Pathways to Disaster
Russia's War against Ukraine and the Risks of Inadvertent Nuclear Escalation

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Executive summary

The risk of inadvertent nuclear escalation due to policies in the conventional domain is a serious, and underrated, feature of the current stand-off between NATO and Russia that has followed Russia's 2022 invasion of Ukraine. NATO leaders and armed forces need to be conscious of unintended signals that can follow the placement of weapons, the movement of forces, and support to Ukraine, especially considering the state of the Russian armed forces.

Europe's security order has drastically shifted after Russia's invasion of Ukraine, with many repercussions that are difficult to predict – that includes Europe's nuclear order. Yet, Europeans have become unaccustomed to the concepts, procedures, and second- and third-order effects of that nuclear disorder. In those circumstances, the worst, previously unlikely, pathways need to be thought through in order to focus current and upcoming arms control efforts.

How has Russia's so far unsuccessful prosecution of its war in Ukraine undermined its nuclear infrastructure and capabilities, and how will this impact strategic stability and raise the chances of inadvertent nuclear escalation? Inadvertent nuclear escalation is escalation brought on by actions in the conventional domain that impact the nuclear domain although they are not intended to. Given the growing stresses and strains on Russian capabilities, stocks, and organisation, multiple pathways appear towards inadvertent escalation. We identify four: (1) uncertainty whether intentions are offensive or defensive, also known as the security dilemma; (2) the nature of military organisations; (3) general informational complexity; and (4) comingling or entanglement of conventional and nuclear weapons, delivery systems, and enablers.

The brief applies the four mechanisms to current trends in Russia and notes that evidence exists for all four pathways (see Table 1).

Our main conclusions are concerning: there are an increasing number of pathways that could lead to inadvertent escalation. Russia's expenditure of dual-capable missile stocks, the shifting balance of power in Europe to the advantage of NATO, and NATO's enlargement bringing it closer to the Kola Peninsula increases the likelihood that Russia faces "use-it-or-lose-it" choices. The Russian armed forces have been overburdened and one could expect civil-military relations to be disturbed. The Russian military is offensively minded, with the nuclear class developing its own parochial ideology. Russian C3I systems are degraded through sanctions and direct attacks. Finally, Russia has launched attacks on Ukraine, and used dual-capable delivery systems, from the same locations as its nuclear arsenal (see Table 1).

Table 1. Pathways to inadvertent nuclear escalation

Pathway to inadvertent escalation	Post-February 2022 situation	Risk inadvertent escalation
Military-organisational features complicate decision-making and command and control (2)	Russian civil-military relations are strained, the military is offensively minded, with the nuclear elite developing its own parochial ideology, and military structures are under unique stress.	High increase
Uncertainty about offensive and defensive intentions (1)	Russia's expenditure of dual-capable missile stocks, the shifting balance of power in Europe to the advantage of NATO, and NATO's enlargement likely bringing it closer to the Kola Peninsula increases the likelihood that Russia faces "use-it-or-lose-it" choices.	Moderate increase
Uncertainty and lack of access to reliable information (3)	Russian C3I systems are degraded through sanctions and direct attacks.	Moderate increase
Commingling, entanglement, and co-hosting of conventional and nuclear weapons and infrastructure (4)	Russia has hosted attacks on Ukraine from similar locations, and using dual-capable delivery systems, as its nuclear arsenal.	Limited increase

We consequently offer nine recommendations for Europeans in particular to keep in mind:

1. *Be careful with NATO's nuclear posture given the stresses the Russian military organisation is under.*

2. *Explicitly incorporate into NATO exercises the risks of inadvertent escalation through conventional confrontations of NATO and Russian forces.*

3. *Look for military-to-military engagement with Russian armed forces.*

4. *Prioritise intelligence on the state of Russian armed forces, specifically the nuclear authorised units.*

5. *Be careful towards the placement of short- and medium-range missiles in Sweden and Finland close to Russia's nuclear bases on the Kola Peninsula.*

6. *Exercise caution towards using cyber tools that could undermine elements of the Russian C3I infrastructure.*

7. *Maintain a moratorium on weapons that target space-based informational infrastructure.*

8. *Separate nuclear issues with Russia from war in Ukraine whenever possible.*

9. *Make use of opportunity of Russian deterioration to leverage their weakness for arms control negotiations.*

1. Introduction:
a weakened Russia and the pathways to escalation

... Russia has created a pretext whereby it can more credibly threaten to escalate to nuclear weapons.

Russia's nuclear arsenal has been central to its conduct of the war in Ukraine, in terms of deterring NATO from direct conventional intervention in Ukraine or against Russian armed forces, and attempting to coerce Europe and Ukraine into submission. Russia has repeatedly threatened the use of nuclear weapons.[1] Russia also annexed Ukrainian territories in Donetsk, Kherson, Luhansk and Zaporizhzhia oblasts as an attempted deterrent to Ukrainian liberation; by including them among supposedly Russian territories, Russia has created a pretext whereby it can more credibly threaten to escalate to nuclear weapons. The manner in which Russia has made nuclear threats, however, is hardly in line with how its nuclear doctrine is understood, even taking into account how the doctrine has shifted in over the past decades into a broader, more coercive approach to nuclear use.[2]

Following the invasion – and, with hindsight, arguably also in the decade preceding it – Russia has become more nonchalant about invoking the use of nuclear weapons to coerce rather than deter.[3] Russia's conduct of the conventional campaign in Ukraine thus far has been ill-considered, poorly prepared, and poorly executed. The costs, stresses, and strains of the war on Russian armed forces, infrastructure, and economy have been severe. Assessments of Russian casualties as of March 2023, including wounded and killed, are estimated to number up to 200,000, with 60,000 of these being fatalities.[4] The delivery of Western arms,

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1   Braw, Elisabeth, 'Behind Putin's Nuclear Threats', *Politico EU*, 18 August 2015, https://www.politico.eu/article/nato-putin-russia-nuclear-weapons-ukraine-war/; 'Ukraine Conflict: Putin "Was Ready for Nuclear Alert"', *BBC News*, 15 March 2015, sec. Europe, https://www.bbc.com/news/world-europe-31899680.

2   Dima Adamsky, *Russian Nuclear Orthodoxy: Religion, Politics, and Strategy* (Stanford: Stanford University Press, 2019); Dmitry Dima Adamsky, *Moscow's Aerospace Theory of Victory: Western Assumptions and Russian Reality* (Washington: CNA, 2021); Dmitry Adamsky, 'Deterrence à La Ruse: Its Uniqueness, Sources and Implications', in *NL ARMS Netherlands Annual Review of Military Studies 2020: Deterrence in the 21st Century—Insights from Theory and Practice*, ed. Frans Osinga and Tim Sweijs, NL ARMS (The Hague: T.M.C. Asser Press, 2021), 161–75, https://doi.org/10.1007/978-94-6265-419-8_9; Kristin Ven Bruusgaard, 'The Russian Rogue in the New Nuclear Posture Review', *Texas National Security Review*, Policy Roundtable: The Trump Administration's Nuclear Posture Review, 13 February 2018; Kristin Ven Bruusgaard, 'Russian Strategic Deterrence', *Survival* 58, no. 4 (2016): 7–26; Hans M. Kristensen and Matt Korda, 'Russian Nuclear Weapons, 2022', *Bulletin of the Atomic Scientists* 78, no. 2 (4 March 2022): 98–121.

3   Pierre de Dreuzy and Andrea Gilli, 'NATO Review - Russia's Nuclear Coercion in Ukraine', NATO Review, 29 November 2022, https://www.nato.int/docu/review/articles/2022/11/29/russias-nuclear-coercion-in-ukraine/index.html; John Erath, 'In Ukraine, Putin Tries His Hand at Nuclear Blackmail. Here Are Seven Ways to Thwart Him.', *Bulletin of the Atomic Scientists* (blog), 17 December 2021, https://thebulletin.org/2021/12/in-ukraine-putin-tries-his-hand-at-nuclear-blackmail-here-are-seven-ways-to-thwart-him/; 'Putin Puts Russia's Nuclear Deterrent Forces On High Alert, Raising Tensions Further', Radio Free Europe / Radio Liberty, 27 February 2022, https://www.rferl.org/a/putin-russia-nuclear-deterrant-forces-alert/31726441.html.

4   Matthew Luxmoore, 'Russia's Death Toll From Ukraine War Is as High as 60,000, U.K. Says', *Wall Street Journal*, 17 February 2023, sec. World, https://www.wsj.com/articles/russias-death-toll-from-ukraine-war-is-as-high-as-60-000-u-k-says-14305ba5.

such as the HIMARS, has contributed to these losses. Russia has also expended large numbers of cruise missiles and other precision guided munitions (PGM) at Ukrainian civilian and military targets,[5] including the dual-capable Iskander and S-300 ground-launched missiles, Kalibr sea-launched missiles, and Kh-101, Kh-22, and Kh-47M2 Kinzhal air-launched missiles. Russia's conventional capabilities have thus severely deteriorated. Unclear is whether and how Russia's conventional losses and poor preparations extend to Russia's nuclear arsenal and infrastructure.

After February 2022, European security has again become more complicated, and includes multiple nuclear dynamics that were previously thought unthinkable; scenarios that were on the backburner for three decades must be brought to the fore again and we must think hard about how to prevent the risk of nuclear escalation.[6] Importantly, as European states continue their material and rhetorical support for Ukraine, realistic and informed discussion must be had about the risks entailed, however uncomfortable. Additionally, European arms deliveries are couched in terms of support for Ukraine, rather than on shaping Russian behaviour towards favourable outcomes. U.S. support has seemingly been more cautious, with particular hesitation in providing longer-range missiles that could strike deep into Russian territory.[7]

This brief explores whether the costs, stresses, and strains of the war on Russia's capabilities, infrastructure, and organisation have made Russian inadvertent escalation more likely, considering how its doctrine has integrated nuclear weapons into its conventional strategy. With inadvertent escalation, we look specifically at the use of nuclear weapons unintentionally brought on by actions of Ukraine or NATO members in the conventional domain. This means that we do not consider escalation due to error (accidental escalation) and not a deliberate set of actions undertaken to deter or to coerce (deliberate escalation).[8] Nor is the focus on the miscalculation of deliberately sent signals. Rather, the emphasis is on those seemingly non-escalatory actions in the conventional domain, from a Dutch and/or NATO perspective, that unintentionally trigger a nuclear response. Reducing the risk of inadvertent escalation is not served by instilling existential fear in Russia for the consequences of its actions. Instead, it requires establishing a shared understanding of the purpose of one's own actions, and by refraining from actions that could trigger inadvertent escalation.

The question of the likelihood of Russian inadvertent escalation is relevant because this is arguably the first time that a nuclear great power has been involved in a war that is so close to existential for the survival of its regime.[9] It is certainly the first time that a state that has been so dependent on nuclear weapons for its international status has seen its other pillars of powers challenged. An imperfect analogy is the 2017 U.S. – North Korean nuclear crisis, which raised

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5   Jack Buckby, 'Russia Has Used Almost 90% Of Its Iskander Missiles in Ukraine', *19FortyFive* (blog), 22 November 2022, https://www.19fortyfive.com/2022/11/russia-has-used-almost-90-of-its-iskander-missiles-in-ukraine/.

6   Daan Sanders, Tim Sweijs, and Paul Van Hooft, 'Preventing the (Un)Thinkable: Escalation Scenarios and Risk Reduction Measures for Russia and NATO Following the War in Ukraine' (The Hague, Netherlands: Hague Centre for Strategic Studies, 2022), https://hcss.nl/report/preventing-unthinkable-escalation-risk-reduction-measures-russia-nato-war-ukraine/.

7   Paul McLeary, Lara Seligman, and Alexander Ward, 'U.S. Tells Ukraine It Won't Send Long-Range Missiles Because It Has Few to Spare', *Politico*, 13 February 2023, https://www.politico.com/news/2023/02/13/u-s-wont-send-long-range-missiles-ukraine-00082652.

8   Forrest E. Morgan, Project Air Force (U.S.), and United States, eds., *Dangerous Thresholds: Managing Escalation in the 21st Century*, Rand Corporation Monograph Series (Santa Monica, CA: RAND Project Air Force, 2008), 19–28. See also: Sanders, Sweijs, and Van Hooft, 'Preventing the (Un)Thinkable'.

9   Arguably the closest similar case is during the 1973 Yom Kippur War when Israeli prime minister Golda Meir considered the use of nuclear weapons as Israeli armed forces were threatened by the coalition of Arab states.

the spectre of a nuclear war due to the heightened risk of inadvertent escalation. Heightened rhetoric and forces on high alert made it almost impossible to separate the signal from the noise along the demilitarized zone (DMZ).[10] That such risk occurred within a relatively minor power should warrant caution in the Russian case.

In this brief, we apply insights from both classic Cold War scholarship on inadvertent escalation, as well as the growing literature on the effect of emerging technologies and dual-use conventional and nuclear weapons and infrastructure on the likely emerging status quo in Russia during and after a prolonged war in Ukraine. We also provide recommendations that Dutch and other European policymakers should be mindful of when engaging both bilaterally and within wider forums, particularly in NATO.

We establish four mechanisms for inadvertent escalation: (1) uncertainty about offensive and defensive intentions; (2) military-organisational features that strengthen offensive outlooks; (3) uncertainty and lack of access to reliable information; and (4) commingling, entanglement, and co-hosting of conventional and nuclear weapons and infrastructure. We then apply these to the case of Russia moving forwards from 2022 and conclude that there is an increased risk of inadvertent escalation for all four. On that basis we offer recommendations how to close these windows of inadvertent escalation before they open.

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10   Van Jackson, *On the Brink: Trump, Kim, and the Threat of Nuclear War* (Cambridge: Cambridge University Press, 2018), 197, https://doi.org/10.1017/9781108562225.

2. Inadvertent escalation:

unintentional spill over from conventional to nuclear war

Inadvertent escalation is escalation to the nuclear level that is unplanned and unintentional and the result of a combatant's intentional actions in the non-nuclear domain.

Inadvertent escalation is escalation to the nuclear level that is unplanned and unintentional and the result of a combatant's intentional actions in the non-nuclear domain. These non-nuclear actions can include both large conventional operations that come in direct contact with the adversary's nuclear forces, and thereby undermine the target's confidence in their ability to use these forces appropriately in the future, as well as the use of kinetic and increasingly also non-kinetic means to disrupt and destroy the adversary's command, control, communication, and information (C3I) systems and infrastructure. The direct contact between actions in the non-nuclear domain with the adversary's nuclear forces can unintentionally cross a vertical or horizontal threshold that sparks the inherent fears of the adversary that they are about to lose their secure second strike capability.

Inadvertent escalation is therefore one pathway to escalation within crisis instability. Crisis instability and deterrence instability are both different aspects of strategic instability. Deterrence instability looks at whether one or both nuclear-armed adversaries believe they are losing their secure second strike in the medium-to-long term through the existing or future capabilities of the adversary. The perception of being at a disadvantage can trigger arms racing through quantitative or qualitative investments. Crisis instability describes the situation during a crisis when a state believes it will lose its second strike ability unless it takes immediate action against the adversary. Within this category of crisis instability, inadvertent escalation is the result of unintended second- and third-order consequences of the use of non-nuclear forces.[11]

During the Russian war in Ukraine, so far, NATO and Russian armed forces have not directly fought each other. This would seem to undermine the need to examine the pathways to inadvertent escalation between them. However, NATO and Russian forces are consistently close to direct contact, are likely to come closer due to the northern enlargement of NATO, while NATO-trained, armed, and supported Ukrainian forces are directly engaging against Russian

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11   Barry Posen, *Inadvertent Escalation: Conventional War and Nuclear Risks*, Cornell paperbacks edition (Ithaca, New York: Cornell University Press, 2014), 1–2. Morgan, Project Air Force (U.S.), and United States, *Dangerous Thresholds*, 23; James M. Acton, 'Escalation through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risks of an Inadvertent Nuclear War', *International Security* 43, no. 1 (August 2018): 56–99, https://doi.org/10.1162/isec_a_00320; Caitlin Talmadge, 'Would China Go Nuclear? Assessing the Risk of Chinese Nuclear Escalation in a Conventional War with the United States', *International Security* 41, no. 4 (2017): 50–92.

dual-use capabilities and infrastructure. These crisis dynamics are taking place while Russian forces, dual-use capabilities and infrastructure, and Russian leadership have been and are consistently under pressure, if not actively deteriorating.

In the sections below we discuss the four general mechanisms of inadvertent escalation, the predictions for Russia after its 2022 invasion of Ukraine, and the evidence for those mechanisms or pathways being present.

3. General mechanisms of inadvertent nuclear escalation

The stresses on Russia's material and personnel, as well as the changes in the distribution of capabilities and points of contacts with NATO and its partners, contribute to an increased likelihood of inadvertent escalation and thereby undermine strategic stability.

In our discussion of the mechanisms of inadvertent escalations as they relate to Russia as a nuclear power during and after the war in Ukraine, we draw on Barry Posen's foundational work on inadvertent escalation,[12] to which we consider subsequent scholarship.[13] Posen identifies three origins of inadvertent escalation, which other scholars have used as well: (1) the security dilemma that makes offensive and defensive actions difficult to distinguish; (2) the nature of military organisations and their organisational dynamics; (3) the uncertainty / absence of reliable information in the midst of a crisis. Based on subsequent scholarship, we include an origin of inadvertent escalation that is close to the first, but still distinct, namely (4) the increased co-mingling of the infrastructure of advanced conventional and nuclear weapons.[14] We argue that the addition of the latter is needed due to the increasing use of emerging technologies that complicate and blur the distinction between the conventional and nuclear domains. That said, all four mechanisms are mutually reinforcing and non-mutually exclusive. Table 2 below summarises the four mechanisms of or pathways to inadvertent escalation.

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12   Posen, *Inadvertent Escalation*.

13   Among others, Keir A. Lieber and Daryl G. Press, 'The New Era of Counterforce: Technological Change and the Future of Nuclear Deterrence', *International Security* 41, no. 4 (April 2017): 9–49, https://doi.org/10.1162/ISEC_a_00273; Caitlin Talmadge, 'Emerging Technology and Intra-War Escalation Risks: Evidence from the Cold War, Implications for Today', *Journal of Strategic Studies* 42, no. 6 (19 September 2019): 864–87, https://doi.org/10.1080/01402390.2019.1631811; Jesse T. Wasson and Christopher E. Bluesteen, 'Taking the Archers for Granted: Emerging Threats to Nuclear Weapon Delivery Systems', *Defence Studies* 18, no. 4 (2 October 2018): 433–53, https://doi.org/10.1080/14702436.2018.1528137; Andrew F. Krepinevich, 'The Eroding Balance of Terror: The Decline of Deterrence', *Foreign Affairs* 98, no. 1 (February 2019): 62–75; Zenel Garcia, 'Strategic Stability in the Twenty-First Century: The Challenge of the Second Nuclear Age and the Logic of Stability Inter-dependence', *Comparative Strategy* 36, no. 4 (8 August 2017): 354–65, https://doi.org/10.1080/01495933.2017.1361207.

14   Acton, 'Escalation through Entanglement'.

Table 2. General pathways to inadvertent nuclear escalation

		Pathway to inadvertent escalation
Security dilemma + offensive/ defensive indistinguishability	(a)	inability to distinguish whether conventional attack is a defensive or offensive move when in contact with or in the proximity of nuclear forces, leading to an incorrect assessment of adversary intentions
Nature of military organisations + the dynamics of civil-military relations	(a)	military organisations search for organisational autonomy vis-à-vis each other and civilians, leading to disconnects during crises
	(b)	military organisations have a preference for offensive operations with a "theory for victory", leading to more aggressive actions during crises;
	(c)	individuals and groups within military organisations are likely to make mistakes during a crisis
Uncertainty / overload of information exacerbated by C3I deterioration	(a)	absence of information during a crisis due to adversary's actions against information network, leading to incorrect assessment of adversary intentions
	(b)	overload of information during a crisis due to multiple sensors, leading to incorrect assessment of adversary intentions
Commingling / entanglement conventional and nuclear	(a)	use of dual-use conventional and nuclear delivery systems leading to incorrect assessment of adversary intentions
	(b)	co-location of dual-use conventional and nuclear systems leading to incorrect assessment of adversary intentions
	(c)	attack on dual-use / entangled C3I networks leading to incorrect assessment of adversary intentions

Mechanism 1:
Security dilemma and the indistinguishability of offensive and defensive actions

> Actions intended to be defensive may appear offensive to the adversary and could then trigger a reciprocal action...

The first mechanism emphasises the uncertainty at the heart of the nature of the security dilemma; the same military means that states acquire to defend themselves can be used for attack and decision-makers thus struggle to interpret the intentions of their adversaries.[15] Actions intended to be defensive may appear offensive to the adversary and could then trigger a reciprocal action, specifically if they fear it faces a situation of asymmetry.[16]

Due to this inherent uncertainty about intentions, nuclear-armed adversaries can therefore misinterpret the use of conventional weapons or simply be overwhelmed by the speed or overflow of information. For example, when discussing the assertive Maritime Strategy the US Navy pursued during the 1980s, Posen argued that the ostensibly defensive objectives where US attack submarines would hunt down Soviet strategic ballistic missile submarines could have led the Soviet Union to conclude that the United States has initiated offensive operations.[17] Or, for example, the inclusion of artificial intelligence in air and missile detection and defence systems would increase the speed of decision-making to the extent that human decision-makers would have difficulties interpreting the signals of adversaries.[18] There are many possible sources of misinterpretations of intentions that can undermine appropriate interpretations of adversary intentions.

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15 Jeffrey W. Legro, 'Military Culture and Inadvertent Escalation in World War II', *International Security* 18, no. 4 (1994): 108, https://doi.org/10.2307/2539179. James Johnson, 'Inadvertent Escalation in the Age of Intelligence Machines: A New Model for Nuclear Risk in the Digital Age', *European Journal of International Security*, 15 October 2021, 1–23, https://doi.org/10.1017/eis.2021.23. Posen, *Inadvertent Escalation*, 113.

16 Johnson, 'Inadvertent Escalation in the Age of Intelligence Machines'.

17 Barry R. Posen, 'Inadvertent Nuclear War?: Escalation and NATO's Northern Flank', *International Security* 7, no. 2 (1982): 32.

18 Johnson, 'Inadvertent Escalation in the Age of Intelligence Machines'.

Mechanism 2:
Nature of military organisations and organisational dynamics

The second mechanism underlines the organisational features of military organisations, inter-service competition, and civil-military dynamics. Military organisations – like all organisations – look for greater autonomy and resources. Military services can be in competition with each other over these resources. Moreover, military organisations are inherently pre-occupied with winning wars and thus have a proclivity for offensive operations. They resist civilian interventions when they believe these will hinder offensive operations.[19] They also tend towards insularity and secrecy, particularly within strategic forces charged with managing and operating nuclear weapons. A key methodological problem however is that looking behind the curtain of internal dynamics within such forces is difficult in peacetime and even more so during an ongoing conflict. Past patterns of behaviour coupled with insights gained as time progresses can alleviate some of this challenge to support analyses.

Due to the organisational interests and dynamics of and within the military, the armed forces may seek to acquire conventional or dual-use capabilities and/or pursue an offensive doctrine with these capabilities that threatens the nuclear capabilities of the adversary. For example, the pursuit of the Maritime Strategy by the US Navy was a consequence of their desire to play a more active role in the primarily air and land centric nature of NATO's planning for a conventional conflict in Europe. Or, as another example, the nuclear triad on which the United States armed forces rely not only derives from a strategic incentive for greater flexibility to ensure a secure second strike. The Intercontinental Ballistic Missiles (ICBM), Sea-Launched Ballistic Missiles (SLBM), and strategic bombers give both the navy and air force a role in the nuclear enterprise. In the Russian, and in the past Soviet, context, such autonomy-seeking is just as common, and often played a role in nuclear crises. In 1962, the head of the Soviet Strategic Missile Forces Marshal Kirill Moskalenko argued against the placement of weapons in Cuba based largely on parochial interests, and was removed from his position by Khrushchev.[20]

> ...military organisations are inherently pre-occupied with winning wars and thus have a proclivity for offensive operations.

Mechanism 3:
Uncertainty caused by C3I deterioration

The third mechanism underlines the general role of complexity and the difficulties for decision-makers to gather reliable information during a crisis as their command, control, communications, and intelligence (C3I) systems are stressed.[21] As the stresses and strains on the system mount, misperceptions by either of the nuclear-armed adversaries become more likely, as will be the loss of information due to attacks on or collateral damage to information systems. The so-called "fog of war" complicates the assessment of the character and direction of the crisis, further impedes the ability to distinguish the adversary's offensive from

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19   Posen, *Inadvertent Escalation*, 16. Legro, 'Military Culture and Inadvertent Escalation in World War II'.

20   Steven Zaloga, 'The Missiles of October: Soviet Ballistic Missile Forces during the Cuban Crisis', *The Journal of Soviet Military Studies* 3, no. 2 (1990): 307–23.

21   Posen, *Inadvertent Escalation*, 19. Legro, 'Military Culture and Inadvertent Escalation in World War II'.

defensive intentions, and could give the false impression that the nuclear arsenal and/or the supporting infrastructure is under attack.[22]

Due to the general absence of reliable or complete information, decision-makers may wrongly conclude that their second strike capability is deteriorating and consequently inadvertently commit to nuclear escalation. For example, during the Cuban Missile Crisis, the US enforced the blockade of Cuba by anti-submarine warfare. Attacks on Soviet forces were misunderstood by the commanding officers of the Soviet submarine B-59 as part of a US first strike and almost led to the launch of the submarine's nuclear weapons. Information complexity is a general characteristic of armed conflict, but one that has been amplified by emerging technologies – specifically the ubiquity of networked sensors that boost the volume, speed, and character of information.[23] Ironically, for current-day decision-makers, the collection, management, and interpretation of information may be more difficult than for their Cold War predecessors.[24] This is particularly likely during the current war against Ukraine, where Russian, Ukrainian, and NATO forces and alert systems are heightened, creating a situation where the primary indicators each side might look for to assess whether a strike is imminent are continuously active. The signal is becoming more and more difficult to separate from the noise.[25]

Mechanism 4:
Commingling of conventional and nuclear weapons and infrastructure, specifically with emerging technologies

The fourth mechanism emphasises the entanglement and commingling of conventional and nuclear weapons and infrastructure. Entanglement takes place through (1) the fielding of dual-capable delivery systems that can carry both conventional and nuclear payloads; (2) the co-location of conventional and nuclear forces, as well as their support infrastructure; (3) the overlapping command, control, communication, and intelligence (C3I) infrastructures, which includes early warning, space surveillance, and air defence radars.[26]

Due to this entanglement and commingling of conventional and nuclear weapons and infrastructure, the risk increases that a state attacks an asset that is crucial for the adversary's ability to conduct conventional conflict, which the adversary may then interpret as a part of a counterforce attack. For example, the Chinese nuclear forces rely on dual-capable ballistic missiles to target US aircraft carriers, airfields, and ports to impede US air- and naval power

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22　Posen, *Inadvertent Escalation*, 10. Johnson, 'Inadvertent Escalation in the Age of Intelligence Machines'.

23　Rebecca K.C. Hersman and Reja Younis, 'Surveillance, Situational Awareness, and Warning at the Convention-al-Strategic Interface', Nuclear Nexus (CSIS, 15 January 2021).

24　Johnson, 'Inadvertent Escalation in the Age of Intelligence Machines'.

25　Jackson, *On the Brink*, 197.

26　A Peczeli and B Bahney, 'The Role of Nuclear-Conventional Intermingling on State Decision-Making and the Risk of Inadvertent Escalation', 4 October 2021, https://doi.org/10.2172/1836194. Rebecca K.C. Hersman and Reja Younis, 'Surveillance, Situational Awareness, and Warning at the Conventional-Strategic Interface'. Talmadge, 'Would China Go Nuclear?' Michael T. Klare, 'A Strategy for Reducing the Escalatory Dangers of Emerging Technologies', *Arms Control Today* 50, no. 10 (December 2020): 23. Acton, 'Escalation through Entanglement'.

Emerging technologies exacerbate the entanglement and comingling problems.

projection, and on an integrated air defence network to intercept attacks. Yet, following its Joint Concept for Manoeuvre in the Global Commons concept, the United States would likely immediately target launch sites for missiles and radars to prevent China's so-called anti-access area denial strategy from succeeding.[27] This could then very well lead the Chinese to believe that their nuclear forces are under attack.

Emerging technologies exacerbate the entanglement and comingling problems.[28] For example, evolved cyberweapons could be used to temporarily disable C3I capabilities in the opening stages of conflict, but also unintentionally undermine the C3I used for nuclear decision-making.[29] Cyberespionage could appear to be an attack; the ubiquitous nature of networked information has made such attacks nearly inevitable as it has the response.[30] Improvements in speed and precision allow conventional weapons – specifically hypersonic weapons – to fulfil counterforce tasks, and their use could be misperceived by the adversary.[31] The growing complexity of informational infrastructure – sensors and computers, as well as artificial intelligence – facilitating the gathering of information for decision-making on both offensive attacks as well as air- and missile defence has made warning time and assessments of intention more difficult due to the sheer volume of data.[32]

27 Talmadge, 'Would China Go Nuclear?'

28 Based on Cold War cases, Caitlin Talmadge argues that emerging technologies are likelier to act as intervening variables that may or may not accelerate escalation. Talmadge, 'Emerging Technology and Intra-War Escalation Risks', 865.

29 James M. Acton, 'Cyber Warfare & Inadvertent Escalation', *Daedalus* 149, no. 2 (April 2020): 133–49, https://doi.org/10.1162/daed_a_01794. 133

30 Acton, 'Escalation through Entanglement', 62,63.

31 Michael T. Klare, 'A Strategy for Reducing the Escalatory Dangers of Emerging Technologies', 23. Rebecca K.C. Hersman and Reja Younis, 'Surveillance, Situational Awareness, and Warning at the Conventional-Strategic Interface'.

32 Rebecca K.C. Hersman and Reja Younis, 'Surveillance, Situational Awareness, and Warning at the Conventional-Strategic Interface'.

Applying mechanisms of inadvertent nuclear escalation to the Russia post-2022 case

We take the four mechanisms identified above and then apply them to Russia in the wake of its second invasion of Ukraine in February 2022. Table 3 below summarises our central expectations for the Russian case. We then explore evidence for each of these pathways in the following section.

Table 3.

Mechanism	Pathway to inadvertent escalation in Russian case	
Security dilemma + offensive/defensive indistinguishability	(a) (b) (c)	decline in Russian dual-use missile stocks and air defence interceptors increase in European advanced conventional weapon capabilities enlargement of NATO bringing NATO forces closer to nuclear bastion on Kola Peninsula
	➔	create "use-it-or-lose-it" dynamics where NATO intentions are misinterpreted.
Nature of military organisations + dynamics civil-military relations	(a) (b) (c) (d) (e)	Russian armed forces overburdened by civilian demands Frustrated Russian armed forces searching for greater autonomy from Kremlin Armed forces agitation for offensive measures Highly insular nuclear forces entangled with Russian Orthodox Church influence Overtaxed individuals and groups potentially prone to errors
	➔	create incentives for aggressive actions versus NATO and Ukraine or for accidents to occur.
Uncertainty + absence / overload of information	(a) (b) (c)	overuse of Russian C3I systems poor maintenance of Russian C3I systems damage to Russian C3I systems
	➔	create gaps in information where NATO intentions are misinterpreted.
Commingling / entanglement conventional and nuclear	(a) (b)	use and collocation of dual-use missiles in attacks on Ukraine increases the risk of cyber-espionage and attacks, or kinetic attacks on key parts of infrastructure use of space assets for ground war in Ukraine increases the risk of cyber-espionage and attacks (or other) on key partss of infrastructure
	➔	create additional pressures to misinterpret intentions by NATO.

4. Evidence for pathways to inadvertent nuclear escalation with Russia

For each of the four mechanisms of (1) security dilemma, (2) the nature of military organisations, (3) information access, and (4) commingling and entanglement we examine the empirical evidence so far from Russia's invasion of Ukraine. We recognise that this an inherently incomplete exercise, based on open-source information. Yet, given the drastic changes in the European security environment due to the war in Ukraine that directly affect decades of established norms and expectations built up around nuclear weapons, nuclear doctrine, and employment together with conventional weapons, we believe this is an essential exercise to perform nonetheless.

> Russian civilian and/or military decision-makers may come to the conclusion that NATO is attacking their weakened nuclear infrastructure...

Mechanism 1.
Security dilemma: Russian declining capabilities worsen difficulty in distinguishing offensive from defensive intentions

From the Russian perspective, due to (a) the decline of their own military capabilities due to their expended missile stocks during their invasion of Ukraine, including dual-use missiles, as well as air defence interceptors; (b) the increases in European NATO spending and specifically investments in advanced conventional weapons such as (cruise) missiles; and (c) the ongoing enlargement of NATO with the addition of Finland and pending accession of Sweden bringing the concentration of NATO forces potentially closer to the Kola Peninsula where they can threaten Russia's nuclear forces and C3I infrastructure, the balance of power has shifted to the disadvantage of Russia. During a crisis, Russian civilian and/or military decision-makers may come to the conclusion that NATO is attacking their weakened nuclear infrastructure and taking advantage of their declining numerical advantage, and consequently escalate to the nuclear level more quickly than before ("use-it-or-lose-it").

Expended missile stocks

During its conventional invasion of Ukraine, Russia has used both its oldest as well as its more modern missiles. This includes the dual-capable sea-launched 3M-14 Kalibr cruise missiles and air-launched Kh-101. Moreover, it has launched S-300 air defence systems, in principle dual-capable, to target ground targets.[33] In addition, Russia started using Kh-22 (AS-4)

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33   Ian Williams, 'Russia Doubles Down on Its Failed Air Campaign', Center for Strategic & International Studies, 13 October 2022, https://www.csis.org/analysis/russia-doubles-down-its-failed-air-campaign.

missiles.[34] It has also fired nuclear-capable Kh-55 cruise missiles, the Iskander-M SRBMs, and OTR-21 Tochka SRBMs.[35] It should be also noted that Russia admitted using the obsolete Tochka-U missiles.[36] Out of the missiles discussed, the Iskander and S-300 ground-launched missiles, Kalibr sea-launched missiles, and Kh-101, Kh-22, and Kh-47M2 Kinzhal air-launched missiles are dual-capable.

Russia had been modernising its nuclear arsenal. It currently has a stockpile of approximately 4,477 nuclear warheads, of which approximately 1,588 strategic warheads are deployed: about 812 on land-based ballistic missiles, with a roughly equal split between mobile launchers and siloed launchers, about 576 on submarine-launched ballistic missiles, and possibly 200 at heavy bomber bases.[37] Russia stated that 83% of their ICBMs went through the modernisation process of replacing all missiles from the Soviet era.[38]

The implication of this expenditure of Russian missile stocks is that Russia faces more difficult choices during a conventional conflict regarding whether to prioritise arming its dual-capable missiles with conventional or nuclear warheads, where it is likely to have less flexibility in terms of response to the nuclear level. The likelihood of inadvertent escalation goes up as Russian decision-makers face more use-it-or-lose it choices as they risk having fewer potential responses.

European balance of power shifting against Russia

The European balance of power is shifting. Beyond the expenditure of its missile stocks, according to the latest estimates at the time of finalising the brief, Russia has suffered military fatalities of approximately 60,000 to 70,000 personnel, lost around 1,500 to 2,000 major battle tanks, 799 armoured carriers, 78 fixed-wing aircraft, and 80 rotary wing.[39] At the same

34 Mark B. Schneider, 'Lessons from Russian Missile Performance in Ukraine', U.S. Naval Institute, 5 October 2022, https://www.usni.org/magazines/proceedings/2022/october/lessons-russian-missile-performance-ukraine.

35 Brian Niemietz, 'Russia Firing Nuclear-Capable Missiles with Dummy Heads: Ukraine Officials', Yahoo!News, 2 December 2022, https://news.yahoo.com/russia-firing-nuclear-capable-missiles-233700890.html; Josh Smith, 'Russia's Use of Missiles in Ukraine Is Real-World Case Study for Countries with Similar Weapons', National Post, 28 February 2022, https://nationalpost.com/news/world/russias-use-of-missiles-in-ukraine-is-real-world-case-study-for-countries-with-similar-weapons.

36 Isabel van Brugen, 'Russian Official Accidentally Reveals Missiles Being Used in Ukraine', Newsweek, 13 July 2022, https://www.newsweek.com/russian-official-accidentally-reveals-missiles-used-ukraine-tochka-u-1724266.

37 Approximately another 977 strategic warheads are in storage, along with about 1,912 nonstrategic warheads. In addition to the military stockpile for operational forces, a large number – approximately 1,500 – of retired but still largely intact warheads await dismantlement, for a total inventory of approximately 5,977 warheads." Kristensen and Korda, p.98.

38 Kristensen and Korda, pp.102-103. "The remaining Soviet-era ICBMs include the SS-18 and the SS-25 [...] 36 missile regiments are now equipped with modern strategic missile systems – 20 of which are mobile regiments and 16 of which are siloed regiments [...] The SS-18 is scheduled to formally begin retiring in 2022, when the SS-X-29 (Sarmat or RS-28) ICBM will begin to replace it at the Uzhur missile field."

39 'How Many Russians Have Been Killed in Ukraine?', The Economist, 8 March 2023, https://www.economist.com/graphic-detail/2023/03/08/how-many-russians-have-been-killed-in-ukraine. Luxmoore, 'Russia's Death Toll From Ukraine War Is as High as 60,000, U.K. Says'; Peter Weber, 'Russia Has Lost More than 1,500 Battle Tanks in Ukraine War, Dutch War Monitor Confirms', The Week, 10 February 2023, https://theweek.com/russo-ukrainian-war/1020877/russia-has-lost-more-than-1500-battle-tanks-in-ukraine-war-dutch-war; Brad Lendon, 'At Least 1,000 Russian Tanks Destroyed in Ukraine, Monitoring Group Says', CNN, 9 February 2023, https://www.cnn.com/2023/02/09/europe/1000-russian-tanks-destroyed-ukraine-war-intl-hnk-ml/index.html; Oryx, 'Attack On Europe: Documenting Russian Equipment Losses During The 2022 Russian Invasion Of Ukraine', Oryx (blog), accessed 7 March 2023, https://www.oryxspioenkop.com/2022/02/attack-on-europe-documenting-equipment.html.

time, European states are investing in advanced 4-5th generation aircraft, cruise and other missiles, long-range artillery, missile defence, and other capabilities.[40]

For example, in 2022 alone Finland, Germany, Poland, and Canada invested into the F-35 programme while several other European states including the Netherlands, Belgium, Denmark, and Italy will continue to build their existing F-35 fleets.[41] In Scandinavia, both Sweden[42] and Norway[43] have invested into next-generation anti-ship missiles that will be both fielded by their own forces and available for export. Responding to the war in Ukraine, a group of 14 NATO allies plus Finland and Sweden signed a letter of intent to procure a new air-defence system with the overall programme dubbed the European Sky Shield Initiative.[44] Poland and the three Baltic states have stated they will acquire the HIMARS long-range artillery system,[45] while an EU European Defence Fund project aims to provide a similar, European-built system.[46] Taken together, and this list is not exhaustive, European states are taking serious steps to increase the capability of their armed forces.

There are two implications of this gradual shift in the military balance in Europe, even without the role of the United States: (1) European states gain relatively more options in a conventional confrontation; and (2) European states gain capabilities that have some counterforce potential. Both are pathways where Russian decision-makers may believe that their second strike capabilities are threatened, and therefore escalate more quickly than before.[47]

...European states are taking serious steps to increase the capability of their armed forces.

Enlargement of NATO in the North

With the enlargement of NATO to include Finland, and likely Sweden, NATO's presence around the Russian Kola peninsula has increased. The pressure on Kola has further increased due to Russia's removal of the vast majority, i.e. over 80%, of its armed forces for the war effort in Ukraine.[48] The Kola peninsula is highly important for Russia's secure second strike, as well as its non-strategic weapons. The Russian Navy operates 10 nuclear-powered nuclear-armed ballistic missile submarines (SSBNs) of two classes: five Delta IV (Project 667BRDM) and five Borei (Project 955). Not all of these submarines are fully operational. The Deltas are all part of the Northern Fleet and based at Yagelnaya Bay (Gadzhiyevo) on the Kola Peninsula. Three Borei are assigned to the Pacific fleet, located on the Kamchatka Peninsula, with the plan to

40 In addition to a large buildup of European land capabilities which are not discussed here as they bear less directly on our argument pertaining to inadvertent escalation pressures.

41 'F-35 Global Enterprise', Lockheed Martin, accessed 30 December 2022, https://www.f35.com/f35/global-enterprise.html.

42 'Robot 17', Försvarsmakten, accessed 30 December 2022, https://www.forsvarsmakten.se/sv/information-och-fakta/materiel-och-teknik/vapen/robot-17/.

43 'NSM – Naval Strike Missile – Missile Systems', Kongsberg, accessed 30 December 2022, https://www.kongsberg.com/kda/what-we-do/defence-and-security/missile-systems/nsm-naval-strike-missile-nsm/.

44 '14 NATO Allies and Finland Agree to Boost European Air Defence Capabilities', North Atlantic Treaty Organization, 13 October 2022, https://www.nato.int/cps/en/natohq/news_208103.htm.

45 Jake Thomas, 'Poland, Baltic States Now Looking at HIMARS for Protection Against Russia', Newsweek, 26 July 2022, https://www.newsweek.com/poland-baltic-states-now-looking-himars-protection-against-russia-1728199.

46 Christina Mackenzie, 'EU Investing Millions in New Missile Range Extension Program MARSEUS', *Breaking Defense* (blog), 26 July 2022, https://breakingdefense.sites.breakingmedia.com/2022/07/eu-investing-millions-in-new-missile-range-extension-program-marseus/.

47 Dmitry Stefanovich, 'Proliferation and Threats of Reconnaissance-Strike Systems: A Russian Perspective', *The Nonproliferation Review* 27, no. 1–3 (2020): 107.

48 Thomas Nilsen, 'Land Forces at Kola Reduced to One-Fifth, Norwegian Intelligence Says', *The Independent Barents Observer*, 13 February 2023, https://thebarentsobserver.com/en/security/2023/02/four-fifths-kola-land-forces-wiped-out.

eventually have an equal split in SSBNs between the Northern and the Pacific Fleets.[49] On the Kola Peninsula, Yagel'naya base hosts the 31st Submarine Division of the Northern Fleet, with the Delta IV-class submarine carrying 16 R-290RM/SS-N-23 with four warheads. Nerpich'ya is a base of lesser importance because the submarines at base scheduled for elimination or conversion for test launches, with the launchers operationally non-deployed.[50]

The implications are three-fold: (1) NATO's conventional anti-submarine warfare (ASW) capabilities can threaten Russia's SSBN as they operate near their bastions to a greater extent than before; (2) acquisition or expansion of short- and medium-range precision-strike by Sweden, Finland, and Norway, mentioned in the previous section, can threaten the Kola bases; and (3) the potential placement of short- and medium-range precision-strike by NATO members can threaten the Kola bases. Whether this happens or not, and whether the individual states or NATO's actions are defensive, from the Russian perspective the potential for offensive actions has increased and this may shorten their response timelines.

In short, all three developments could create pathways towards Russian decision-makers concluding that their nuclear arsenal or their delivery systems are at risk, and thus lead them to escalate.

Mechanism 2.
Nature of the Russian political-military organisation

After the stresses and strains of prolonged war against Ukraine, the Russian armed forces are (a) under significant civilian burden to perform; (b) offensive, secretive, and insular, leading to more dangerous and reckless actions with dual-use and nuclear forces; and (c) under intense strain from a high operational tempo.

Due consideration of the individual and organisational level dynamics for those charged with the handling and use of nuclear weapons is vital to understand how inadvertent escalation could occur. At the core of the escalation challenge are the individuals involved in decision-making, early warning systems, and those who would actually target and fire a nuclear weapon. There is ample historical evidence from both during and after the Cold War of 'near-misses' caused by insular organisations and human error. This section unravels the rationalistic assumptions that nuclear command and control is a line of simple, direct orders passed along from political leaders to military forces.

There are three levels in which to explore this mechanism from an organisational perspective. First, the civil-military aspects of the Russian armed forces, especially those surrounding nuclear command and control. A second lens is the organisational culture of the military itself, particularly within the General Staff and the Strategic Rocket Forces. Finally, the individual/psychological level of the officers and operators of nuclear weapons who exist in a high-pressure and stressful environment.

> At the core of the escalation challenge are the individuals involved in decision-making, early warning systems, and those who would actually target and fire a nuclear weapon.

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49 Kristensen and Korda, pp.107-108.

50 Tamara Patton, Pavel Podvig, and Phillip Schell, 'A New START Model for Transparency in Nuclear Disarmament: Individual Country Reports' (New York & Geneva: United Nations Institute for Disarmament Research, 2013), 32–33, https://unidir.org/sites/default/files/publication/pdfs//a-new-start-model-for-transparency-in-nuclear-disarmament-individual-country-reports-en-415.pdf.

Civil-military relations

The relationship between the political and military authorities in Russia is sometimes difficult to understand from a North American or European perspective. Additionally, the very nature of the Russian regime and the heightened state of security makes any concrete information difficult to find, making analysis of internal dynamics problematic. Nevertheless, past patterns and some research by Russian experts allows for a look behind the Kremlin doors.

The lines between military and civilian roles in Russia are often quite blurred. For example, the Russian minister of defence, despite never serving in the armed forces, holds the rank of General.[51] Both Sergei Shoigu and Putin have made deliberate efforts to blur these lines in attempts to bridge the apparent civil-military divides emerging from the wars in Chechnya and the 2008 Georgian War. This included replacements of civilian staff with active duty officers in the Ministry of Defence, increasing the military roles of the FSB, and strengthening the GRU (military intelligence) within the General Staff structure. In doing so, the military became increasingly independent, while the civilian government became statist and far more security oriented.[52]

In the nuclear realm, and unlike the United States, the president does not have the sole authority to authorise a nuclear strike. It requires the sign-off of two out of three officials: the president, the minister of defence, and/or the chief of the general staff. The president is required but the second can be either official. This places the military in a particularly powerful position, as the Strategic Rocket Forces are under the general staff organisation rather than the ministry. Despite this, the ministry of defence maintains the physical control of nuclear warheads in storage sites under its 12th Directorate.[53] This divided control over nuclear weapons across civilian and military authorities places the state of Russian civil-military relations at the core of escalation considerations.

This independence of the armed forces gained in recent years has been under strain during the invasion of Ukraine. From the planning stages to operational details, the privileged place of the military has been under pressure. The special services, particularly the FSB, played a significant (though thus far unsuccessful) role in planning the initial stages of the war. The GRU shared in the FSB's planning failures as well, particularly in regards to failing to understand the disposition of Ukrainian forces.[54] Putin has also frequently fired generals who have been unsuccessful in their efforts, making consistency and unity of command a challenging aspect of the war.[55]

For the nuclear forces, the civil-military relationship is the core of their mission. Nuclear command and control operates within this relational axis and is frequently exercised. It is

> For the nuclear forces, the civil-military relationship is the core of their mission.

51   Margarete Klein and Kristian Pester, 'Russia's Armed Forces on Modernisation Course. Progress and Perspectives of Military Reform', SWP Comments (Stiftung für Wissenschaft und Politik, 2014), 2.

52   Kirill Shamiev, 'Civil–Military Relations and Russia's Post-Soviet Military Culture: A Belief System Analysis', *Armed Forces & Society* 0, no. 0 (30 December 2021): 17, https://doi.org/10.1177/0095327X211062932; Kirill Petrov and Vladimir Gel'man, 'Do Elites Matter in Russian Foreign Policy? The Gap between Self-Perception and Influence', *Post-Soviet Affairs* 35, no. 5–6 (2019): 450–60; Ihor Kovalevskyi, 'Civil-Military Relations in Putin's Russia', in *Routledge Handbook of Civil-Military Relations*, 2nd ed. (Oxon: Routledge, 2022), 13–25.

53   Kristin ven Bruusgaard, 'How Russia Decides to Go Nuclear: Deciphering the Way Moscow Handles Its Ultimate Weapon', Foreign Affairs, 6 February 2023, https://www.foreignaffairs.com/ukraine/how-russia-decides-go-nuclear.

54   Mykhaylo Zabrodskyi et al., 'Preliminary Lessons in Conventional Warfighting from Russia's Invasion of Ukraine: February–July 2022' (London, UK: Royal United Services Institute, 30 November 2022), 7–12.

55   Andrews S. Bowen, 'Russia's War in Ukraine: Military and Intelligence Aspects' (Washington, D.C.: Congressional Research Service, 14 September 2022), https://crsreports.congress.gov/product/pdf/R/R47068.

highly likely that the Strategic Rocket Forces and the General Staff elements tasked with nuclear matters are under pressure by the authorities in the Presidential Administration. The increased readiness alert to a 'special regime of combat duty',[56] which has seen no evidence of being lifted, the testing and deployment of the newly developed Sarmat (NATO reporting name Satan-II) ICBM[57], and the conduct of a large-scale *Grom* nuclear exercise in October 2022 have likely created major demands on the capacity of the nuclear forces.[58]

This higher alert status and integration of a new weapons system has likely increased the daily pressure on the responsible staffs and operators. Additionally, civilian pressure during exercises to stick to an acceptable 'script' makes operators more susceptible to surprise and inadvertent action in the face of surprises. Most conventional exercises, such as the *Zapad* series, are highly scripted, especially when a high-level political spectator is scheduled to attend.[59] Given that *Zapad* already includes nuclear escalation dynamics, there is little reason that the explicitly nuclear *Grom* exercise does not face similarly high political pressure.

Separately, there is the potential that the normally independent Russian armed forces could be agitating internally for nuclear escalation. Military organisations often express a bias towards taking the offensive, including in nuclear affairs.[60] US intelligence reported in November 2022 that "senior Russian military leaders" had discussed the potential use of tactical nuclear weapons in the face of battlefield setbacks in Ukraine. Given that this was out of line with a recent speech by Putin which stressed that nuclear use in Ukraine was not imminent, there is potential that this is a point of civil-military tension.[61] That there is little discrepancy between NATO's deterrent messaging and posture does not necessarily mean that this is a similar dynamic in Russia, however. The possibility of tension on this matter remains quite possible, but the current evidence is not yet sufficient and is an area for further study.

Finally, there is the non-zero risk of a *coup d'etat* by the armed forces against Putin which carries with it an attendant risk of inadvertent escalation. During the August 1991 coup in Moscow, Soviet leader Mikhail Gorbachev was not in control of the nuclear command and control "suitcase" for over three days at a time when the military was on high alert.[62] Lack of clear lines of authority during and after the chaos a coup presents can allow for both misunderstandings and for orders to be erroneously given by those who lack authority. Ascertaining the precise level of risk in the current moment is a challenge, one not aided by frequent tabloid headlines.[63] It should not be underestimated the extent to which Putin has successfully

56 'Putin Puts Russia's Nuclear Deterrent Forces On High Alert, Raising Tensions Further'.

57 'Putin Tests Satan II Missile Capable of Carrying Multiple Nuclear Warheads', The Telegraph, 18 November 2022, https://www.telegraph.co.uk/world-news/2022/11/18/ukraine-news-russia-latest-missile-strikes-power-blackouts-dnipro/?ac=culture_personalised&utmsource=email#liveblog.

58 Shannon Bugos, 'NATO, Russia Conduct Simultaneous Nuclear Exercises', Arms Control Association, November 2022, https://www.armscontrol.org/act/2022-11/news/nato-russia-conduct-simultaneous-nuclear-exercises.

59 Michael Kofman, 'ZAPAD-2021: What to Expect from Russia's Strategic Military Exercise', War on the Rocks, 8 September 2021, https://warontherocks.com/2021/09/zapad-2021-what-to-expect-from-russias-strategic-military-exercise/.

60 Jack Snyder, 'Civil-Military Relations and the Cult of the Offensive, 1914 and 1984', *International Security* 9, no. 1 (1984): 108–46.

61 Helene Cooper, Julian E. Barnes, and Eric Schmitt, 'Russian Military Leaders Discussed Use of Nuclear Weapons, U.S. Officials Say', *New York Times*, 2 November 2022, https://www.nytimes.com/2022/11/02/us/politics/russia-ukraine-nuclear-weapons.html.

62 John B. Dunlop, 'The August 1991 Coup and Its Impact on Soviet Politics', *Journal of Cold War Studies* 5, no. 1 (Winter 2003): 94–127.

63 Will Stewart and Kit Roberts, 'Putin Faces "creeping Coup" as "Orders Not Properly Done to Sabotage Dictator"', mirror, 12 November 2022, https://www.mirror.co.uk/news/world-news/putin-threatened-creeping-coup-orders-28474455.

engaged in coup-proofing efforts particularly by playing state institutions such as the military and intelligence services off one another.[64]

This leads to the possibility that Putin could escalate the conflict to out-manoeuvre more hawkish opponents and use the escalation as a domestic pressure valve. That such opponents, such as Wagner Group CEO Yevgeny Prigozhin, could pose a risk to Putin's power has been raised in recent commentaries.[65] The existence of the National Guard, to which the regular Armed Forces can be subordinated by presidential orders[66], could facilitate a coup-proofing effort which limits military advice that advocates restraint. Conversely, it could be used to bring a recalcitrant Wagner Group in line, though not without risk of further deepening divisions between the armed forces and the infamous private military company.[67] Despite this, the risk cannot be summarily discounted when considering inadvertent escalation in relation to a regime which could lose civilian control of the military. There is within all of this the consideration that past research has shown that the Russian public is unsupportive of nuclear use, though supportive of maintaining a nuclear deterrent.[68] Though crackdowns on dissent have been effective since the beginning of the war, a full write-off of public opinion is politically unwise and analytically questionable. Elites seeking to court public opinion may have an impact on civil-military deliberations on nuclear use.

In general, the nature of Russian civil-military relations makes inadvertent escalation more rather than less likely. Political pressure on nuclear forces, tensions over the conduct of the war between civilians and military officers, a heightened alert status, and an atmosphere of tension with NATO during the war against Ukraine is all contributing to a mechanism that leads to a higher risk of misperception.

Organisational culture

Military organisations, especially those charged with operating nuclear weapons, are insular, highly-prized, and secretive. That these groups are so separated from other forces and specialised in such hazardous technologies has led to some referring to such groups as a 'nuclear priesthood'.[69] An example of this insular community and its influence on policy is the General Staff Military Academy's Centre for Military-Strategic Research (TsVSI), founded in 1985. The TsVSI was composed of some of the Soviet Union's most prominent military academics, and since that time has included amongst its tasks "elaborating nuclear strategy and the development of [the country's] nuclear forces."[70] Its influence on Russian strategy and thought includes involvement in developing the country's national security strategies,

64   Adam E. Casey, 'Putin Has Coup-Proofed His Regime', *Foreign Policy* (blog), 23 March 2022, https://foreignpolicy.com/2022/03/23/putin-coup-russian-regime/; Mitchell Prothero, 'Key Putin Allies "Openly Attacking" Russia's Military Operations in Ukraine', *Vice* (blog), 25 October 2022, https://www.vice.com/en/article/bvmpa4/vladimir-putin-wagner-ukraine.

65   Mikhail Zygar, 'The Man Who May Challenge Putin for Power', *New York Times*, 26 January 2023, sec. Opinion.

66   Aleksandr Golts, 'The Russian Army to Be Subordinated to the National Guard in a Crisis', *Jamestown Foundation Eurasia Daily Monitor* 14, no. 76 (8 June 2017).

67   Jamie Dettmer, 'Russia's Military Chiefs Go to War … with Each Other', Politico, 22 February 2023, https://www.politico.eu/article/yevgeny-prigozhins-ramzan-kadryov-feud-with-russia-top-brass-boils-over/.

68   Michal Smetana and Michal Onderco, 'From Moscow With a Mushroom Cloud? Russian Public Attitudes to the Use of Nuclear Weapons in a Conflict With NATO', *Journal of Conflict Resolution* 67, no. 2–3 (2023): 183–209; Jack Watling, 'Russia Through the Kremlin's Eyes', Royal United Services Institute, 27 January 2023, https://www.rusi.org.

69   Lewis A. Dunn, 'Beyond the Cold War Nuclear Legacy: Offense-Defense and the Role of Nuclear Deterrence', *IFRI Proliferation Papers*, Winter 2001, 10–11.

70   Steven J. Main, 'The "Brain" of the Russian Army: The Centre for Military strategic Research, General Staff (TsVSI GSh), 1985–2000', *The Journal of Slavic Military Studies* 13, no. 3 (September 2000): 47–62.

military doctrines, and its concepts on nuclear and non-nuclear deterrence.[71] The closed-off nature of debates related to nuclear strategy makes fully assessing any singular organisation difficult, though it is precisely this secrecy and insularity that is the point.

In Russia, given the political saliency of nuclear weapons, the Strategic Rocket Forces have a place of high importance in the armed forces. Their prioritisation in defence budget battles is often taken as a given in the Russian military culture. This saliency has only increased following Putin's 2018 speech in which he unveiled a litany of new nuclear programmes and subsequent nuclear coercion during the war against Ukraine. This has caused the General Staff to make nuclear weapons more "useful" in policy,[72] and could explain the increased emphasis on so-called "tactical" weapons in recent years. Indeed, internal strategy debates on nuclear deterrence and use are almost completely dominated by the military, as there are no civilian structures inside Russia that can raise substantive challenges to state policy on military affairs.[73]

> The organisational culture in which the Russian nuclear forces exist then is small, secretive, highly politically salient, and decidedly religious.

Continuing the priesthood metaphor, there has been a parallel development within the Russian Strategic Rocket Forces that bears attention. The role and influence of the Russian Orthodox Church and its clergy has grown to a level in which priests are akin to Soviet-era political officers within the structure. Each leg of the nuclear triad even has its own patron saint. The extent of this involvement of the Church, which is also closely aligned to the government, has led to the argument that in a moment of crisis there could exist at the unit level "two parallel lines of command authority."[74] In relation to escalation dynamics it is also argued that, "…the Russian nuclear clergy is less likely to constrain conflict. It might even ensure a relatively easier path to escalation by legitimizing a belligerent political course…"[75] This has been seen in war against Ukraine, in which Patriarch Kirill has stated that current "dangers…challenge the very existence of our country."[76] That the Russian Orthodox Church has become so interwoven into the nuclear command structure and is engaging in such existential rhetoric merits attention from an organisational culture perspective.

The organisational culture in which the Russian nuclear forces exist then is small, secretive, highly politically salient, and decidedly religious. Though these elements alone do not bode well for avoiding inadvertent escalation, it is an optimistic sign that there is no evidence of the Strategic Rocket Forces themselves having an institutional history of belligerence within the military structures, though as described above this could well be changing. Yet, inadvertent escalation does not necessarily require institutional agitation for pre-emption. Overall, the implication is that Russian organisational arrangements do not lessen the risk of misperception and inadvertent escalation while the culture in which it operates can be argued to increase their risk.

71   Anya Fink and Michael Kofman, 'Russian Strategy for Escalation Management: Key Debates and Players in Military Thought' (Center for Naval Analyses, April 2020).

72   Pavel K. Baev, 'The Interplay of Bureaucratic, Warfighting, and Arms-Parading Traits in Russian Military-Strategic Culture', The George C. Marshall European Center for Security Studies, April 2019, http://www.marshall-center.org/en/publications/security-insights/interplay-bureaucratic-warfighting-and-arms-parading-traits-russian-military-strategic-culture.

73   ven Bruusgaard, 'How Russia Decides to Go Nuclear: Deciphering the Way Moscow Handles Its Ultimate Weapon'.

74   Adamsky, *Russian Nuclear Orthodoxy: Religion, Politics, and Strategy*, 11.

75   Ibid.

76   'Патриарх Кирилл заявил, что нынешние вызовы грозят самому существованию России', Interfax, 6 November 2022, https://www.interfax.ru/russia/871222.

Individual and group psychology

At the core of the nuclear enterprise are small groups of military professionals who are as equally susceptible to stress, poor judgement, and mistakes as the rest of the population. Despite in-depth screenings and rigorous training, accidents can always occur. Soviet premier Yuri Andropov confided to the West German politician Hans-Jochen Vogel that "the button that activates the nuclear weapon could be a drunken American sergeant or a drug addict."[77] This is an important point when considering inadvertent escalation, wherein the possibilities of misperception and poor judgement permeate down to the individual level. Given the immense pressure that staffs and operators are under in Russia at this moment, the capacities of individuals to be aware of understand behaviour correctly is vital.

Nuclear weapons facilities are often geographically isolated and create immense pressures on the individuals stationed there. Operators in ICBM launch centres, aboard nuclear submarines, and those in the air in bombers or command and control aircraft spend long periods in near isolation, rigorously drilling and testing the most hazardous weapons on Earth. In a 1985 study conducted on behalf of the U.S. National Institute of Health it was found that, "Nuclear weapons duty is known to be conducive to serious behavioural problems," and "During emergencies, sleep deprivation and heavy responsibilities may cause inaccuracy in judgment, hostility, or paranoia."[78] A former U.S. naval officer described his duties as "sustained, debilitating vigilance."[79]

Such an environment that equally mixes stress and boredom breeds misperception. There are any number of close-calls when it comes to nuclear weapons, many of which have been caused by human error. Disaster would then only be averted via human intervention or luck. Whether it is missiles with nuclear warheads being accidentally loaded onto bomber wings or falsely interpreting a conventional missile as a nuclear one[80], such incidents have a real possibility of triggering a spiral of misperception and fear that causes inadvertent escalation. Individuals have also thwarted inadvertent escalation as well. Stanislav Petrov, a former lieutenant-colonel of the Soviet Air Defence Forces, disobeyed protocol in a 1983 incident by not reporting a warning of incoming missiles to his superiors. There were no missiles and Petrov correctly judged it a false alarm.[81]

The organisational culture of general isolation also isolates those in the nuclear forces from the rest of the military and the consequences of ongoing fighting. Staff at the Main Computational Centre of the General Staff (GVC), which has the task of targeting nuclear-capable cruise missiles, operates far from the battlefield of Ukraine from offices in Moscow and St. Petersburg. An investigative report by Bellingcat described an environment in which, "these young people work from secure command centres in Moscow and St. Petersburg, and appear to go about their lives with little interference from a war in which they play a crucial

77   Nate Jones, *Able Archer 83: The Secret History of the NATO Exercise That Almost Triggered Nuclear War* (New York, NY: The New Press, 2016), 29.

78   Herbert L. Abrams, 'Sources of Human Instability in the Handling of Nuclear Weapons', in *The Medical Implications of Nuclear War* (Washington, D.C.: National Academy Press, 1986), 491.

79   Colin Raunig, 'When Nuclear Deterrence Is Your Job', The Atlantic, 30 January 2018, https://www.theatlantic.com/international/archive/2018/01/the-lasting-psychological-stress-of-nuclear-deterrence/550280/.

80   'Close Calls with Nuclear Weapons' (Cambridge, MA: Union of Concerned Scientists, 15 January 2015), https://www.ucsusa.org/resources/close-calls-nuclear-weapons.

81   Pavel Aksenov, 'Stanislav Petrov: The Man Who May Have Saved the World', BBC World News, 26 September 2013, https://www.bbc.com/news/world-europe-24280831.

At the core, inadvertent escalation is caused by individuals at radar screens, generals in command centres, and civilians at conference tables.

role."[82] There is a possibility that the distance from the actual fighting of this highly technocratic staff inoculates them from battlefield nerves that can cause inadvertent escalation, though could also lead to a reduction of warfighting to spots on a map.

The implications of the individual level for understanding inadvertent escalation is that overworked and isolated individuals and groups are more prone to misperception. Given that certain groups, like radar operators and missile targeteers, play central roles in the Russian nuclear command and control apparatus, there is little reason to expect that the risk for misperception is much higher now given that the already stressful work is only heightened by the war against Ukraine and maintaining a broader posture against NATO. Jim Storr's book *The Human Face of War* reminds us that war is, "fundamentally human, and waged between complex human organizations."[83] Put simply, civil-military tensions, the idiosyncrasies of organisational cultures, and individual and group psychologies have material outcomes when it comes to causing and/or avoiding inadvertent escalation. Past crises and current dynamics have shown each of these elements acting individually and reinforcing one another in practice. At the core, inadvertent escalation is caused by individuals at radar screens, generals in command centres, and civilians at conference tables.

Mechanism 3.
Uncertainty and information absence or overload: Russia's C3I systems are deteriorating and under attack

Russia's C3I networks are deteriorating due to persistent overuse in its war against Ukraine. These networks are part of both the Russian nuclear command and control apparatus as well as its early warning system. Degradation of this system poses risks of inadvertent escalation due to the potential misinterpretation of NATO intentions should a crisis, related to the war or otherwise, emerge. This deterioration of capability is caused by three primary factors: (a) second-order impacts of the war itself; (b) the effects of sanctions on the Russian military-industrial complex; and (c) the potential consequences of offensive cyber operations.

The impact of the war and the role of sanctions

Understanding the impact of the war itself on Russian nuclear C3I requires an overview of how the system works in theory, how it has modernised alongside conventional command and control systems, and the measures that could interfere with its functioning. Given the secrecy of the programme and any efforts to disrupt it, there is little in the way of measurable impact on the nuclear systems themselves. However modern armed forces, including Russia's, are largely beholden to a systems approach that leaves them vulnerable to measures that degrade the ability of that system to function.

82 Christo Grozev, 'The Remote Control Killers Behind Russia's Cruise Missile Strikes on Ukraine', Bellingcat, 24 October 2022, https://www.bellingcat.com/news/uk-and-europe/2022/10/24/the-remote-control-killers-behind-russias-cruise-missile-strikes-on-ukraine/.

83 Jim Storr, *The Human Face of War*, Birmingham War Studies (London: Continuum UK, 2009), 4.

...Moscow may perceive itself vulnerable enough to overreact to Western posturing or to draw on incomplete and flawed information.

Russian C3I is made up of a complex of command centres, communications systems, and technical intelligence assets. For example, the early warning system is maintained by the Main Centre for Missile Attack Warning (GTsPRN), which is fed information by a network of radar stations and early-warning satellites. In the event of a nuclear conflict, the Main Centre would transmit information to the nuclear 'briefcases' possessed by the president, minister of defence, and the chief of the general staff. These cases are in turn connected to the *Kazbek* system which would facilitate communications for decision-makers involved in the command decisions to use nuclear weapons. This communications system is generally assumed to be quite resilient and designed to function even in the event of nuclear war.[84] However, it is important to note the system upon which it relies. While the ultimate decision might be secure, it is another matter for the radars, satellites, and command centres that connect it.

Early-warning radar systems operate persistently to track potential incoming missiles and aircraft. Identifying and tracking a wide range of commercial and military traffic is difficult enough in peacetime. In wartime, though alert statuses are heightened, the airspace is much more crowded and frequently interfered with by electronic warfare measures. During the current war, there are any number of cruise missiles, Russian and Ukrainian jets, drones, and aircraft of NATO states that are either directly over or cruising near Russia. This is surely a technically taxing state of affairs, both for the systems themselves and those who operate them. There is also the risk of various radar failures, which can contribute to significant miscalculation. When the Soviet Far East Command lied to Moscow about the functionality of radar systems on the Kamchatka peninsula, it contributed to the shooting down of the civilian airliner, Korean Air 007.[85] Given the reportedly high levels of corruption and official dishonesty within the Russian Armed Forces,[86] there is reason enough to suspect that not all systems are fully functioning as they should, risking escalation in that systems could falsely communicate that an attack is incoming.

Radars are one piece of the puzzle, satellites another. The war against Ukraine has been called the "first two-sided space war", where both Russia and Ukraine have been able to put space to operational use.[87] Russia has seemingly been unable to leverage its space assets to its fullest extent, with Western-provided space-based reconnaissance out-matching Russian capabilities.[88] The overall Russian space industry is facing setbacks from the imposition of sanctions as well, particularly through being closed off from commercial markets amongst North American and European states. Russia may even face difficulties offsetting these setbacks in maintaining space access by partnering with others, as other states such as China have been reticent to circumvent the sanctions regime.[89] Should this spill over into a degradation of the early-warning satellite system, Moscow may perceive itself vulnerable enough to overreact to Western posturing or to draw on incomplete and flawed information.

However, sanctions may not have quite the impact on the overall Russian nuclear enterprise as perhaps expected. A report from the Center for a New American Security (CNAS) has

84   Mikhail Tsypkin, 'Adventures of the "Nuclear Briefcase": A Russian Document Analysis', *Strategic Insights* 3, no. 9 (2004): 2–7.

85   Los Angeles Times, 'Radar Outage Cited in KAL Tragedy', Los Angeles Times, 2 January 1993, https://www. latimes.com/archives/la-xpm-1993-01-02-mn-2610-story.html.

86   Polina Beliakova, 'Russian Military's Corruption Quagmire', Politico, 8 March 2022, https://www.politico.eu/article/russia-military-corruption-quagmire/.

87   David T. Burbach, 'Early Lessons from the Russia-Ukraine War as a Space Conflict', Atlantic Council, 30 August 2022, https://www.atlanticcouncil.org/content-series/airpower-after-ukraine/early-lessons-from-the-russia-ukraine-war-as-a-space-conflict/.

88   Burbach.

89   Jeremy Grunert, 'Sanctions and Satellites: The Space Industry After the Russo-Ukrainian War', War on the Rocks, 10 June 2022, https://warontherocks.com/2022/06/sanctions-and-satellites-the-space-industry-after-the-russo-ukrainian-war/.

assessed that, "Russia has a history of insulating defense spending from economic down-turn," and "It is reasonable to assume that Russia will allocate significant funds to replace its most sensitive technologies."[90] There is little reason to assume that both the war and sanctions will seriously degrade the functionality of Russia's nuclear arsenal in the short-term. Long-term deficiencies in critical supplies however could lead to the deterioration of sensitive systems, particularly those electronic components imported from the West.

The degradation suffered by Russian *conventional* capabilities, alongside the strain on early-warning systems, could impact the possibilities for inadvertent escalation. The same CNAS report above warned that the pathway to nuclear war could become shortened as the Russian ability to generate conventional deterrent forces and capabilities deteriorates.[91] Coupled with an over-taxed C3I architecture, the potential for non-war related degradation (i.e., corruption and/or ineptitude), and the connection of these systems to overall nuclear command and control could create accelerated pathways for escalation. The implication is that inaccurate or missing information caused by faltering systems could create fears of an imminent first strike and generate a 'use it or lose it' response.

The impact of direct attacks on C3I networks

The preceding section considered the degradation of C3I networks due to overtaxed systems, second-order effects of conventional warfare, and the impact of sanctions. This has not yet considered the potential degradation caused by direct actions taken during the course of the war that could be degrading Russian C3I networks. The role of the cyber domain is central to this consideration, as it has both featured prominently in the war and is a frequently noted fear by Russian military leaders and theorists.[92]

Evidence of the impact of cyber-attacks on secure Russian C3I systems is largely speculative. There has been significant activity by both the Russian and Ukrainian states against one another, with Ukraine supported by a vast array of volunteers, some organised into the Ukrainian IT Army, others acting as hacktivists through groups like Anonymous. These actions have led to many government sites and services being taken offline and the leak of personal details from thousands of Russian military personnel and Ministry of Defence staff. Russia has been under cyber-attacks at an "unprecedented scale."[93] The question is if this flurry of activity in the cyber domain extend to more sensitive systems?

The opacity and high-level secrecy surrounding cyber-operations is a well-known challenge to research on such actions.[94] Despite this, there are clues that point to potential cyber-attacks on such systems elsewhere. First is the acknowledgement that such operations are in fact possible. In 2007, Israel hacked Syrian S-300 radars prior to bombing the Al Kubar

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90 Michael Kofman et al., 'Assessing Russian State Capacity to Develop and Deploy Advanced Military Technology' (Washington, DC: Center for a New American Security, 2022), https://www.cnas.org/publications/reports/assessing-russian-state-capacity-to-develop-and-deploy-advanced-military-technology.

91 Kofman et al., 12.

92 Alexander G. Savelyev and Olga M. Alexandria, 'What Factors Affect Strategic Stability?', *Russia in Global Affairs* 20, no. 1 (2022): 93–111.

93 Matt Burgess, 'Russia Is Being Hacked at an Unprecedented Scale', Wired, 27 April 2022, https://www.wired.com/story/russia-hacked-attacks/.

94 David E. Sanger, *The Perfect Weapon: War, Sabotage, and Fear in the Cyber Age* (Brunswick, Victoria: Scribe Publications, 2018), 12.

nuclear facility.[95] Fifteen years later, it is well within expectations that such capacities have increased and are being fielded on modern battlefields. Secondly, there have been comments from senior Western officials about such operations. The commander of US Cyber Command, General Paul Nakasone, stated at a NATO conference in June 2022 that the United States had "conducted a series of [cyber] operations across the full spectrum; offensive, defensive, [and] information operations," in support of Ukraine. That this was within US policy in the cyber domain was later confirmed by the White House.[96]

It is technologically feasible to breach sensitive military systems and there is evidence pointing towards this ongoing activity against Russia. Does this pose a serious risk of degradation that could cause a second-order effect for escalation? From a technical perspective, the redundancy between C3I systems reduces the overall effectiveness of cyber-attacks, which is only reinforced in the nuclear C3I environment.[97] Still, should the vital systems upon which nuclear C3I depends (radars, satellites, and data links) be perceived as vulnerable to persistent attacks or part of a disarming first strike, this could lead to a misinterpretation of intentions should a crisis expand, inadvertently leading a cyber operation to escalate to the nuclear level.

Russia's C3I networks are (a) deteriorating due to persistent overuse during their war in Ukraine; (b) the sanctions regime targeting sensitive military components; and (c) damaged due to cyber- and other attacks from Ukraine and its partners. The deterioration and damage of Russia's nuclear infrastructure could lead to misinterpretation of NATO intentions during a crisis, or even cause a crisis where inadvertent escalation becomes more likely.

> The deterioration and damage of Russia's nuclear infrastructure could lead to misinterpretation of NATO intentions during a crisis...

Mechanism 4.
Commingling and entanglement of conventional and nuclear systems

Russian armed forces (a) comingle and co-host conventional and nuclear system, while relying on dual-capable missiles; (b) rely on dual-use advanced conventional weapons which increases the risk of cyber-espionage and attacks (or through other means) by NATO, Ukraine, or others against key parts of the infrastructure; and (c) rely on space-based assets to guide conventional war in Ukraine which increases the risk of cyber-espionage and attacks (or through other means) by NATO, Ukraine, or others against the space-based assets. Importantly, while this risk has been consistently serious over time, and deserves serious attention on its own merits, we do not assess it as having markedly increased solely due to the ongoing war.

Dual-capable systems and co-hosting

Russia co-hosts dual-capable bombers and conventional and nuclear warheads at key bases and uses dual-capable missiles across a number of delivery platforms that it could rely on

95   Christopher Bronk, Gabriel Collins, and Dan Wallach, 'Cyber and Information Warfare in Ukraine: What Do We Know Seven Months In?', Baker Institute, 6 September 2022, https://www.bakerinstitute.org/research/cyber-and-information-warfare-ukraine-what-do-we-know-seven-months.

96   Michael N. Schmitt, 'Ukraine Symposium - U.S. Offensive Cyber Operations in Support of Ukraine', Lieber Institute West Point, 6 June 2022, https://lieber.westpoint.edu/us-offensive-cyber-operations-support-ukraine/.

97   Acton, 'Cyber Warfare & Inadvertent Escalation', 138.

for non-strategic attacks. Russia relies on two types of nuclear-capable heavy bombers: the Tu-160 Blackjack and the Tu-95MS Bear-H. The airbases in Engels and Ukrainka are estimated to 11 bombers of the former type and 56 of the latter.[98] Both bombers have ranges exceeding 8000 km and may carry the nuclear AS-15 Kent (Kh-55) air-launched cruise missile and are in the process of being upgraded to carry the new AS-23B (Kh-102) nuclear cruise missile. The nuclear warheads are believed to be in central storage, with several hundred deployed at the bases.[99] The Long-Range Aviation Command supervises both bases,[100] which have been used for attacks on Ukrainian cities, industry, and energy plants, especially during the last months of 2022. In response, in December 2022, Ukrainian armed forces conducted multiple drone strikes on the Engels airbase. As a result, Russia has moved at least six of its strategic bombers based there to an unknown location.[101]

Russia has also relied more on the threat of low-yield, so-called "tactical" nuclear weapons. Kristensen and Korda estimate that Russia possesses approximately 1,912 nonstrategic nuclear warheads that can be delivered through air, naval, ground, as well as defensive forces. These include air-to-surface missiles, short range ballistic missiles, gravity bombs, and depth charges for medium-range bombers, tactical bombers, and naval aviation, as well as anti-ship, anti-submarine, and anti-aircraft missiles and torpedoes for surface ships and submarines, a nuclear ground-launched cruise missile, and Moscow's antiballistic missile system.[102] As noted above, Russia has multiple dual-capable missiles that it has used in the Ukraine War, including the Iskander and S-300 ground-launched missiles, Kalibr sea-launched missiles, and Kh-101, Kh-22, and Kh-47M2 Kinzhal air-launched missiles. The Russian navy is the key possessor of nonstrategic nuclear weapons with roughly 935 warheads for use by land-at-tack cruise missiles, anti-ship cruise missiles, anti-submarine rockets, anti-aircraft missiles, torpedoes, and depth charges, and these weapons could be fired from submarines, aircraft carriers, cruisers, destroyers, frigates, corvettes, and naval aircraft.[103] For example, the Yasen-M class submarine is an updated version of the first Yasen submarine and can carry 32 dual-capable Kalibr missiles, as well as the SS-N-26 anti-ship cruise missile, SS-N-16 (Veter) nuclear anti-submarine rockets, and nuclear torpedoes.[104] The Russian Air Force is the second service in charge of nonstrategic nuclear weapons, to be carried by Tu-22M3 (Backfire) intermediate-range bombers, Su-24M (Fencer-D) fighter-bombers, the new Su-34 (Fullback) fighter bomber, and the MiG-31K. The development of long-range, dual-capable, air-launched ballistic missiles – the 9-A-7760 Kinzhal – adds to a much-publicised element to the Russian threat to escalate.[105] Russia's development of hypersonic weapons also contributes to its escalation potential, including the Avangard and the Tsirkon, that have primarily but perhaps not exclusively nuclear tasks.[106] Beyond the air- and sea-components, the 9M729 (SSC-8) ground-launched cruise missile – the missile that the United States considered in violation of the INF Treaty - is also believed to be dual-capable.[107] Finally, Russia also has plans

98 Patton, Podvig, and Schell, 'A New START Model for Transparency in Nuclear Disarmament: Individual Country Reports'.

99 Kristensen and Korda, pp.109-110.

100 Patton, Podvig, and Schell, 'A New START Model for Transparency in Nuclear Disarmament: Individual Country Reports'.

101 Howard Altman, 'Ukraine Strikes Back At Bomber Base Deep Inside Russia', The Drive, 26 December 2022, https://www.thedrive.com/the-war-zone/ukraine-strikes-back-at-bomber-base-deep-inside-russia.

102 Kristensen and Korda, p.111.

103 Kristensen and Korda, p.112.

104 Kristensen and Korda, p.112.

105 Akshai Vikram, 'Russia's New Nuclear Weapons: Understanding Avangard, Kinzhal, and Tsirkon', Nuclear Network, 2 August 2021, https://nuclearnetwork.csis.org/russias-new-nuclear-weapons-understanding-avangard-kinzhal-and-tsirkon/. Kristensen and Korda, pp.112-113.

106 Vikram, 'Russia's New Nuclear Weapons'.

107 Kristensen and Korda, 'Russian Nuclear Weapons, 2022'.

to use nuclear warheads in its air and missile defence forces, which is why the S-300 and S-400 air and missile defence systems are considered dual-capable."[108]

There are implications for the likelihood of inadvertent escalation. The tactical weapons can be launched within minutes; fortunately, the tactical weapons are stored at limited number of locations where they would require significant amount of time – hours to days – to be matched to delivery systems.[109] However, the extensive dual-capable delivery systems, located at limited numbers of locations, add to the risks of misuse or misinterpretation of NATO or Ukrainian intentions when confrontation comes close to them or when these bases are in effect attacked.

Entangled C3I systems vulnerable to cyberattacks.

The 2022 Russian invasion of Ukraine saw a series of back-and-forth cyberattacks taking place on C3I systems. Most of these originated from Russia. For example, one of the most relevant and grave cyberattacks related to the Russian invasion of Ukraine concerns a hostile cyber activity against Viasat's (a satellite provider) KA-SAT network.[110] The attack was carried out an hour before the invasion with the objective to paralyse Ukrainian command and control.[111] Moreover, since the beginning of the invasion, Russia has engaged in jamming of signals and spoofing of global navigation satellite systems.[112] The cyber operations launched before and at the beginning of the invasion were intended to create chaos and overburden Ukrainian defence systems and social resilience. It is noteworthy that cyber operations combined with precision-guided strikes, electronic warfare, and disinformation campaigns are designed to undermine informational advantage consisted of communications and intelligence to gain advantage in the battlefield – this could explain why Russians intensified their attacks shortly before and at the beginning of the invasion.[113] It is extremely difficult to conduct cyber operations so that they create a lasting strategic advantage, however, when aptly combined with conventional attacks, they could help create a tactical advantage.[114] Yet, Russia's C3I infrastructure is now a legitimate target for Ukraine to stop precision attacks on its cities and industries.

The implication of potential vulnerabilities on the part of Russia for cyberattacks on its C3I infrastructure for inadvertent escalation is that cyberweapons are difficult to attribute and relatively asymmetric means to interfere with decision-making, making them a legitimate means for Ukraine – and possibly non-state actors – to stop Russia's attacks on its territory.

Entangled space-based assets

Russia uses its space navigation system GLONASS (Global Satellite Navigation System), which, as of 2020, was made up of 27 satellites and helps Russian military operate its nuclear

> ...the extensive dual-capable delivery systems, located at limited numbers of locations, add to the risks of misuse or misinterpretation of NATO or Ukrainian intentions...

108 Kristensen and Korda, p.113.

109 Karoun Demirjian, 'Here Are the Nuclear Weapons Russia Has in Its Arsenal', Washington Post, 5 October 2022, https://www.washingtonpost.com/world/2022/10/05/russia-nuclear-weapons-military-arsenal/.

110 Cynthia Brumfield, 'Space-Based Assets Aren't Immune to Cyberattacks', CSO Online, 21 June 2022, https://www.csoonline.com/article/3664070/space-based-assets-aren-t-immune-to-cyberattacks.html.

111 Brumfield.

112 Brumfield.

113 James Andrew Lewis, 'Cyber War and Ukraine', Center for Strategic & International Studies, 16 June 2022, https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/220616_Lewis_Cyber_War.pdf?S.iEKeom79InugnYWlcZL4r3Ljuq.ash.

114 Lewis.

arsenal.[115] The system that was initiated as a purely military one has become a dual-use programme. In essence, some satellites serve as an early warning system for hostile nuclear missiles, called Lira.[116] The system would seemingly send signals directly to the President of the Russian Federation's nuclear suitcase, Cheget.[117] Yet, GLONASS also carries Ruveta, a signals intelligence system that provides targeting data on NATO surface vessels to Russian naval forces for long-range anti-ship missiles.[118] In fact, Russia seems to actively use the GLONASS system in conventional operations that involve high numbers of high-precision weapons – such as previously in Syria.[119] Russia's satellites are not only integral for early warning and conventional targeting, but also the Russian nuclear command and control system.[120] Moreover, they guarantee the first warning of an incoming nuclear strike.[121] The satellites used for nuclear command and control, as well as early warning systems are located in high-altitude orbits;[122] However, the Pion-NKS, the most advanced satellite in the Lian constellation, seems to be little used in Russia's war on Ukraine. If so, Russia's use of high-precision weapons and aviation can only rely on a limited number of satellites, limiting their effective use.[123]

The implications for inadvertent escalation are twofold: (1) attacks on Russia's GLONASS to stop Russia's use of its satellites for targeting precision weapons on Ukraine could be misunderstood as directed as Russia's nuclear infrastructure; and (2) with its dual-capable stockpile of missiles declining, Russia has a diminished time window to act if it believes an attack is imminent based on its space-based assets.

Summing up, dual-capable missiles and other delivery systems, also used for Russia's coercive nuclear strategy, rely on C3I and space-based assets that are also dual-capable. Consequently, multiple pathways exist that could lead to inadvertent escalation, if Ukraine or its partners attempt to stop Russia's targeting of Ukrainian cities and industries with precision weapons and bombers. Moreover, its dual-capable delivery systems and infrastructure, as well as co-hosting, create additional pathways to escalation when Russian forces interact with NATO forces.

115 Pavel Luzin, 'Russia Is behind in Military Space Capabilities, but That Only Drives Its Appetite', Defense News, 2 April 2020, https://www.defensenews.com/opinion/commentary/2020/04/02/russia-is-behind-in-military-space-capabilities-but-that-only-drives-its-appetite/; Bart Hendrickx, 'The Secret Payloads of Russia's Glonass Navigation Satellites', The Space Review, 19 December 2022, https://www.thespacereview.com/article/4502/1.

116 Hendrickx, 'The Secret Payloads of Russia's Glonass Navigation Satellites'.

117 Holger Roonemaa and Michael Weiss, 'Exclusive: Western Intelligence Fears New Russian Sat-Nav's Espionage Capabilities', New Lines Magazine (blog), 12 July 2021, https://newlinesmag.com/reportage/western-intelligence-fears-new-russian-sat-nav-espionage-capabilities/.

118 Bendett et al., p.39. Hendrickx, 'The Secret Payloads of Russia's Glonass Navigation Satellites'; Roonemaa and Weiss, 'Exclusive'.

119 Samuel Bendett et al., "Advanced Military Technology in Russia: Capabilities and Implications," Russia and Eurasia Programme (London: Chatham House - the Royal Institute of International Affairs, September 2021), https://www.chathamhouse.org/sites/default/files/2021-09/2021-09-23-advanced-military-technology-in-russia-bendett-et-al.pdf, pp.37-38.

120 James Acton, 'Nuclear Command-and-Control Satellites Should Be Off Limits', Space4Peace (blog), 10 December 2021, http://space4peace.org/nuclear-command-and-control-satellites-should-be-off-limits/.

121 Acton.

122 Acton.

123 Pavel Luzin, 'Russia's Space Satellite Problems and the War in Ukraine', The Jamestown Foundation, 24 May 2022, https://jamestown.org/program/russias-space-satellite-problems-and-the-war-in-ukraine/.

5. Conclusion and policy recommendations:

reducing the risk of inadvertent nuclear escalation.

The risk of inadvertent escalation scalation has increased across all four pathways. Our main conclusions are concerning: there are an increasing number of pathways that could lead to inadvertent escalation. Russia's expenditure of dual-capable missile stocks, the shifting balance of power in Europe to the advantage of NATO, and NATO's enlargement likely bringing it closer to the Kola Peninsula increases the likelihood that Russia faces "use-it-or-lose-it" choices. The Russian military is offensively minded, with the nuclear class developing its own parochial ideology. Russian C3I systems are degraded through sanctions and direct attacks. Finally, Russia has hosted conventional attacks on Ukraine from similar locations, and using dual-capable delivery systems, as its nuclear arsenal. (See Table 4)

Table 4. Pathways to inadvertent nuclear escalation

Pathway to inadvertent escalation	Post-February 2022 situation	Risk inadvertent escalation
Military-organisational features complicate decision-making and command and control (2)	Russian civil-military relations are strained, the military is offensively minded, with the nuclear elite developing its own parochial ideology, and military structures are under unique stress.	High increase
Uncertainty about offensive and defensive intentions (1)	Russia's expenditure of dual-capable missile stocks, the shifting balance of power in Europe to the advantage of NATO, and NATO's enlargement likely bringing it closer to the Kola Peninsula increases the likelihood that Russia faces "use-it-or-lose-it" choices.	Moderate increase
Uncertainty and lack of access to reliable information (3)	Russian C3I systems are degraded through sanctions and direct attacks.	Moderate increase
Commingling, entanglement, and co-hosting of conventional and nuclear weapons and infrastructure (4)	Russia has hosted attacks on Ukraine from similar locations, and using dual-capable delivery systems, as its nuclear arsenal.	Limited increase

...it is clear NATO policymakers should exhibit caution and question long-standing assumptions about Russia's nuclear thinking and protocols.

Of the four pathways, we argue that these have increased in the following manners.[124] The risk of inadvertent escalation as a consequence of commingling, entanglement, and co-hosting is significant, but has existed as a structural feature of the way modern weapon systems have evolved. The Russian use of dual-capable missiles and attacks on Ukraine taking place from bases that also host nuclear weapons, however, has led to a *limited* increase in risk. The risk of uncertainty about intentions has increased *moderately* due to simultaneous changes in NATO and Russian troop levels and weapons, especially in areas close to Russian nuclear bases. The use of Russian C3I systems to coordinate conventional attacks on Ukraine, as well as the growing difficulties to maintain equipment due to the sanctions, we judge to have led to a moderate increase in the risk of inadvertent nuclear escalation. However, we believe that that the stresses and strains on the Russian military, the pressures to maintain good relations with the Kremlin, the fear of disappointment, the resentment over facing strong opposition from Ukraine and its NATO partners, alongside the existing trend towards a more isolated nuclear class within the Russian armed forces, have led to a *high* increase in the risk of inadvertent escalation.

While it is impossible to make strong predictions of probabilities for each of these pathways, it is clear NATO policymakers should exhibit caution and question long-standing assumptions about Russia's nuclear thinking and protocols. This opens particular opportunities for Dutch officials to influence alliance level consultations and guide multilateral and bilateral discussions. We consequently offer the following nine recommendations.

1. **Exercise caution with NATO's nuclear posture given the stresses Russian organisation is under.** The pathways to inadvertent escalation are nearly all active. It is almost impossible to separate the signal from the noise at this point; the leading indicators each side might look for are continuously active.

2. **Explicitly incorporate risks of inadvertent escalation through interaction between NATO's and Russia's conventional forces into NATO's exercises.** It is important to increase awareness of which Russian forces are dual-capable, commingled, and co-hosted.

3. **Maintain military-to-military engagement with Russian armed forces to reduce uncertainty.** In line with the previous recommendations, maintaining engagement with the Russian military can diminish the chances for misperceptions.

4. **Prioritise the organisation, state, and morale of Russian nuclear units in intelligence assessments, as well as in outside research.** The risks of inadvertent escalation increase due to misperceptions of doctrine and approaches of decision-makers with delegated launch authority, and who are likelier to interact with during a crisis.

5. **Exercise restraint with the placement of short and medium range missiles in Sweden and Finland close to Kola Peninsula.** These missiles offer an opportunity to pressure Russia but are likely to be highly destabilising. With the new Russia, the limited number of missiles may increase fears about the security of the Russian second-strike capability.

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124 It is difficult to operationalise the scale and overall level of inadvertent nuclear risk, especially within the limited scope of this research report. Our preliminary assessment reflects the degree of deviation from the base rate that existed prior to the February 2022 Russian invasion of Ukraine, and are based on the authors' expert judgment. For additional research on assessing the risk of nuclear escalation, see: Charles L. Glaser, *Analyzing Strategic Nuclear Policy* (Princeton, NJ: Princeton University Press, 1990), 138–65; Talmadge, 'Would China Go Nuclear?'

6. **Exercise caution towards using cyber tools that may interfere with Russian C3I infrastructure.** Given Russia's depleted stocks and weakened infrastructure, the fears of counterforce attacks will increase. Interruptions of Russia's C3I infrastructure are likelier to be perceived as tipping points than at other moments in the past three plus decades.

7. **Maintain the moratorium on testing of space weapons.** Given Russia's relative weaknesses, counterforce fears are likely to be high. Space weapons consequently present an even greater threat to Russia's secure second strike than before its invasion of Ukraine.

8. **Separate nuclear issues from war in Ukraine whenever possible.** Channels between NATO and Russia on arms control and deterrence need to be kept open, regardless of Western support for Ukraine and Russia's continuing invasion of and misconduct in Ukraine. Given the multiplication of risks compared to the situation before the war, maintaining as much transparency regarding capabilities and doctrine has become even more important.

9. **Make use of the opportunity presented by deteriorating Russian nuclear delivery systems and infrastructure to pressure on Russia to engage in arms control negotiations.** The four mechanisms discussed by which Russia's nuclear infrastructure is under significant pressure, if not actively deteriorating, may open pathways to compel and induce Russia into renewed arms control negotiations. Each of these four, alongside Russia's significant munitions expenditure against Ukraine, may leave Moscow with little choice but to talk and avoid falling far behind NATO allies militarily. This is likely to be strengthened by pressure stemming from increases in defence investment by European states, and newly developed concepts by NATO. Conversely, NATO Europe could consider not arming itself, but this would waste an opportunity to build up leverage to force Russia to engage.[125]

In conclusion, in 2022 Europe entered a new security order, including a new nuclear order. Given that pathways to escalation were treated as a thing of the past for over three decades, it is an essential policy exercise to consider which policies may trigger responses from a severely weakened Russia. As it is, we judge there to be a real risk of inadvertent escalation leading to nuclear use. In late October 2022, Russian defence minister Sergei Shoigu warned of "uncontrolled escalation."[126] The British Chief of Defence Admiral Sir Tony Radakin warned in March of the same year, shortly after the invasion, that he was advising political leaders to "avoid doing things that tactically might lead to miscalculation or escalation."[127] A seemingly positive element appears to have been behind-the-scenes talks between senior Western and Russian officials regarding these risks. India and China have also expressed their concerns directly to Putin.[128] However, as this brief has shown, the pieces are in place that could lead to an escalatory spiral, serving only to heighten the carnage of this already brutal war. Reducing the risk of inadvertent escalation should therefore be a key priority for all actors involved.

125 Paul Van Hooft and Davis Ellison, 'Good Fear, Bad Fear: How European Defence Investments Could Be Leveraged to Restart Arms Control Negotiations with Russia' (The Hague, Netherlands: Hague Centre for Strategic Studies, 2023).

126 Peter Beaumont, 'Ukraine War Heading for "Uncontrolled Escalation", Says Russia', *The Guardian*, 24 October 2022, sec. World news, https://www.theguardian.com/world/2022/oct/24/ukraine-war-heading-for-uncontrolled-escalation-says-russia.

127 Marie Jackson, 'Don't Go to Ukraine, Military Boss Tells Britons', BBC News, 6 March 2022, https://www.bbc.com/news/uk-60637185.

128 Judy Woodruff, 'CIA Director Bill Burns on War in Ukraine, Intelligence Challenges Posed by China', PBS NewsHour, 16 December 2022, https://www.pbs.org/newshour/show/cia-director-bill-burns-on-war-in-ukraine-intelligence-challenges-posed-by-china.

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