlined in this report, such as inclusivity.
Republic of Korea

These and other relatively informal and ad hoc groups and mechanisms formed to target specific action areas have been highly successful in helping to strengthen global governance against WMD threats. Equally important, the specific actions they have contributed to reducing WMD risks help convey the message that progress is imminently possible. An added benefit is that they create fora that can be leveraged for states to coordinate rapid action on pressing WMD threats when they arise.

Though there are downsides and critiques of the efforts highlighted here, they carry many benefits that often stem from several common traits. First, they are action-oriented. Second, their narrow focus on highly specific outcomes can help make it more politically manageable for countries to increase their commitments to reducing WMD threats. Third, they can help bring the right parties to the table---often a difficult task as implementing specific WMD threat reduction actions can require various communities within any country: health and emergency response workers, defense forces, law enforcement, officials close to heads of government, regulatory agencies, and many others. And in one of their most important features, informal and ad hoc mechanisms work best when they are explicitly designed to complement the treaty pillars and primary implementation bodies of global WMD governance, not detract from them.

Finally, it is helpful that many ad hoc mechanisms for reducing WMD risks have welcomed the participation of nongovernmental, civil society entities. This contributes to another strength of the current system of WMD-related governance: the trend of increasing engagement by the public and nongovernmental actors.

TRANSPARENCY AND PUBLIC ENGAGEMENT

The world is witnessing a new era in civil society engagement regarding WMD governance, and this is manifesting in many forms. Whereas discourse and ideas regarding treaty systems and their enforcement were once predominantly the purview of nation-states, new tools and methods are helping to democratize WMD-related knowledge and action. This is a positive trend that should be further leveraged for strengthening global governance of WMD.

The most prominent example lies in what has become a flood of open-source data, information, and analysis related to nuclear and missile infrastructure. Resources such as satellite imagery of known nuclear-related production, storage, and test sites are increasingly provided by private companies for analysis by nongovernmental experts and publication by news outlets. This kind of clear and relatively consistent imagery that is now readily made public was once rare to find outside of classified government channels. This shift is facilitating more widespread public knowledge and engagement regarding WMD threats, in particular in cases such as the North Korean nuclear program where facts on the ground do not always comport with statements by government officials.[15]

Another example of civil society driving change in WMD governance is the Treaty on the Prohibition of Nuclear Weapons (or "ban treaty," as it is known). Building on past momentum by countries such as Japan and Kazakhstan to draw attention to the humanitarian effects of nuclear weapons, the nongovernmental International Campaign to Abolish Nuclear Weapons helped to ignite a popular movement that led to 122 nations voting to adopt the ban treaty in the United Nations in 2017. As

of mid-2019, it has 26 states parties and 70 signatories, though it will not enter into force unless it reaches ratification by 50 nations.[16]

Civil society organizations and individuals likewise shaped the international reaction to the Syria government's use of chemical weapons. Witnesses to these brutal attacks recorded video and photographic evidence, often on mobile phones, in some cases capturing the physical signals of chemical weapons exposure in suffering victims. Nongovernmental organizations helped spread this evidence, including via social media, contributing to public calls for action and providing additional evidence to efforts to verify WMD use.

Additionally, recent years have seen a trend in individual nations, nongovernmental activists, and experts collaborating on new initiatives aimed at increasing accountability for WMD use---in some ways similar to initiatives behind the nuclear weapons ban treaty. One example is the International Partnership against Impunity for the Use of Chemical Weapons, established in 2018 to gather and publicize (especially via social media) evidence of chemical weapons use with a goal of using existing mechanisms to hold all known perpetrating individuals and organizations accountable.[17] Various Syria accountability projects at universities and non-profit organizations have similar aims. These initiatives certainly fall under the category of ad hoc mechanisms previously highlighted, though they are noteworthy here for their reliance on public-private collaboration (and, in some cases, their establishment and operations being conducted by nongovernmental organizations).

Private citizens and civil society organizations are also playing important roles in a range of nuclear safety and security issues. Numerous protests and social media campaigns both for and against nuclear energy emerged in recent years (albeit at times supported by the nuclear energy industry or anti-nuclear groups). Think tanks and academic institutions likewise contributed to political momentum in support of the Nuclear Security Summits process and, in the United States, the ratification of the New START treaty and JCPOA.

These positive trends driven mostly by individuals and nongovernmental entities have created an environment of greater transparency regarding WMD than ever before. The democratization of WMD information will likely persist and continue to grow as new open-source tools are developed.

To be sure, there are numerous signs of transparency declining as well. Some nation-states are reducing transparency after years of increasing openness, especially regarding nuclear weapons doctrine, plans, and intentions. In one example, in 2019 the Trump administration halted the practice of disclosing total numbers of U.S. nuclear weapons (a practice that began in 2010 to increase transparency and serve the greater cause of stability).[18] The transparency-improving verification regimes tied to nuclear arms control agreements have also declined in some cases when related treaty obligations were completed or abandoned.

PART III:
WEAKNESSES OF THE CURRENT SYSTEM

Though these and other strengths of the current system must be maintained and built upon, global governance for and norm-building against WMD threats suffer from many weaknesses as well. Some of these are inherent characteristics of existing systems and others are evolving over time.

INHERENT CHALLENGES

Several weaknesses in existing WMD-related regimes and institutions are inherent to their design. All elements of global governance reflect the political and security conditions under which they were created, even when they are updated. By their multiparty nature most components of global WMD governance involved compromises that at times did not serve all threat reduction needs or reflect the interests of all countries. The following systemic challenges form perennial complaints by nation-states and other actors that believe current WMD norms and mechanisms do not serve them well.

INCLUSIVITY AND DISCRIMINATION ISSUES

It has long been an issue that some elements of the existing WMD global governance landscape are inherently discriminatory---that is, they apply different requirements to different nations. This is a somewhat less-problematic issue for the BWC and CWC as they ban all countries from possessing these WMD, but it continually creates challenges for the NPT system. An enduring complaint is that the NPT permits five specific countries (China, France, the Soviet Union/Russia, the United Kingdom, and the United States) to possess nuclear weapons based on their arsenals of these weapons at the time of the treaty's entry into force. The treaty has no mechanism for other countries' accession while they possess nuclear weapons, meaning that nations such as India and Pakistan have to remain outside the treaty or relinquish their nuclear arsenals.

The sentiment this can trigger among non-nuclear weapon parties to the NPT was reflected in a September 2019 comment by President of Turkey Tayyip Erdogan: "Some countries have missiles with nuclear warheads, not one or two. But they tell us we can't have them. This, I cannot accept."[19] This challenge is extended by special treatment nuclear weapon states receive as part of the implementation of the treaty, in particular regarding approaches to nuclear inspections.

The discriminatory aspects of the NPT shape how nation-states interact with other elements of global nuclear governance. One example is the Nuclear Suppliers Group, for which all current participating governments are party to the NPT. India and Pakistan continue to seek Nuclear Suppliers Group participation to facilitate their interests in the global civil nuclear market (among other objectives), though others continue to challenge whether the formal participation of non-NPT states parties would further undermine global nuclear weapon-related norms.

Other treaties and agreements that are not yet concluded or entered into force attempt to take on the discrimination issue. The Comprehensive Test Ban Treaty (not yet in force) seeks to treat all states equally in universally prohibiting nuclear explosive tests; however, some still argue this unfairly locks some states into technological inferiority given that the nuclear weapon states that have conducted significant explosive testing will always have that data to inform their programs. A Fissile Material Cut-off Treaty that would universally end production of highly enriched uranium and plutonium among all states, whether they do or do not possess nuclear weapons, has been discussed in the UN Conference on Disarmament. Though the intention in this treaty's pursuit is to form a non-discriminatory system, some states remain concerned that global possession of these materials remains uneven and without addressing this problem it would help lock in superior nuclear capabilities by a small number of states.[20]

A related challenge is inclusivity, in particular regarding export control cooperatives and the ad hoc mechanisms highlighted previously as (on balance) strengths of the global system. Though some are open to any country that wishes to join, others such as some export control fora and the Nuclear Security Summits have limited participation to specific countries or set criteria that de facto exclude some participants. While this is often done for valid reasons (e.g., when progress can be hindered by attempts to accommodate the needs of too many diverse players), exclusivity in some WMD threat reduction mechanisms can create ill will toward them.[21]

ABILITY TO WITHDRAW

Of course, nation states voluntarily join into international treaties and other global governance mechanisms. The NPT, BWC, and CWC all explicitly recognize the sovereignty of nation-states and their ability to withdraw from these treaties, thereby legally enshrining that countries can choose to end participation and outlining the processes for doing so.

While the right to withdraw is a common, enduring component of international treaties, it is increasingly important to highlight given the rise of states employing this option for WMD and other types of agreements. In 2003, North Korea executed its long-threatened withdrawal from the NPT. Though it was a bilateral measure, the United States and Russia ended the Intermediate Range Nuclear Forces Treaty in 2019 rather than working to address their mutual concerns about one another's adherence to it. The U.S. Trump administration likewise took steps to withdraw from the JCPOA, the Paris climate change agreement, and numerous trade deals in recent years.

Some believe this trend reflects long-term changes in the world order and expect these types of examples to build momentum for the further crumbling of existing global governance. Other experts believe it is more of a temporary blip limited to the worldviews of a small handful of individuals, and point to efforts such as the nuclear weapons ban treaty as an example of continuing interest in strengthening global governance. It is yet to be proven what balance of these perspectives will hold true in the decades to come.

DYNAMIC CHALLENGES

While the weaknesses in global WMD governance noted above are inherent to today's systems, new challenges are mounting as well. This is fueling international sentiment that global governance related to WMD is insufficient and further complicating attempts at progress. The following issues are exacerbating existing weaknesses and contributing to the formation of new hurdles.

WMD USE

The most monumental change regarding WMD in recent years has been the uptick in their use. One example lies in nuclear weapons testing. After a long trend of explosive nuclear test numbers declining, North Korea began testing in 2006 and has conducted several since. While this was once dismissed as the actions of a rogue regime, some in the United States and Russia are calling for a resumption of nuclear testing---a monumental shift that would open the door for further and overt testing by others.

Perhaps the greatest weakening of norms against WMD stems from the use of chemical weapons, which has become far too common and no longer appears to be effectively deterred. Though they deny it, there is overwhelming evidence that in recent years the Syrian government used chemical weapons many times on its people, North Korea used a chemical attack for assassination in Malaysia, and Russia attempted the same in the United Kingdom. The Islamic State also developed and used chemical weapons in its reign of terror.[22]

Sadly, this trend is not altogether new, though the examples above highlight that it is gaining new characteristics. The uses of these WMD have been quite blatant, for one, and patterns seem to indicate a greater need to elevate attention back to nation-states employing WMD (even if at times in relatively small-scale, targeted attacks). This is a necessary shift after a few decades of public countering-WMD narratives and major investments focusing heavily on terrorist threats.

The major elevation of WMD terrorism threats came for good reason: until recent years, many examples of WMD use since the creation of the NPT, BWC, and CWC were conducted by non-state actors (with Iraq's uses of chemical weapons serving as the largest-scale, tragic exceptions). Successful and attempted attacks by Japanese cult Aum Shinrikyo in the 1990s included sarin and anthrax.[23] Anthrax attacks in the United States carried out by an individual killed several people and kept the country on edge in the wake of the 9/11 terrorist attacks. While not successful in carrying out major WMD attacks, for years Al Qaeda ran programs to develop these weapons. Many other terrorist groups have made similar attempts.[24]

Terrorist use of WMD is still a serious issue and must remain a high priority. However, WMD interest by non-state actors would have less impact on norms against WMD use if nation-states were not increasingly using these types of weapons as well---often doing so in direct defiance of their treaty commitments. The latter trend is unfortunately conveying the impression that the basic building blocks of global WMD governance are crumbling.

WHY ARE NORMS AGAINST WMD USE BREAKING DOWN?

It is clear that norms against the use of WMD have been breaking down, though it is not fully clear why. Indeed, there is significant disagreement on the causes of this trend.

Some areas of common blame are discriminatory elements of current treaties (i.e., some countries being held to different requirements than others), lack of progress in nuclear disarmament, and the dual-use nature of so many technologies involved in WMD production and use. Many experts believe an accountability deficit is to blame: numerous instances of WMD use and testing remain essentially unpunished. Still others believe a general diffusion of power away from nation-states is weakening the utility and cohesion of global governance mechanisms. Broader political and security trends (e.g., rising nationalism and some countries' leaders acting to diminish treaties broadly) also surely play a role even if those contributing factors are not as frequently cited.

Ultimately, all of these factors and others are contributing to the erosion of norms against WMD use. Likewise, reinvigorating such norms will require a suite of complementary and innovative approaches by many actors addressing a range of root causes, including governments, international institutions, and nongovernmental organizations.

ARMS RACING

Though this trend is not yet extending across the WMD spectrum, a critical recent change in the global system is the start of a new nuclear arms race.

After years of reductions that advanced the security interests of both countries, the holders of by far the world's largest nuclear weapon arsenals, the United States and Russia, are each pursuing new nuclear capabilities to both match and outmaneuver the other. The United States is developing several new nuclear weapon capabilities and bringing back older capabilities that were wisely ended by past leaders. These include the development of a more advanced air-launched nuclear armed cruise missile and a low-yield modification for a submarine-launched ballistic missile warhead, and the resurrection of nuclear-armed submarine-launched cruise missiles.[25] For its part, Russia's planned new nuclear weapons capabilities include a nuclear-powered cruise missile and a nuclear-powered unmanned underwater delivery vehicle that could carry a nuclear warhead.

Russia and the United States are not alone, even if they are playing the leading roles in a new arms race. Both countries pull China into their nuclear weapons calculations due not to the size of its nuclear arsenal but to its rise as a global power and driving role in international affairs. Though its nuclear arsenal is significantly smaller than those of the United States and Russia, China has sought to diversify into some new nuclear capabilities. It joins India and Pakistan in the pursuit of a nuclear triad---the full ability to deliver nuclear weapons by air, land, and sea. Additionally, India and Pakistan continue expanding their nuclear capabilities mostly in reflection of one another's behavior but in ways that are triangulated to account for China's nuclear and conventional capabilities and missile defenses.

Shortly after withdrawing from the Intermediate-Range Nuclear Forces Treaty in 2019, the U.S. Department of Defense conducted a flight test of a ground-launched cruise missile that would have defied treaty limitations. While this was a conventional-weapon test, the United States and other countries can easily modify such systems to deliver nuclear weapons. U.S. Department of Defense

Current nuclear weapons trends are pulling the world back toward some of the most dangerous Cold War dynamics. Many countries, including the United States, Russia, and Pakistan, are embracing doctrines of nuclear weapons use and corresponding force plans that elevate the importance of low-yield nuclear weapons. One of the key reasons given for this trend is that such weapons are seen as more usable in the actual conduct of warfare: some defense planners perceive that a head of government is more likely to employ a lower-yield nuclear weapon in conflict, therefore raising the utility of having more of these types of weapons.

Such reasoning dangerously blurs the line between conventional and nuclear conflict and in many cases aims to normalize the idea of escalating a conventional conflict to a nuclear one. It represents a departure from the trend of nuclear weapon states publicly declaring that they hold such arsenals for the purpose of deterrence rather than warfighting. These nuclear plans and rhetoric are further chipping away at norms against the use of WMD.

These trends are also combining with the demise of nuclear arms control as a further hit to global governance. Some past unilateral but relatively reciprocal measures are being undone, for example by new U.S. plans to bring back the sea-launched nuclear cruise missiles that then-President George H.W. Bush took out of deployment in the Presidential Nuclear Initiatives of 1991.[26] Longstanding bilateral arms control measures have been effectively destroyed as well or risk being so in the near term, most recently with the 2019 end of the Intermediate Range Nuclear Forces Treaty and the prospect of the New START treaty not being extended.

DEADLOCK IN INSTITUTIONAL PROCESSES

Despite the many strengths of the major WMD treaty systems, the processes designed to advance progress toward these treaties' objectives have met significant hurdles. This is a weakness in global governance in that small numbers of states can halt movement. However, it is a dynamic challenge: institutions with countering-WMD responsibilities still find ways to work around these issues to make historic progress at times. Still, deadlock remains an important issue to recognize.

Processes to advance toward the full vision set by the NPT are particularly stuck. This has been the case for many years, but it appears to be worsening. A central issue is the creation of a WMD free zone in the Middle East, a concept long pushed by Egypt, Iran, and others. In the 1995 NPT Review Conference (a process held every five years), a formal resolution was adopted calling on all states in the region to establish such a WMD-free zone.[27] Little progress has been made since and the issue has hindered progress in subsequent Review Conferences. This came to a head in 2018, when debate over the issue at the UN General Assembly's First Committee session led to a final resolution requiring the UN Secretary General to convene a one-week meeting in 2019 on a Middle East WMD-free zone.[28] That meeting is scheduled for November 2019 (past the date of this publication), though progress is unlikely and a negative result may contribute to further deadlock in the 2020 NPT Review Conference. The aggregate effect of this continuing issue is further loss of confidence in the NPT overall.

Significant roadblocks likewise have plagued the BWC and CWC, as explored in greater detail in the verification and accountability discussions later in this report. Since its entry into force, BWC processes have been met with significant disagreements over issues such as monitoring and verification. While its challenges are narrower, the OPCW's attempts in recent years to enhance verification and attribution of chemical weapons use have often been hindered by the stonewalling of a few countries. (Some UN attempts at greater accountability regarding chemical weapons use have been similarly hampered.)

A NOTE ON THE SECURITY ENVIRONMENT

Many of the current signs of weakening in global governance against WMD threats relate to extreme tensions in the broad security environment. Among many others, this includes a range of issues among Russia, the United States, and European nations; North Korea's nuclear and missile programs; continuing uncertainty regarding the future of the Iran nuclear agreement; trade wars; terrorism; rising cyber threats; civil conflicts; and more.

However, the state of the international security environment is not an excuse for inaction or stalling regarding WMD threats. Indeed, historical progress in strengthening WMD-related cooperation has often come at times of great strain in international affairs.

For example, Soviet-U.S. lab-to-lab cooperation and the Intermediate Range Nuclear Forces Treaty had roots in just such circumstances. International efforts to eliminate Syria's chemical weapons program gained urgency due to deteriorating security conditions from the country's civil war. On multiple occasions from 2011 to 2016, Libya requested expedited international assistance in eliminating newly-found and not-yet-destroyed chemical weapons and related materials due to mounting threats by

non-state groups and worsening instability within its borders. In a multinational operation completed in 2018, Nigeria hastened the removal of weapons-usable highly enriched uranium from one of its research reactors because of terrorist groups gaining control of territory and numerous other security issues within the country.

These are just a few examples of progress emerging from rising security risks. Together, they show the critical importance of countries, international organizations, and nongovernmental organizations taking bold steps now to find ways to collaborate in reducing WMD threats---and pushing back against efforts to use the tense international security environment as an excuse for delaying progress.

PART IV:
GAPS AND CHANGES AFFECTING THE STRENGTH OF WMD GOVERNANCE

In addition to the strengths and weaknesses of global governance regarding WMD, understanding the system's efficacy requires examination of gaps in current institutions, norms, and mechanisms. Some gaps are legacies in the system---deliberate design features in treaties, agreements, and implementation responsibilities that allowed for knotty challenges to be somewhat set aside for the sake of broader progress. Other gaps are created by technological changes, the evolving face of conflict, and other trends. This section first identifies some of the most significant inherent gaps and follows with descriptions of gaps that are emerging due to global dynamics.

INHERENT GAPS

All elements of global governance are imperfect. They are inherently acts of compromise, often among many parties with diverse needs. While many of them remain invaluable today, honest accounting for gaps in the system is important to identifying new means of progress. This section highlights a few of the most significant gaps that today inhibit progress in reducing WMD threats: verification and accountability regarding WMD possession and use, and gaps specific to nuclear weapons governance.

VERIFICATION AND ACCOUNTABILITY

Verifying that former WMD programs have been fully eliminated and that new ones are not emerging has always been a significant challenge. Attributing WMD use to specific perpetrators and holding them accountable often proves equally difficult. As many issues in verification and accountability are outlined in this report, this section highlights specific gaps in global governance that contribute to challenges in these areas.

One of the most glaring gaps lies in the biological weapons space: while the BWC bans these weapons, it does not include provisions for verifying that signatories are fully abiding by its requirements.

Verification was a thorny issue from the earliest phases of the BWC's creation. Its drafters also foresaw the likely future challenges such a task would bring: today many of the same technologies, materials, and tools that could advance bioweapons programs are ubiquitous for peaceful uses of biology all around the world. Furthermore, most potentially-relevant activity

is conducted outside of government channels. While many countries and nongovernmental entities use standards, laws, regulations, and voluntary measures to show good faith in trying to abide by the BWC, verifying the absence of bioweapons programs is an especially complex problem.

As a further hinderance, the BWC does not have an implementing arm (akin to the OPCW for the CWC). The legal void this creates has been partially filled by UN members assigning some degree of authority to its Secretary General in cases of bioweapons use. After years of unresolved tensions regarding verification, in 2006 BWC parties agreed to add an Implementation Support Unit with a limited mandate to be housed with the United Nations. These are important augmentations but do not yet significantly extend international verification and accountability mechanisms for biological weapons.[29]

Related to the strength of verification systems, accountability for WMD possession and use remains an area for which current global governance regimes remain somewhat weak. It has been a very mixed picture for countries appearing to develop nuclear weapons programs outside of the NPT framework; while some such as North Korea and Iran become the target of sanctions by other nations in attempts to halt their work, others such as India and Pakistan have been increasingly accepted over time.

For bioweapons threats, there is also debate over the degree to which accountability is even necessary for deterring attacks. It can be very difficult to identify the causes of specific diseases and be sure they are not the result of a natural outbreak, let alone clearly articulate the specific source of attack. The investigation of the U.S. anthrax attacks took more than eight years to conclude, serving as an example of how long it can take to make progress even in obvious cases of deliberate bioweapons use. As such, some experts believe that leveraging new and emerging technologies to focus on rapidly responding to any use of bioweapons is a more important deterrent than taking the time to build enough evidence to attribute an attack to specific sources and hold them accountable under national and international law.

Regarding chemical weapons use, even some of the highly-tailored ad hoc mechanisms noted previously---the UN-OPCW Joint Mission and OPCW Fact-Finding Mission---did not have a mandate of attributing chemical weapons attacks to a specific perpetrator. They contributed important information and diplomatic momentum toward the goal of accountability, though further progress has been hindered by the hurdles of attempting verification of WMD use during ongoing conflict and deliberately limited by nation-states with differing interests. In the meantime, the OPCW continues using its authorities and resources to try to confirm state and non-state perpetrators of chemical attacks and work toward accountability.[30]

For the NPT, one critical accountability gap is its lack of a timeline for nuclear weapon states to meet their treaty obligations regarding disarmament. This issue helped fuel the ban treaty movement and is leading some to explore more extensive use of legal concepts such as crimes against future generations to improve accountability.

Despite these gaps, there have been important successes in verification and accountability regarding WMD. Many have stemmed from arms control and transparency agreements between the Soviet Union/Russia and the United States that included significant verification and confidence-building measures. Likewise, progress has come from voluntary confidence-building and transparency measures in biosecurity created to help compensate for the lack of formal verification requirements in the BWC.[31]

NUCLEAR WEAPONS

In addition to the accountability gap left by the NPT not holding a timeline for nuclear weapon states' disarmament, there is a significant gap in the treaty's implementation and verification mechanisms: military materials and programs are treated differently from those tied to civilian, peaceful purposes.

The IAEA performs critical NPT compliance verification activities. However, a major gap in nuclear governance remains given that military nuclear programs are not subject to oversight. Photo of an IAEA inspector at a verification training exercise in Slovakia. IAEA

The NPT has strong oversight mechanisms for verifying that peaceful nuclear programs remain as such. As the implementing arm for this activity, the International Atomic Energy Agency is highly respected and benefits from new tools and authorities that have strengthened its capabilities over time. Its normal work can also be augmented via additional bilateral and multilateral agreements. For example, it has safeguards in place with three non-NPT members (India, Israel, and Pakistan) regarding specific civilian nuclear facilities, and helped conduct specially-designed, robust verification measures in Iran after the signing of the 2015 Joint Comprehensive Plan of Action regarding its nuclear program.

There is no implementation or oversight arm equivalent to the International Atomic Energy Agency for military nuclear programs. This contributes to the inequality issue outlined previously, and introduces many other complications. One is the blurriness of what countries may consider civilian or military purposes. For example, programs to advance nuclear propulsion for military vessels may take some programs outside of safeguards systems; even if these programs are not also used for developing nuclear weapons-relevant capabilities, they can raise such concerns among other nations. Another issue is in securing nuclear materials not under IAEA safeguards: even for military programs, dangerous materials may be diverted or lost by rogue actors or if the regime governing such programs crumbles or loses control of territory where they are located.

Such nuclear weapons-related gaps can vary over time in the dangers they present depending on geopolitical circumstances. Notably, they often hang over into the ad hoc mechanisms designed to augment global WMD governance. The Nuclear Security Summit process, for example, did not extend into nuclear weapons issues. While there are good reasons to make nuclear security progress where it is possible, even if that entails setting aside thorny nuclear weapons issues, the world's entry into a new nuclear arms race and the rising danger of nuclear warfare highlight why this gap requires attention.

DYNAMIC GAPS

Building on these and other inherent gaps in WMD governance, the world experiences constant changes that can create new gaps or otherwise alter how existing norms and mechanisms are used and perceived. This section highlights a few major trends driving significant change, including evolving means of production and character of conflict, and growing convergence among various trends that will influence WMD threats and solutions.[32]

MEANS OF PRODUCTION

Many global trends in manufacturing, production, research, and development are reaching into the WMD space. This begins with knowledge and access. While not universal, many new tools and methods that could be used in developing WMD are commonly available to production facilities or laboratories, or in many cases to any individuals with internet access and funds.

This is particularly true regarding bioweapon threats. Most biology-related innovation is occurring in academia and the private sector around the world. Often developments are not fully on the radar of governments tasked with monitoring biological threats.[33]

The widespread availability of materials that could be used for WMD purposes adds to the challenge. In the past, a major hurdle to non-state actors seeking to produce bioweapons was availability of the right pathogen strains that would allow such weapons to be highly potent among humans. These materials were therefore more tightly monitored and controlled than, for example, those that would affect only animals. Today such security measures are becoming more challenged with the growing capabilities by which people can manipulate biological organisms.

Further building on the diffusion of knowledge and access to relevant materials, broader developments in manufacturing and the growing maker economy hold implications for how WMD are governed. Though today it is far from being as precise and predictable as more robust methods, additive manufacturing is creating new possibilities for producing components of WMD and their delivery systems---potentially with materials and in facilities that help circumvent detection. The speed and trajectory of what possibilities new technologies and methods such as additive manufacturing bring to global WMD challenges will be guided in part by how they combine with the use of purchased or open-source software, modeling tools, and advanced analytical techniques.

Still other advances are accelerating the pace at which research, development, testing, and deployment occur. The pace of discovery and, in many cases, how quickly new ideas lead to available tools, is speeding up. Some bio labs and companies, including those that produce DNA segments to order, are combining the use of robotics, machine learning, and other approaches to create environments for increasingly rapid change. The continuing downward price curves for sequencing and synthesis are helping to pave the way for cheaper and faster experimentation.

In particular in combination, these and other changes in the broad global economy hold strong potential for making WMD production faster, less costly, and easier to hide. This is equally worrisome for WMD threats from both well-resourced nation-states and non-state actors.

CHARACTER OF CONFLICT

The character of conflict likewise evolves over time, as states and other actors leverage new approaches in seeking to meet their political objectives. This evolution shapes and is shaped by changes in WMD threats and solutions---to include the aforementioned more-common use of WMD by nation-states.

Among the most notable regarding the current and future WMD landscape is the prevalence of hybrid approaches that are together highly threatening and destabilizing but are often held just below the threshold of what nation-states would regard as full conflict. Components often used in combination include cyber information-gathering and attacks, low-level overt attacks that preserve deniability for national leaders, the use of non-state proxy forces, disinformation campaigns, covert action, economic pressures, and others.

While such techniques are not new, they are more and more commonly used in the international system. There are inherent dangers in this. Among the most important regarding WMD governance and threats are the heavy erosion of trust this is creating (in particular among nuclear weapons-possessing states), and the introduction of greater uncertainty and confusion regarding countries' intentions and levels of tolerable escalation. Together these trends are creating ever-more ripe conditions for states acting based on miscalculations and misperceptions---an incredibly dangerous situation in particular among states possessing nuclear weapons.

CONVERGING RISKS

Adding to these changes in the global security environment, the convergence of threats (and solutions) will likely serve as the new normal for the 21st Century. We are long past a world in which threats can be simply categorized, and trends now regularly combine to produce new possibilities and non-linear change trajectories. Countless areas of convergence are affecting WMD threats and informing how global governance of them should proceed. The following areas of convergence represent just a few important examples.

Chemical and Biological Threats: Biological and chemical threats have long been converging. The chemical synthesis of DNA and biological means of producing chemicals and toxins both provide new potential pathways to WMD development. These may also make it easier to experiment with and produce novel substances that could serve as poisons or incapacitating agents. This potential has been recognized for decades, yet the aforementioned changes in the methods and costs of bioproduction and increasing commercial use of these methods are bringing it greater attention.

While governments and the international community have long been aware of these issues, adjustments in the relevant areas of WMD governance and threat reduction have yet to catch up (albeit not for lack of attention to the subject). In particular, mechanisms to control and monitor access to biological and chemical materials relevant to the production of WMD are significantly challenged if perpetrators can rely on bioproduction to, for example, make controlled chemical weapon precursors.

This area of convergence also poses unique challenges to verifying that states are not engaging in treaty-prohibited WMD activities.[34] This is causing some to rethink a new approach to adding verification measures into the BWC system, if possible, and is creating interest in the OPCW taking on new roles regarding its mission's overlap with biological threats.

Digital Advances and WMD: Various types of artificial intelligence, advanced analytical methods for large datasets, the continuing spread of cloud computing, cyber means of intrusion and attack, and other progress in the wide world of digital tools all combine with biological, chemical, and nuclear trends in ways that influence WMD risks. As Norwegian security expert Sverre Lodgaard wrote in 2019 of the cyber example, "the growth of cyber warfare will make the world even more unpredictable and chaotic,"[35] and this will influence arms control and global governance regarding WMD.

This trend is seen clearly in the Stuxnet attack on Iran's Natanz nuclear facility discovered in 2010. In just one other type of example, advances in sequencing, synthesis, health record sharing, and other fields are creating an ever-expanding digitized landscape in biology. Growing troves of genomic and health data open up many new possibilities for those who wish to cause harm by biological means, and they may play a critical role in contributing to WMD solutions if managed and secured properly.

Nuclear and Climate Trends: The global crisis of climate change is forcing many countries to reevaluate their policies regarding all no- and low-greenhouse gas emitting energy sources. As part of their climate plans, many countries with nuclear energy have pledged to more rapidly expand their reactor fleets. Others that are exploring adding nuclear power to their energy mix have made this an explicit climate change mitigation commitment. No matter how the future of nuclear energy plays out as informed by climate change and other factors, it will hold implications for the future of nuclear security, safety, and nonproliferation.

Importantly, this is just one manifestation of nuclear and climate issues becoming intertwined---in particular against the general backdrop of the changing global security environment.[36] Physical effects of climate change around nuclear sites and personnel are a growing concern, from deadly heatwaves to extreme disasters to sea level rise. In some countries, climate stresses are converging with other security, economic, and political strains to drive new internal threats in countries where nuclear facilities are housed. In one relatively recent example, a multilateral effort expedited removal of highly enriched uranium from one of Nigeria's

A multinational effort worked to expedite the removal of highly enriched uranium from one of Nigeria's research reactors as terrorism, climate change effects, and other trends combined to make security conditions in the country increasingly concerning. Converging risks will continue to influence WMD issues in the 21st Century. IAEA

research reactors when growing pressures from terrorist groups, drought and desertification, internal migration, and other trends combined to increase urgency regarding security for the weapons-usable material.[37] Still other concerns include whether climate change will combine with other strains to further complicate relations among nuclear weapon-possessing states (e.g., India, Pakistan, and China), thereby adding more complexity and potentially increasing conflict risks.[38]

Unfortunately, there is one long-enduring example of the convergence of WMD risks that has hindered progress in global governance regarding these threats for years. Though it is mostly affecting NPT processes as outlined previously, those countries seeking a nuclear-free zone in the Middle East deliberately expanded this vision to become a regional zone free of all WMD. This remains the negotiating position of countries pushing this concept via the UN and NPT systems.

These are just a few examples of convergence influencing the WMD landscape. These specific focus areas and many others stand to create new gaps in norms against WMD, implementation of treaties and agreements, the efficacy of export controls, and the very understanding and categorization of dual use materials and technologies. Recognizing the interrelations among wide-ranging trends is therefore critical to strengthening WMD governance.

PART V: RECOMMENDATIONS

This report's survey of key strengths, weaknesses, and gaps regarding global governance of WMD shows the critical need for new ideas for improving upon the current system. This section recommends a few core concepts that should guide activities meant to improve WMD governance, as well as several specific, practical steps that would help reverse the current trajectory of rising WMD threats. All of these ideas are compatible with one another, and all may form components of grander changes in global governance of weapons of all kinds.

STRENGTHEN AND AUGMENT EXISTING REGIMES

A core tenet to improving global governance related to WMD should be upholding the existing core pillars of the system---namely the NPT, CWC, and BWC, and the UN's special WMD-related responsibilities. Due to the deficiencies outlined above and other reasons, there are rising calls in particular for moving past the NPT. This is premature. No other mechanisms stand ready to replace the functions of current WMD arms control and disarmament treaties, and it would be a tragedy to dismiss the importance of their near-universal acceptance. While existing regimes clearly need continued updating and augmentation, and creative destruction can be an important means of progress in the international system at times, no core elements of current WMD governance can be dismissed without creating even more risk-heightening gaps.

Additionally, some of the success of the ad hoc mechanisms described previously stems from the fact that they were designed to augment the existing WMD-related regimes. They did not force countries into tough decisions about whether their participation would in practice or by perception signal a weakening of their commitment to the NPT and other pillars of the international system. In most cases, the actions driven by these mechanisms were deliberately designed to prompt more rapid progress regarding the weaknesses and gaps outlined in this report.

Importantly, though, maintaining the current system must not come at the cost of progress. Indeed, that would be a recipe for further weakening norms against WMD possession and use. More tailored, ad hoc mechanisms to augment the current system must be designed and implemented. Governments and international organizations must carry ideas forward in ways that better account for public sentiment and involve nongovernmental actors as they do so.

ADAPT TO CONVERGENCE

The international system of norms and institutions designed to mitigate WMD threats must continually adapt to the technological and political convergence that is reshaping the world.

While it seems basic, even greater connectivity among the nuclear, chemical, and biological communities would be a big step forward. Though it is often for legitimate reasons, the nuclear field in particular remains plagued by expert elitism and various nuclear communities tend to interact within themselves more than they welcome "outside" people and thinking. In just one type of example, nuclear arms control discussions too rarely include experts in broader areas of security, diplomacy, and WMD threat reduction. As has become a common understanding in the private sector and academia, too many good ideas are left off the table when methods that are single-disciplinary or teams that lack diversity remain dominant.

The heightening risks and weakening norms of WMD non-use are certainly connected and mutually reinforcing across the WMD spectrum. Examining nuclear, chemical, and biological weapons risks in tandem is too-rarely done but is critical to developing a full appreciation of the obstacles to more effectively reducing the risk of WMD proliferation and use, and identifying opportunities to improve upon the current system. There are many good reasons the histories of the NPT, CWC, and BWC were related, and their interconnections will again be crucial to their stronger futures.

One important step would be to form a coalition of WMD experts and communications and media experts to develop methods of identifying and countering misinformation. Deliberate misinformation has hampered progress toward accountability for WMD use in recent years. The consequences of larger-scale misinformation campaigns could be even more catastrophic, for example if the public is deliberately misled regarding disease outbreak causes or the use of countermeasures in the wake of a biological attack. Getting ahead of this confluence of WMD and information challenges could create great progress in preparedness and establish new lines of cooperation in strengthening WMD-related norms.

Many of these activities are ideal to be led, at least in part, by think tanks and other nongovernmental organizations. Much relevant expertise lies outside of governments, and academic and private sector experts are often less than fully open in sharing their work and visions in government-led fora so as to protect trade secrets, not draw unwanted government scrutiny, and for other reasons. Think tanks, on the other hand, tend to be more adept at convening government and nongovernmental experts in diverse types of environments and drive progress using creative methods that respect the unique needs of participants.

GET CREATIVE IN LEARNING AND BRIDGE BUILDING

Processes that respect the convergence among issue sets are critical to improving WMD governance. Further benefits can stem from updating the ways in which stakeholders and the public convene, drive discourse, and learn.

One challenge to progress in improving global governance of WMD is that, to most people, these weapons and their effects are entirely abstract. This is the case even for experienced policy makers, many of whom around the world have never seen the destruction of a nuclear accident or use of a nuclear weapon, witnessed a real or simulated response to a massive disease outbreak, visited a biotech lab, or seen chemical weapons or the signs of their use.

Visceral experiences can have far more profound and life-long influence on people's decision-making than other forms of education. Improving global governance of WMD will require a greater focus on experiential learning. While this can take countless forms, initiatives to bring more WMD and national security thought leaders to places like Hiroshima and Nagasaki, former nuclear test sites in countries such as Kazakhstan and the Marshall Islands, and nuclear accident sites such as the Fukushima exclusion zone (to the degree that such visits are safe and permitted) would create unforgettable, personal experiences that take WMD use from abstraction to reality.

In addition to improving the methods behind cross-community sharing and education, new efforts should be initiated to help bridge specific divides in the international system. In addition to the convergence areas listed above (e.g., the nuclear, chemical, and biological security communities), these subjects should include the following.

Eastern and Western Views on Strategic Stability. Regarding nuclear weapons in particular but extending to conventional and other weapons issues, there is insufficient understanding of how various countries and alliance/partnership structures view strategic stability. Indeed, several countries are developing new nuclear and other weapons capabilities that they believe will not upset strategic stability, but which other nations view as highly destabilizing.[39]

This is an incredibly dangerous trend. As this is key to the foundations of how countries drive weapons programs, it is critical to better understand varying views on strategic stability among a wide range of players: China, Russia, the United States and its European and Asian allies, and others. This work can ideally be conducted by think tanks and other nongovernmental organizations that can convene Track 1.5 meetings of both experts and government officials while holding unofficial and exploratory conversations.

NPT and Ban Treaty Compatibility. Regarding the future of nuclear weapons governance, many believe that the NPT and ban treaty are not just compatible, but necessary complements to one another. Yet not all countries and experts agree; some believe that the ban treaty's mere existence undermines the NPT, including by distracting the attention and resources of governments away from that treaty's implementation and getting past the hurdles it is facing.

This gap is now highly politicized and it is quite possible that it won't be resolved any time soon. However, that is no reason not to work on building greater common understanding regarding these dominant elements of nuclear weapons governance discourse.

One option would be to bring together stakeholders to discuss the merits of only specific elements or effects of the treaties in order to rethink them at a different level. There may also be utility in creating exchanges that deliberately leave out those who are deeply knowledgeable regarding these treaties and have official roles regarding them, and instead convene emerging national security generalists, or Parliamentarian and Congressional representatives with foreign policy duties but limited nuclear weapons experience to review and discuss these treaties. The outcomes of such conversations would be deliberately unpredictable, but may enlighten areas of agreement and divergence that could help in identifying concrete steps past the current impasse.

Nuclear Weapon States and Non-Nuclear Weapon States. The actions and interests of countries that possess nuclear weapons (those party to the NPT and outside it) and those that do not appear to be increasingly divergent. This is a clear signal of the ban treaty movement, and is seen in more subtle but persistent ways (often beyond the public eye) in official diplomatic and security channels. This is increasing tensions among neighbors and even treaty allies.

There are many practical steps that could help to improve cooperation and show that states with nuclear weapons understand and respect the security needs of those without them. Future arms control control measures---in particular political (versus legal) commitments of support for new directions in arms control---may include nations that do and do not possess the weapons under consideration. More effort can also go into developing multilateral verification and confidence building measures that could be employed if new arms control measures are adopted. (This could add new dynamics regarding nuclear weapons, but would build on the already-multinational teams that conduct such work for civil nuclear programs and chemical weapons). Though political conditions in many nuclear weapon states are not yet ripe for such a move, the future may present openings for such nations to ratify nuclear weapon free zone treaties where they have not yet done so. In general, this is another area ripe for creative thinking, including by nongovernmental organizations.

TELL SUCCESS STORIES

Rebuilding norms against WMD possession and use will require the recounting of successes in countering WMD threats. It must not be lost that nation-state actions, global governance systems, and norms against WMD led to monumental progress in reducing these threats in the past.

However, even relatively recent past successes have largely vanished from public discourse due to the speed of news cycles and evolving means by which the public receives information. Turnover in governing bodies (including major, positive generational changes in leadership for some countries and international organizations) can also contribute. This is not all bad:

Libyan and international personnel who contributed to the elimination of the country's chemical weapons stockpile at the Ruwagha destruction facility. February 2014. OPCW

perhaps new leaders will emerge who do not share negative preconceived notions regarding what's possible in reducing WMD threats and be willing to embrace bolder actions. Yet it is critical to retell the most inspiring stories of WMD threat reduction, and continually take in their lessons and more deeply understand how they were achieved.

Success stories should be spread in creative ways designed to reach a variety of audiences, including both the broad public and key decision makers. This would require new models of collaboration among experts and those who took part in great WMD-related successes and story-tellers of various types (writers, those in film, podcast hosts, and many others).

As the prior sections of this report highlighted, there are countless examples. As of this writing, there are efforts underway to develop public-reaching stories of the Syrian chemical weapons elimination mission and efforts to remove highly enriched uranium from Kazakhstan at the dawn of the post-Cold War period. There are countless other success stories that must be more widely shared and repeated beyond academic and expert communities.

Each success in reducing WMD threats is inspiring in unique ways, and more broadly this process can help in overcoming a general challenge to the field. Acts that succeed in avoiding

catastrophic incidents are too often not recognized---often not publicly discussed at all, at times due to classification of information. This void in learning the positive lessons of history contributes to policy leaders believing some WMD challenges are "too hard" to solve and therefore cannot be attempted; some in concerned governments were long seized by this intellectual hurdle regarding Syria's chemical weapons.

Moreover, creative storytelling can help to continually emphasize the win-win nature of arms control and reestablish why countries have sought the benefits of collective security concepts in the past.

This is not to imply that failures and setbacks should not be highlighted. The lack of public outcry or true accountability for chemical weapons use in Syria, Malaysia, and the United Kingdom shows the importance of persistent public focus on WMD use and potential use. Clearly more must be done in this area. Yet tales of past successes can be some of the world's most instructive and inspiring resources for developing new solutions to WMD challenges and reinforcing norms against these weapons.

FOCUS ON WMD CAPABILITIES

The successes to date in *numerically* decreasing WMD globally must continue to be celebrated. This will be important if nuclear weapons stocks continue to be reduced and with what will hopefully soon be an end to nearly all large-scale chemical weapons stockpiles. However, the trends in this paper point to a necessary shift toward greater focus on WMD *capabilities*.

As this report highlights, WMD threats are growing more complex. This is certainly the case with the ever-expanding spectrum of potential bioweapons threats, the use of more novel chemical weapons in recent years (e.g., the novichok agent used in the UK Skripal attack), and convergence related to chemical and biological threats. The changing means of WMD production further indicate that special attention to qualitative changes in this landscape is warranted.

In the nuclear arena, most nuclear weapon-possessing countries are more focused now on qualitative improvements to these arsenals than quantitative ones. Often such improvements are directed at better circumventing the defensive capabilities of others, as is the case for several current U.S. and Russian nuclear weapon programs. The aforementioned areas of convergence are also being addressed in ways that raise rather than lower WMD risks, for example with some nuclear weapon states elevating policies to use these weapons in response to massive, strategic cyber attacks.

These and other WMD capability changes warrant heightened attention. They also offer new and important areas of potential threat reduction cooperation among countries---potentially even in the form of new arms control agreements.

Several efforts to date have laid the groundwork for such initiatives. Since 2015, former defense leaders, experts, and some nations have been drawing attention to the uniquely destabilizing qualities of nuclear cruise missiles and calling for either formal or informal mechanisms for reducing the mounting risks from these weapons. The ultimate goal of this effort is the elimination of especially-dangerous classes of nuclear weapons.[40]

This is perhaps even more important today than several years ago, given the demise of the Intermediate Range Nuclear Forces Treaty and U.S. and Russian plans to develop or bring back to deployment several nuclear cruise missile-centered concepts. Notably, progress in discussing the dangers of this type of nuclear weapon and potential solutions have largely come at the hands of a small group of individuals (in this case former defense and diplomatic officials) and relatively small, agile think tanks.

Building on this, in 2019 retired UK Rear Admiral John Gower called for work to advance a new concept of nuclear strategic stability, which would necessitate reduction in the previously-mentioned East-West divide. Writing in his capacity as a Council on Strategic Risks Senior Advisor, Gower outlined strong rationale for focusing near-term nuclear weapons arms control and reduction efforts on the capabilities specific weapon systems carry, and prioritizing those with the most destabilizing qualities: nuclear cruise missiles other dual-capable (nuclear/conventional) missiles to start.[41] This concept holds great promise for remediating serious challenges regarding the current global nuclear weapons trajectory.

These specific efforts should continue, and additional initiatives should be launched to generate and implement ideas for reducing the risks that stem from specific WMD capabilities.

ELEVATE SCIENCE AND TECHNOLOGY

One year after his tenure as Director General of the OPCW ended, Ambassador Ahmet Üzümcü wrote that "In spite of several attacks to undermine it, the OPCW proved its resilience. Its procedures and findings have always been science-based. I have learned over the years that science never lies."[42]

Across all WMD, progress in reducing risks is being hindered by science-related attacks. Countries and other actors frequently cast doubt on scientific approaches or results whether they are seeking to undermine efforts to hold perpetrators accountable for chemical weapons use, attack the strength of the Iran nuclear agreement, or create other roadblocks to better WMD governance. This is a tactic shared among WMD issues and with other global challenges such as climate change.

In addition to the inherent dangers in this, diminishing confidence in the sciences ignores critical lessons from successes in WMD threat reduction. Science and technology exchanges have often contributed directly to nuclear arms control efforts, including collaboration among scientists tasked with exploring verification methods. Similarly, new possibilities for

progress regarding the Syrian chemical weapons challenge were created well in advance of related diplomacy when U.S. experts developed new technical options designed specifically to provide options for eliminating that stockpile in various peaceful and conflict scenarios. Other scientific and technical cooperation initiatives, such as the International Science and Technology Center, created strong, steady improvement in trust and transparency in tense circumstances.

The time is ripe for new science and technical exchanges and cooperative mechanisms. This is occurring some in the private sector, and nongovernmental organizations should continue building in this area with an eye toward extending cooperation into official channels. In particular in the nuclear field, this could be a means of opening lines of communication that can help reduce the risks of nuclear war (in particular by miscalculation and misperception).

Adding to their utility in confidence building, science and technical exchanges can more robustly focus on solutions to specific WMD threats---including for the gaps and weaknesses identified in this report. The biological-chemical convergence described previously, for example, could offer new opportunities in detecting and creating countermeasures for WMD attacks, as well as environmental remediation after testing or release has occurred. Bold initiatives in providing open-source data, if they can be done securely, should be explored in particular by nongovernmental organizations. New and emerging tools relevant to WMD governance, such as open-source monitoring systems and cheap sensors that could be used persistently to confirm the presence or absence of specific chemicals, should be examined for their utility as focus areas for WMD risk reduction collaboration.

RECOGNIZE THE CHALLENGES IN ACCOUNTABILITY

Governments, international organizations (especially those with legal standing), and nongovernmental organizations should continue working toward new methods of increasing accountability regarding WMD commitments, possession, and use. Further effort is also warranted on how new tools and technologies can fit into this picture.

Yet it is critical to recognize the new issues that attempts at accountability can create. The processes behind holding parties accountable can carry important risks and potential liabilities that must be considered carefully.

One such issue was seen among the ad hoc accountability mechanisms launched by international organizations and autonomous ones regarding chemical weapons use in Syria: even with the best of intentions, such groups may publicly release inconsistent and even contradictory information. This can be used for leverage and disinformation work by those trying to cast doubts regarding WMD use and thereby inadvertently impede accountability efforts.

Another set of issues can stem from "naming and shaming" efforts, even those with the most sound intentions. New analytical tools can be used to track scientific publications, social

media, and other data that are perceived as indicators of whether individuals may be engaged in WMD programs (whether on their own or in working for state-run efforts). Publicly identifying such individuals risks ruining the careers and lives of innocent people, and would likely have little benefit toward improving WMD-related accountability.

Some experts have called for independent tribunals and other mechanisms to further enhance accountability for WMD use. Many legal scholars reiterate that existing international law regarding war crimes holds various avenues for pursuing justice.[43] These ideas and many others deserve deeper consideration.

TEST BOLD NEW IDEAS

Global governance of WMD and efforts to reduce WMD threats often do not receive the resources and attention they should given the world-altering consequences of failure. There are many reasons for this, but one that does not have to continue is the lack of bold, inspiring visions in this field.

Biological threats stand out as most ripe for a moonshot-level vision. As outlined in this report, there are unique governance deficiencies regarding biological weapons. It is also the WMD area of perhaps the most significant change.

At the Council on Strategic Risks (CSR), we are exploring a new initiative that would both capitalize on progress made to date in reducing biothreats and present an inspiring new way forward: examining the question of how to altogether eliminate bioweapons threats as a category of mass-destruction weapons.[44] While this work is nascent, it has to date been well received among academic, government, and private sector experts. In addition to the tangible, systemic changes such a vision could help drive, it holds enormous value in reinforcing norms against WMD.

CSR is also carrying forward the previously-described efforts to reduce the risks of the most dangerous classes of nuclear weapons, ambitiously calling for these types of nuclear weapons to be next in line for elimination. The CSR team, working with experts and government officials from around the world, have found these ideas resonate broadly and hold the potential to be the most politically-viable nuclear weapons elimination options in the near to medium term. Additionally, they mimic history: the Intermediate Range Nuclear Forces Treaty likewise focused on getting rid of an especially-destabilizing class of nuclear weapons, and its implementation then helped pave new pathways to reductions in strategic nuclear weapons.

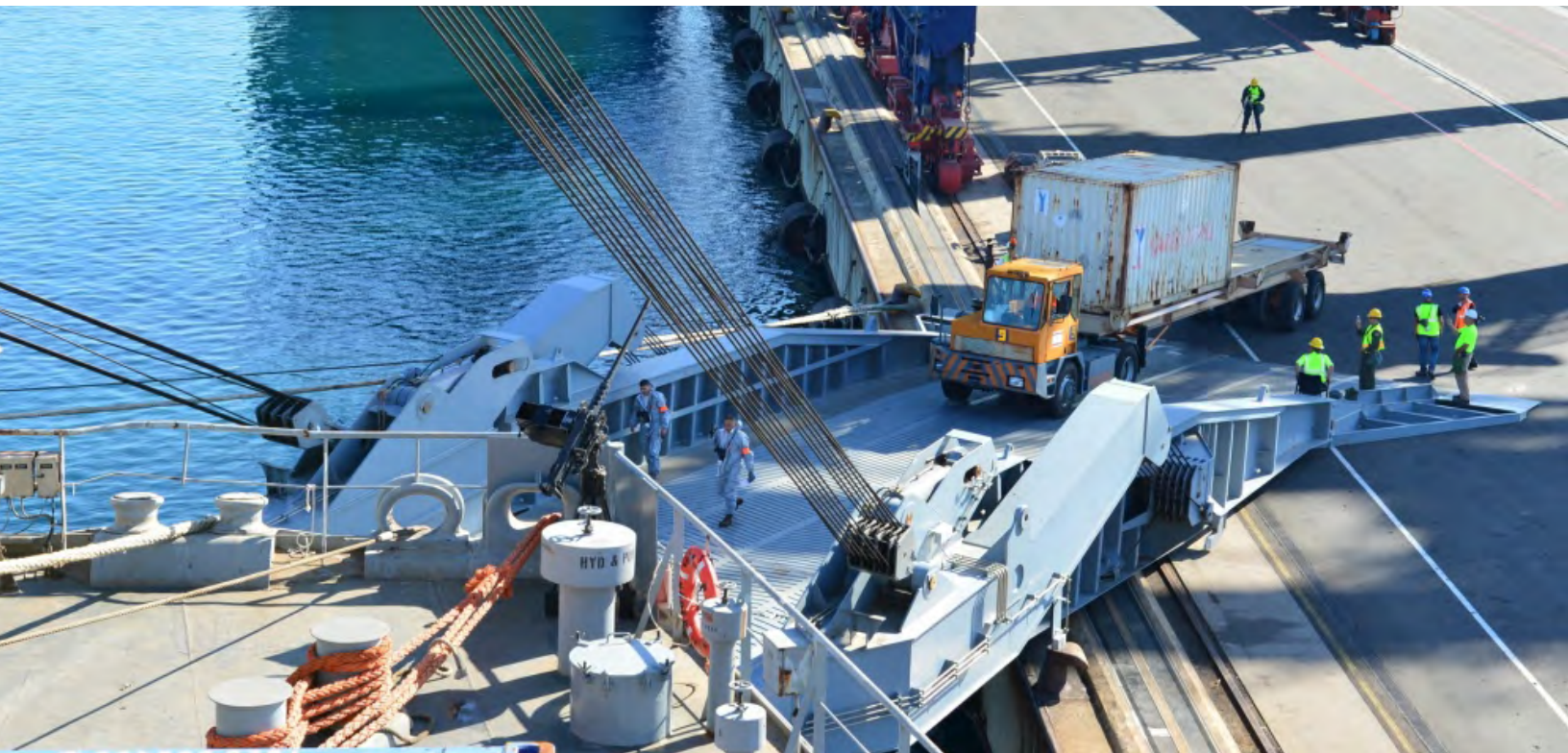
These are just a few examples. Certainly the creation of the existing WMD governance system can be seen as equally bold when looking back at its history. It is time once again to experiment with big ideas.

CONCLUSION

Though it provides only an overview of many important issues, this report shows both significant challenges and great potential for progress in reducing WMD threats. This is an area ripe for dramatic and possibly rapid improvement. There is abundant will from most of the world's nation-states to reestablish norms against WMD use and strengthen global governance in this regard; the drive of these countries will be one key factor in determining whether the world moves back to stronger mitigation of WMD risks. Many international organizations and countries are actively searching for new ideas that could change the current WMD trajectory and reinvigorate arms control---and they are looking to nongovernmental organizations for leadership in developing these ideas.

The stakes for action in this area could not be higher. The use of WMD is becoming more frequent, and there are no limits to the potential escalation the world could experience if global governance against WMD is not strengthened and expanded with urgency. Reducing such catastrophic risk is fully achievable, and the time to act is now.

A container is transferred from the MV Ark Futura, a Danish cargo ship, to MV Cape Ray, a U.S. vessel on which more than 1,000 tons of chemical weapons materials from Syria were neutralized in 2014. This extraordinary multilateral effort showed the flexibility that existing international bodies such as the OPCW and UN can achieve in using their powers to reduce urgent WMD risks. U.S. Department of Defense



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44 Link to CSR page

WEAPONS OF MASS DESTRUCTION:

THE STATE OF GLOBAL GOVERNANCE AMID RISING THREATS & EMERGING OPPORTUNITIES

BY CHRISTINE PARTHEMORE

OCTOBER 2019

COUNCIL ON STRATEGIC RISKS