The Hague Centre
for Strategic Studies

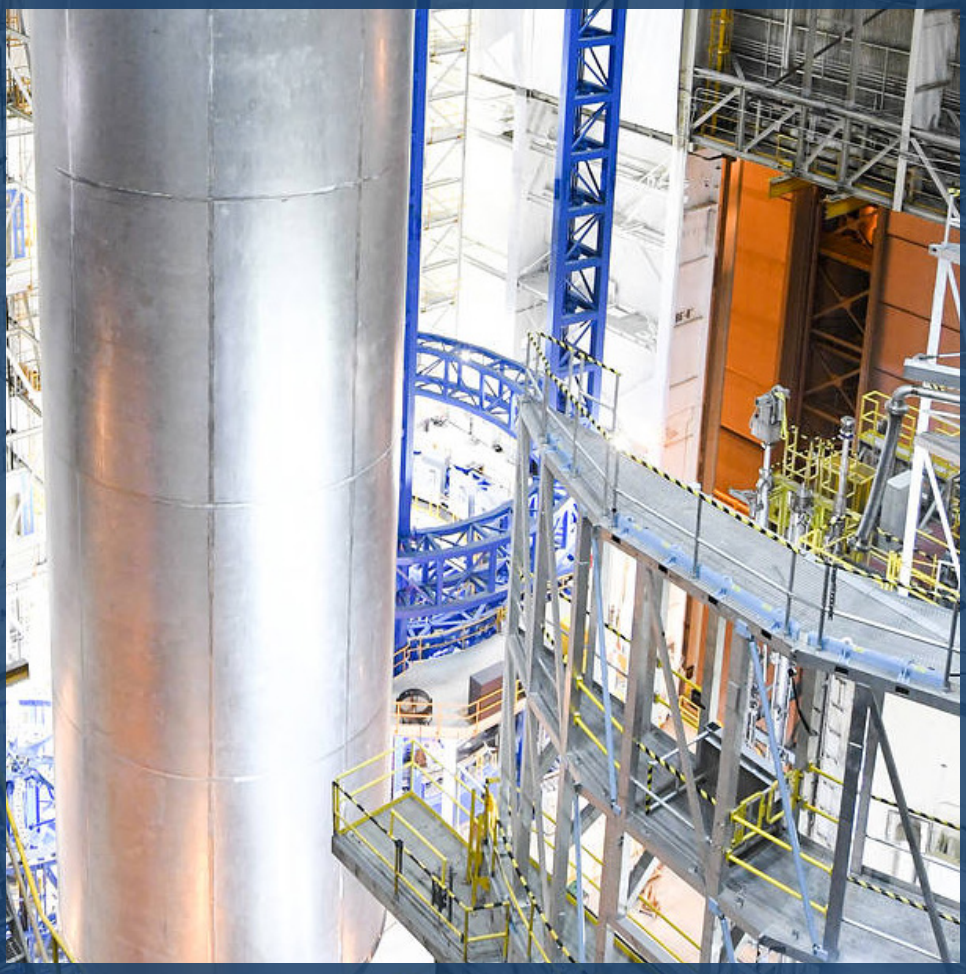
Executive Summary

Shifting sands of strategic stability

Towards a new arms control agenda

Paul van Hooft, Lotje Boswinkel and Tim Sweijs

February 2022



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Executive Summary

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Executive Summary

Increased geopolitical competition, nuclear multipolarity, and emerging technologies are steadily undermining strategic stability as well as the existing arms control and non-proliferation regime architecture. The 1980s and 1990s were a high-water point in terms of the normative and legal institutionalization of arms control and non-proliferation regimes, including, but not limited to, the Intermediate-Range Nuclear Forces (INF) Treaty, the Strategic Arms Reductions Treaty (START) and the Strategic Offensive Reductions Treaty (SORT), the Missile Technology Control Regime (MTCR), the Open Skies Treaty (OST), the Vienna Document (VD), and the Wassenaar Arrangement. We are seeing a disintegration of these regimes.

This report first offers an in-depth analysis of how both geopolitical and technological developments affect strategic stability. It then looks at the arms control, non-proliferation and deterrence policy measures that states have at their disposal to contain and prevent the *production*, *proliferation*, *deployment* and *employment* (PPDE) of weapon technologies that threaten strategic stability, to provide new solutions for a new generation of durable arrangements. While arms control and non-proliferation efforts are aimed at countering the production, the proliferation and the deployment of such capabilities, deterrence seeks to prevent their actual employment. Rather than singling out one weapon technology or one specific arms control regime, it introduces a new analytical framework that assesses the feasibility of policy measures to control weapon technologies along the PPDE-chain. Applying this framework to ten emerging weapon technologies, the report identifies specific policy measures to curtail the risks associated with each of them. The overview of measures offers European and Dutch policymakers a blueprint for a broader integrated arms control agenda, and facilitates careful consideration of the appropriate balance of policy mixes along the PPDE-chain included therein. On that basis the report offers a set of policy recommendations to policymakers to bolster strategic stability.

The reemergence of geopolitical competition, the advent of nuclear multipolarity, and multiple emerging technologies, are reshaping incentives to search for a first strike advantage as well as prompting more reckless behavior of actors during a crisis

Strategic stability

Geopolitical competition, nuclear multipolarity, and emerging technologies affect both aspects of strategic stability: deterrence stability and crisis stability. Nuclear deterrence aims to raise the costs of aggression to unacceptable levels. Its credibility depends on ensuring that a state will always have a secure second strike capability to inflict catastrophic damage on its opponent even after a first strike by the adversary. Deterrence stability can then be defined as a situation in which both adversaries remain confident of their capability to conduct a retaliatory second strike. If neither party believes they nor their adversary can gain an advantage by attacking first, neither has an incentive to engage in quantitative or qualitative arms racing over extended periods of time. Crisis stability, in turn, can be defined as a situation in which actors believe their ability to retaliate remains intact even if they do not immediately respond to aggression. When they do not believe this, use-it-or-lose-it dynamics emerge. Crisis stability lies close to *escalation control*, or the ability to prevent conventional or limited nuclear use to escalate uncontrollably into a catastrophic conflagration. Unlike the former, the time horizon is very short for crisis stability. The reemergence of geopolitical competition, the advent of nuclear multipolarity, and multiple emerging technologies, are reshaping incentives

to search for a first strike advantage as well as prompting more reckless behavior of actors during a crisis (see Table 1).

Table 1. Effects of increased competition and multipolarity on deterrent and crisis stability

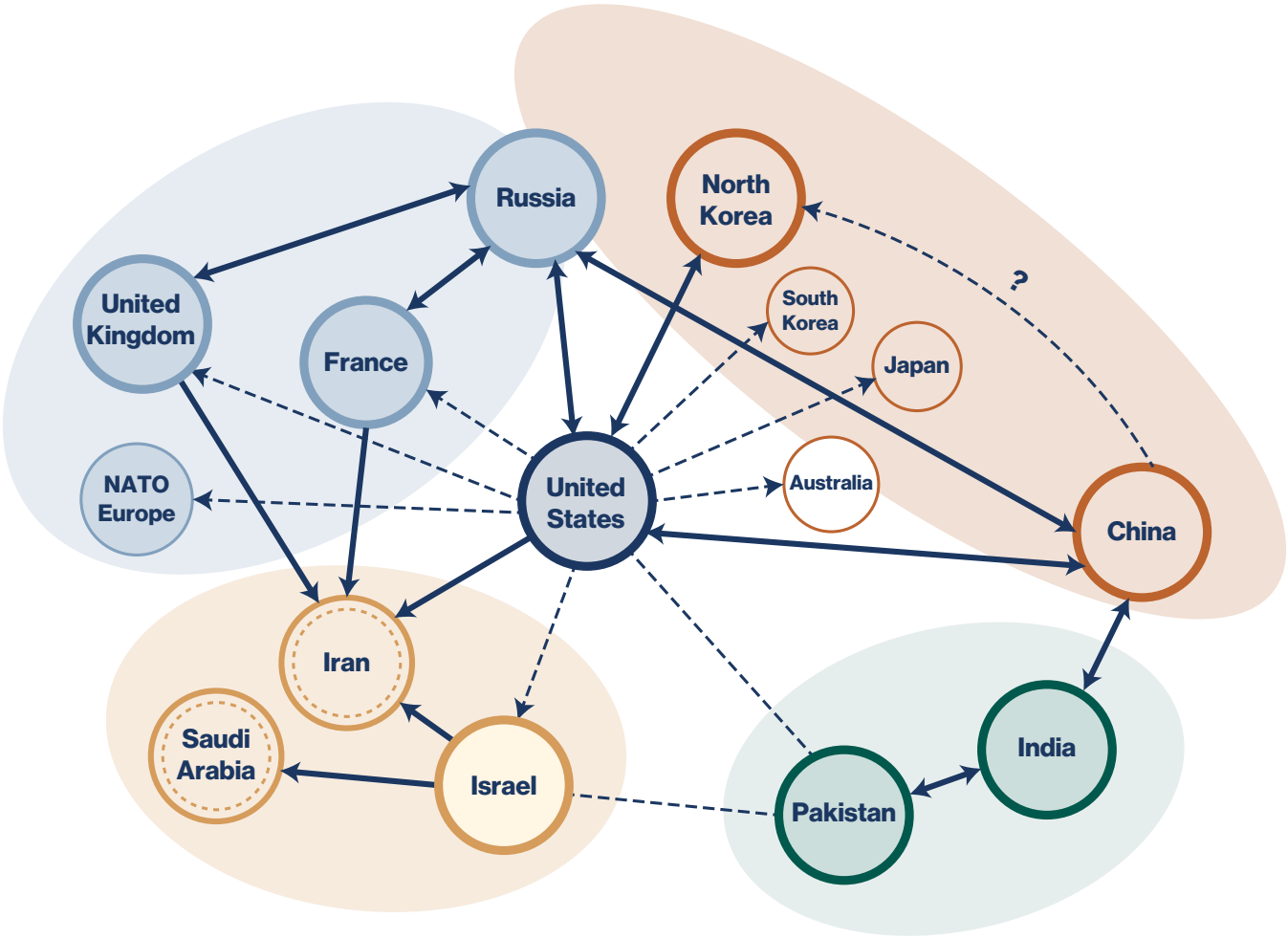
	Deterrence Stability	Crisis Stability
Competition	The intensification of conventional and nuclear competition diminishes the confidence in a secure second strike.	Misunderstandings during a crisis are likely to increase due to the unpredictability of purpose of policies and stark outcome differences.
Multipolarity	The complexity of long-term strategic calculus increases, given the growing number of nuclear actors and access to technology.	The lack of deeply institutionalized ties among powers increases uncertainty and the likelihood of errors in judgement.

Geopolitical trends

Intensified competition between great powers and new regional powers, interacting with the addition of new nuclear powers since the end of the Cold War, has led to a second nuclear age that is no longer characterized by the bilateral relationship between the United States and the Soviet Union. During the Cold War, the two superpowers held large and dispersed nuclear arsenals that were, for all intents and purposes, impossible to eliminate in a first strike. Arms control efforts between the two eventually became deeply institutionalized.

At the center of the current nuclear age, however, is the triangular relationship between the United States, Russia, and China. Interacting with this core of great powers, are the UK, France, and Israel, as well as three states that have acquired nuclear weapons after the Cold War: Pakistan, India, and North Korea. As the extra-regional hegemonic power in Europa, Asia and the Middle East, the United States occupies a uniquely central position in the dyads. Its nuclear rivals aim to deter the US from involvement in regional issues, whether through nuclear or conventional means. The competitive pressures therefore exist at the regional level and secondarily on the global level (see Figure 1).

Figure 1. Interacting nuclear dyads and strategic relationships



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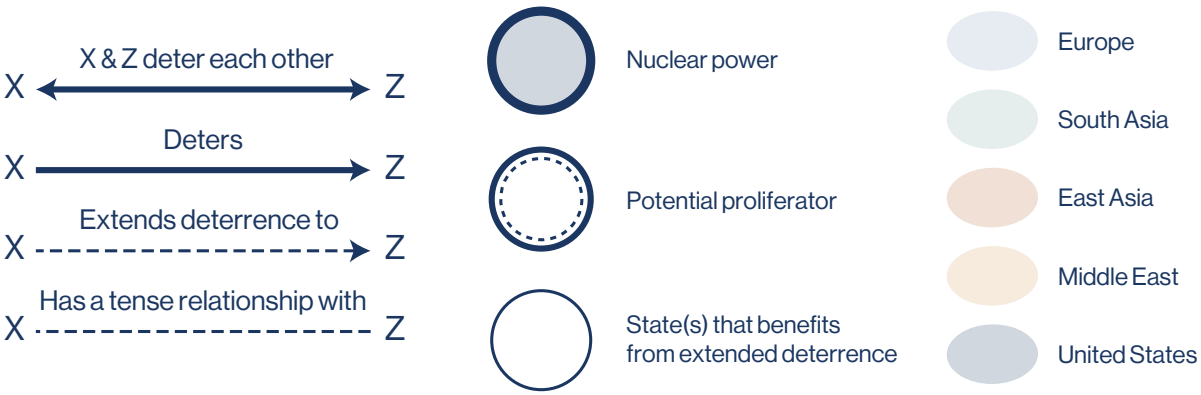

Emerging technologies

The development and weaponization of new and existing technologies, in turn, is largely driven by the new geopolitical competition. The report looks at ten weapon technologies for strategic stability through their impact on deterrence and on crisis stability: 1) hypersonic missiles; 2) anti-satellite weapons; 3) directed-energy weapons; 4; dual-capable missiles; 5) missile defense systems; 6) offensive cyber capabilities; 7) lethal autonomous weapon systems; 8) remote sensing, 9) artificial intelligence; and 10) dual-capable C3I systems. Each has different effects on deterrent and crisis stability.

First, the means to achieve a competitive advantage have increased. Emerging technologies could re-open the door of arms racing for first strike advantages and secure second strikes (see Table 2). The nuclear revolution is not absolute and nuclear stalemate is reversible. The sophistication of precision-guided weapons through sensing, data fusion, and machine speed responses provides military planners with nuclear as well as conventional counter-force options, as these advanced conventional weapons can fulfill some of the same tasks as nuclear weapons due to increased precision. In combination with the revolution or evolution of missile technology that hypersonic cruise missiles and glide vehicles represent – with their abilities to fly at speeds above Mach-5, fly low, and maneuver in order to evade timely detection and interception – the decision-making windows for policymakers are shrinking. While part of the answer may lie in more effective air and missile defense, aided by the defender's own artificial intelligence and autonomous sensing, such measures themselves may also lead states to pursue next generation offensive capabilities. Together this may further a general use-it-or-lose-it sense. It is also more difficult than during the Cold War to erect clear barriers between strategic weapons and advanced conventional weapons. The same Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) systems that enable effective conventional precision-strike overlap with those used for nuclear weapons. Disabling the C4ISR infrastructure that underpins an adversary's Anti-Access Area Denial (A2/AD) may be essential within a conventional conflict but may be indistinguishable from the first stage of a nuclear first strike. The risk that a conventional conflict inadvertently escalates further destabilizes European and Asian security. Complicating matters further is that many of the technologies driving the new instability are dual-use in nature. Unlike the Cold War era, most of today's innovation may in fact be taking place in the commercial sector. This poses a challenge to non-proliferation agreements, such as the Wassenaar Arrangement and the MTCR. New arms control agreements that deal with these technological changes will consequently need to take into account this more multi-faceted view of technology and the evolved configuration of the political landscape – similar to how the 1996 Wassenaar Arrangement superseded the Cold War's era Coordinating Committee for Multilateral Export Controls launched in 1949.

The nuclear revolution is not absolute and nuclear stalemate is reversible

Table 2. Emerging technologies and strategic stability

Emerging Technology	Deterrence Stability	Crisis Stability
Hypersonic missiles	Compressed timelines increase suitability for conventional or nuclear first strike.	Compressed timelines may create misperception and miscommunication.
		A failure to discriminate between conventional and nuclear warhead during flight could lead to errors of judgement.
Anti-satellite weapons	Disruption of sensing and command and communication can become an opening stage of first strike.	Errors of judgements may occur due to uncertainty about whether attack is directed at conventional or nuclear infrastructure.
Directed energy weapons	Potential use in missile defense and as ASAT undermines confidence in second strike capabilities.	Errors of judgment may occur as a consequence of speed of delivery and low detectability.
Dual-capable C3I and missiles	Dual-capable systems create the opportunity to conduct conventional first strikes on adversary's nuclear arsenal without nuclear weapons.	Risk of inadvertent escalation increases due to inability to distinguish between opening stages of nuclear or conventional attack.
Missile defense	Missile defense decreases adversary's confidence in its second strike.	Need for speed increases potential for technical and human errors of judgement.
	Defenses may incentivize the adoption of launch-under-attack posture.	
Offensive cyber capabilities	Cyber capabilities create new opportunities for non-kinetic left-of-launch attacks on first strike.	Errors of judgment may arise from discrimination problem in cyber intrusion between surveillance and attack.
	Capabilities allow for the manipulation of data to influence, disrupt, or decapitate command and control.	
Lethal autonomous weapons	Attacks on nuclear weapon delivery systems, command and control systems, and sensitive infrastructure components can overwhelm an adversary.	Limited human involvement and the speed of LAWS could increase unintended escalation.
Remote sensing	AI-enabled detection of concealed and mobile nuclear launch-platforms undermines second-strike capabilities.	Attacks on satellites could be mistaken for attacks on the nuclear infrastructure.
Artificial intelligence	Improvements in data analysis and speed can create first strike capabilities.	Compressed timeframes and potential biases in machine learning could lead to errors of judgement.

Second, the opportunities to pursue a competitive advantage have grown, and European policymakers will need to deal with the implications of emerging nuclear and conventional precision-strike multipolarity. The emergence of China as a challenger to American power in Asia alongside a revanchist Russia has created a three-way interaction with consequences for deterrence within Europe as well as for arms control. Russia has looked to its large and varied arsenal of nuclear weapons to compensate for its declining status. Moreover, Russian military strategy includes plans to use this arsenal for leverage in concrete scenarios in northeastern Europe. Simultaneously, the intensifying Sino-American competition has spurred China to innovate a series of conventional missile capabilities – generally referred to, together with its set of sensing and Command and Control assets, as A2/AD capabilities – that aim to raise the costs for US power projection in the Western Pacific. Moreover, as China

makes advances in missile technology, it is likely that smaller and medium powers within Asia and elsewhere will seek to acquire their own conventional precision-strike capabilities. While these states long had the motive, now they have the opportunity to act on it. In a multipolar world they will be able to purchase such capabilities from China and Russia, or emulate their successes through their own indigenous efforts. These developments have various consequences for Europe. In part, the United States withdrew from the INF with Russia to free itself to develop short and middle range missiles for the Western Pacific. The US National Defense Strategy already underlined that the United States will only plan for one major regional war at a time, relying on deterrence in the second region. It is apparent from the 2018 Nuclear Posture Review (NPR) that US officials perceive deterrence gaps in the European theater. In fact, US officials implicitly acknowledge that the linkage between American conventional deterrence through a physical presence in Europe has been weakened, because the NPR increased the role of low-yield nuclear weapons as a substitute for conventional forces in the European theater. Durable arms control efforts in the emerging multipolar world must therefore evolve from the arrangements that were based on the bipolar Cold War context and adapt to the circumstances of today.

Unsurprisingly, Europe has a more limited role in a geopolitical environment that centers around a trilateral American-Russian-Chinese nuclear relationship. However, European states could address the conventional imbalance between NATO Europe and Russia. This imbalance in NATO's northeast adds escalatory pressure to the US to fill the deterrence gaps in the escalation ladder through greater flexibility in its nuclear arsenal and investments in advanced conventional weapons. In the realm of strategic stability, a distinction can be made between deterrence by punishment and deterrence by denial. Nuclear weapons are nearly exclusively used for deterrence by punishment. An avenue to prevent the re-nuclearization of European security is therefore to strengthen Europe's capability for conventional deterrence by denial. Similar to the success of Cold War arms control and non-proliferation efforts, acquiring such capabilities would also improve the negotiation position of European states to pursue new agreements with Russia. Most European states are not yet directly involved in the arms competition, with the partial exceptions of the UK and France. But the interlocking competitions will involve them eventually, and Europe is certainly central to the nuclear competition between the US and Russia. More importantly, Europeans are closely involved with the development of the plethora of dual-use technologies that are driving the technological dynamics of strategic instability. Consequently, Europeans must take their responsibility, for strengthening strategic stability, both through arms control and counter proliferation (see below) and through greater investments in deterrence. The consequences of inaction are high.

Assessments along the production-proliferation-deployment-employment chain

This report therefore assesses which arms control, non-proliferation an deterrence approaches are best suited for the various technological developments. It examines the stages through which an emerging (or existing) weapon technology is being developed and brought into use. Each of these stages has a different logic. *Production* encompasses possession of the technological knowledge, basic skills, and access to materials to indigenously produce a weapon technology. *Proliferation* includes the ability to acquire technologies and materials from other states or non-state actors. *Deployment* refers to what other hard constraints, such as platform technologies or access to specific locations, would allow the weapon technology to be put to use. *Employment* covers all the soft constraints such as organizational aptitude and fitness to effectively use the technology.

Along this production-proliferation-deployment-employment chain, the ten emerging technologies are evaluated using a rigorous assessment framework on the basis of desk research, expert interviews and iterative discussions within the project team followed by an independent review of a subject matter expert (see Table 3 and Figure 4 for a visual representation). Using the assessment framework, each technology is scored low, medium or high, indicating the ease, feasibility or likelihood of its production, proliferation, deployment and employment.

Table 3. Assessments for all weapon technologies and stages

	Production	Proliferation	Deployment	Employment
Hypersonic missiles	Low	Low	Medium	High
ASATs	Low	Medium	Medium	Low
DEWs	Low	Medium	Low	Low
Dual-capable missiles	Medium	Medium	Medium	Medium
Missile defense	Low	Low	Low	High
Cyber	Medium	High	Low	Medium
LAWS	Low	Medium	Medium	Low
Remote sensing	Medium	Medium	Medium	High
AI	Low	Medium	Medium	Low
Dual-capable C3I	High	Medium	High	High

The assessment of technologies along the PPDE-chain offers a number of insights. First, the production of most emerging technologies is still highly complex and will thus be restricted to major military powers. Crucially, only those applications of relevance to strategic stability are considered: cyber attacks on critical national infrastructure or high-value military infrastructures for sustained periods of time and antisatellite weapons taking out nuclear communication assets are therefore considered; simple LAWS or anti-drone laser systems are not. With the exception of hypersonic missiles and missile technology, the proliferation of all discussed technologies scores at least medium if not high: emerging technologies' dual-use nature is most often to blame for this. Offensive cyber capabilities spread most rapidly, as the technology is not merely dual-use but even omni-use, in addition to being largely intangible. When it comes to deployment, the majority of technologies require fairly or very sophisticated infrastructures, weapon platforms and enablers, with at times modification of existing technologies possible. Only the deployment of dual-capable C3I is supposedly straightforward, even if strictly limited to nuclear powers. Finally, the assessment reveals that more "traditional" technologies such as offensive and defensive missile capabilities are most easily employable. For more novel ones, various organizational, doctrinal and normative constraints often hinder their use. In a next step, the assessments help identify the stages where arms control, non-proliferation and deterrence measures can be most effectively targeted.

More "traditional" technologies such as offensive and defensive missile capabilities are most easily employable

Figure 2. Technology assessments along the PPDE-chain

Solutions

Emerging technologies lend themselves to a wide variety of both time-tested and newer arms control, non-proliferation, and deterrence measures along the PPDE chain. Compared to the past, today the focus of arms control lies less on arsenal size reductions. Our analysis shows that in this emerging landscape the emphasis of arms control is shifting from controlling primary production inputs to limiting their military applicability and proliferation. Because emerging technologies are often of dual-use nature and intangible or miniaturized, traditional export control tools are increasingly difficult to design, implement and verify. As a result, dual-use export control lists need to be highly specific and tailored; and because of the extremely fast-paced environment, continuously revised and updated. For some technologies, such as cyber, AI and LAWS, limiting the proliferation of expertise could be promising. Furthermore, traditional quantitative measures that were salient in previous times (INF, START, ABM) have become less relevant for newer technologies. This is partly political: multipolarity lends itself less to a quantity-based approach because different geopolitical dynamics ask for different arms control solutions. But the intangible nature of several of the emerging technologies makes capping deployment also technically complex, if not impossible. Finally, it appears that confidence-building measures constitute a considerable part of the toolbox at hand. In times of increased international competition and eroding trust, working towards arms control and achieving the intended effects of confidence-building measures will prove challenging. States are naturally inclined to seek comparative advantages, a tendency which is further exacerbated by notions such as an AI winner-takes-all market and fears of a hypersonic missile gap.

A closer look at the blueprint for a new arms control, non-proliferation and deterrence agenda (see Table 4) suggests four robust and general avenues for European and Dutch policy-makers to focus their efforts on. Each of these encompasses the longer and much more detailed list of solutions presented in Table 4.

1. Curbing production and proliferation: update, coordinate, collaborate

The first type of solutions should be aimed at curbing production and proliferation. Traditional export control regimes are challenged but still relevant. In their role as major producers and consumers of high-end technology, the EU, and the Netherlands particularly, have much greater leverage in setting the standards for dual-use technologies. Constantly reviewing and revising specific and tailored export lists is key, even if they are hard to implement and verify, and technological developments fast outpace regulation efforts. Involving the private sector in creating and evaluating export regulations is crucial to ensure support and ease of implementation. Private sector activities rather than products can also be specifically targeted through know-your-vendor laws. The proliferation of knowledge and expertise can be countered by contract obligations. More traditional measures such as pre-launch notifications for tests or stricter regulation for testing could help curb the production of tangible, more traditional technologies such as hypersonic missiles, ASATs, DEWs and missile defense.

2. Reducing risk through technical and political means: specify, verify, declare

The second type of solutions should focus on risk reduction: when the deployment of technologies cannot be curbed, the risks associated with deployment and use should be controlled

to prevent inadvertent escalation. Risk reduction can be achieved both through technical and political means. Cross-checking is crucial when dealing with automation, but necessary more generally in an age of mis- and disinformation. Confidence-building measures include political hotlines, technical cross-verification measures, and optimal situational awareness capabilities, preferably shared. Unilateral declaratory statements may further enhance trust or increase risk-awareness.

3. Developing norms and rules: shape, regulate, demonstrate

The stakes in strategic stability are high for everyone

The third set of measures should target regulation of the production, deployment and use of technologies by setting norms and rules. Developing and implementing frameworks through which self-restraint is exercised is a good start; efforts to share such rules and norms internationally should follow suit. Europe could play the role of a mediator between the US and Russia, and between the US and China. Particularly with China, Europe could help with the socialization of the norms built up during the Cold War through Track 1.0 and Track 2.0 dialogues. Currently, standards that are being developed include frameworks that ensure human control over AI-enabled systems. Discussions here should not be limited to democratic states only. Even if underlying motivations differ, the incentive to maintain certain degrees of human control is shared more widely if it comes down to preventing nuclear escalation. Furthermore, regulation tools should be co-developed and shared with (and, if needed, imposed on) private sector actors. Industry codes of conduct and security-over-efficiency rules are among the tools at hand.

4. Strengthening integrated deterrence: communicate, attribute, reciprocate

Finally, deterrence remains an important policy pillar in support of strategic stability. While not commonly discussed in tandem with arms control and non-proliferation, integrated deterrence postures may complement these measures aimed at risk reduction. It is noticeable that deterrence by denial is becoming increasingly difficult for emerging technologies. Given the expansion of domains and instruments, deterrence is likely to be more cross domain in nature than in the past, which requires robust, integrated deterrence postures. New technologies are faster and more efficient, to the detriment of traditional defensive measures such as hardening. And while defense against cyber operations can be enhanced, bullet-proof software is unlikely. Transparency and attribution is key, especially when it comes to more secretive technologies such as cyber. As a result, one can either foresee a shift to deterrence by punishment[1] or newer forms such as deterrence through entanglement (even if risky) and cumulative deterrence complemented with efforts to build norms in a more integrated fashion in the realm of new technologies.

The current climate of increasing geopolitical competition between great powers and regional powers further undermines collective action. Fortunately, it can be concluded that the arms control agenda expands, combining time-tested measures with novel ones. Finding ways to develop an arms control and counterproliferation agenda in times of low trust will thus be one of the major challenges ahead. But efforts are by no means futile. The stakes in strategic stability are high for everyone. It is only through negotiation and communication that states can hope to prevent the breakdown of strategic stability and avoid disaster.

1 See, for example, the discussion on asymmetric deterrence in: Rob de Wijk, "The Role of Deterrence in a New European Strategic Environment," *SIRIUS-Zeitschrift Für Strategische Analysen* 2, no. 1 (2018).

Table 4. Arms control policy agenda

	Production	Proliferation	Deployment	Employment
Hypersonic missiles	• Expand the HCoC to including pre-launch notification obligations for hypersonic missile tests	• Expand coverage of existing export regimes, notably MTCR and UNSCR 1540	• Limit sites where nuclear-tipped (hypersonic) missiles may be deployed.	• Promote data exchanges including advance test notifications • Restrain sea-based tests • Separate launch locations as well as nuclear and conventional assets • Publicly specify that hypersonic missiles will be conventionally-tipped only and used against conventional targets only • Explore both punishment- and denial-based deterrence options
Anti-satellite weapons (ASATs)	• Clear inconsistencies in the OST and further control ASAT tests • Promote pre-launch notifications for ASATs tests under existing regimes such as the HCoC	• Expand coverage and increase verification of existing export regimes, such as MTCR and UNSCR 1540	• Clear inconsistencies in the OST and (further) limit the deployment of ASATs • Place limits on the proximity of space objects • Enhance verification through broadcasting obligations and potentially shared SSA capabilities	• Work towards an international code of conduct for space, building on existing efforts such as the UK-sponsored UN resolution A/RES/75/36 • Implement national and international space situational awareness systems to monitor and enforce space activities • Explicitly include the risks associated with ASATs in bilateral and multilateral strategic dialogues concerning nuclear weapons • Examine the possibilities and constraints associated with space deterrence
Directed-energy weapons	• Clear inconsistencies in the OST and further regulate the testing of space-based DEWs • Step up verification, potentially through shared situational awareness capabilities	• Refine and reinforce existing arms control regimes including the Arms Trade Treaty and the Wassenaar Arrangement	• Start the discussion of international rules limiting the number of DEWs that can be deployed through formal gov-to-gov talks (track 1) and expert-to-expert (track 2) meetings	• Establish a working group of legal experts to reflect on the legal implications of collateral damage of DEW • Include the use of DEWs in the efforts to set norms for behavior in space
Dual-capable Missiles		• Reinforce the implementation and verification of MTCR	• Limit the deployment of nuclear-tipped missiles, e.g. by banning nuclear weapons from sites	• Publicly commit to no-first-use • Work internationally to create pre-launch notification protocols
Missile defense			• Reflect on the utility of missile defense as a bargaining chip to facilitate further arms control discussions, also including offensive weapons	• Ensure and communicate that defensive systems are not intended to undermine second strike capabilities • Clearly separate strategic from regional missile defense efforts • Consider regional rather than global solutions tailored to specific regional strategic constraints • Determine and limit the minimally required nuclear arsenal size to ensure a second strike capability vis-à-vis adversaries' strategic missile defense postures
Offensive cyber capabilities	• Invest in AI-enabled coding to limit opportunities for zero-day exploits • Impose stricter regulations for software developers to prioritise security over efficiency • Identify and fix potential zero-day exploits by bolstering cooperation with hackers	• Continuously review and update EU export control rules • Introduce "know your vendor laws" to the access-as-a-service industry • Impose stricter regulations on cyber specialists offering their services to work for foreign governments		• Build notification procedures and crisis deconfliction mechanisms • Build on efforts to set norms in cyberspace, including by the UN Group of Governmental Efforts and the Paris Call for Trust and Security in Cyberspace • Add weapons of mass disruption to existing regulatory frameworks • Enhance cyber situational awareness to increase transparency in the cyber domain • Develop attribution frameworks (digital forensic, legal, political) to facilitate timely attribution and support deterrence • Develop cyber deterrence (capability, communication, political will) posture

Table 4. Arms control policy agenda (continued)

	Production	Proliferation	Deployment	Employment
LAWS	• Ensure high-level ethical standards in the production phase and promote morally responsible engineering through the introduction of industry codes of conduct • Work with multistakeholder working groups to ensure implementability and support • Continue international dialogue, such as initiated by the CCW Group of Governmental Experts, to agree and commonly adopt system-tailored rules ensuring meaningful human control • Promote legal compliance, e.g., through formalizing Article 36 in domestic procedures	• Continuously revise and adjust existing export control lists, including the Wassenaar Arrangement, the MTCR and EU dual-use regulations • Strictly control the export of semiconductor equipment while implementing tailored end-use and end-user controls on chips only • Explore options to limit the proliferation of expertise, e.g., imposing contract obligations	• Foster international dialogue on LAWS deployment, especially among US, Russia, and China • Provide training to military personnel on the ethical issues related to the deployment of LAWS	• Share best practices and develop context-specific human control standards • Apply tort law by subjecting LAWS to strict liability regimes that allow to hold a defendant accountable even without evidence of clear fault • Assign a legal personhood to LAWS to grant compensation to parties injured by an autonomous system • Promote trust by declaring the ways in which LAWS could be used • Examine the possibilities and constraints associated with deterring adversaries from deploying LAWS
Remote sensing		• Continue to implement, verify and update export control regimes applicable to remote sensing		• Increase the resilience of systems whose survivability may be undermined by remote sensing
AI	• Ensure high-level ethical standards in the production phase and promote morally responsible engineering through the introduction of industry codes of conduct • Continue international dialogue, such as initiated by the CCW Group of Governmental Experts, to agree and commonly adopt system-tailored rules ensuring meaningful human control • Promote legal compliance, e.g., through formalizing Article 36 in domestic procedures	• Continuously review and update tailored dual-use export control lists that include AI software, algorithms and datasets • Strictly control the export of semiconductor equipment while implementing tailored end-use and end-user controls on chips only • Explore options to limit the proliferation of expertise, e.g., imposing contract obligations	• Share best practices and develop context-specific human control standards • Establish regulations limiting the deployment of AI-enabled systems involved in warfighting only to highly tested and proven technologies under strict ethical regulations • Keep humans *in the loop* and require strict operator trainings; • Specify the conditions under which a human *on the loop* and *out of the loop* is legitimate and illegitimate • Implement cross-checking requirements • Boost system resilience through bolstering cyber security • Separate early warning from command and control	• Share best practices and develop context-specific human control standards • Promote the use of goal functions that cannot be changed by the AI-enabled system to ensure compliance with ethical, legal and military guidelines • Introduce the use of ethical governors to verify the legality of AI-driven actions (and potentially block them) • Openly communicate national regulatory frameworks, strategies and policies • Lower alert levels of AI enabled weapon systems in order to reduce inadvertent escalation (e.g., a battlefield equivalent of the "flash crash")
Dual-capable 3CI				• Establish confidence-building measures such as hotlines between key nuclear adversaries • Publicly highlight the escalatory risks associated with C3I entanglement • Publicly commit to not targeting one another's C3I capabilities • Strengthen deterrence by punishment posture by clearly communicating the consequences of attack on C3I capabilities

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