

## Strategic Stability and the Ukraine War

### *Implications of Conventional Missile Technologies*

Fabian Hoffmann



## Abstract

The war in Ukraine represents the first major inter-state conflict involving the widespread employment of long-range strike weapons and missile defense. The implications resulting from the deployment and use of these weapon systems extend beyond the Ukrainian theater and affect the broader strategic competition between Russia and NATO. This paper explores those implications, asking how the deployment and use of long-range strike weapons and missile defense systems in Ukraine affect NATO-Russia strategic stability. I argue that the missile war in Ukraine affects the prospects of strategic stability by shaping Russian and NATO force posture and strategy development, and helping to predict the technological trajectories of offensive and defensive missile capabilities. In the medium to long term, this can put additional pressure on arms control and crisis stability between Russia and NATO.

This report is part of a series generously funded by a grant from the Carnegie Corporation of New York.

CNA's Occasional Paper series is published by CNA, but the opinions expressed are those of the author and do not necessarily reflect the views of CNA or the client.

Approved for public release. Unlimited distribution.

This work was performed under Specific Authority Contract No. G-19-56503.

**Cover image:** Launch of Iskander missile. Russian Ministry of Defense.

This document may contain materials protected by the Fair Use guidelines of Section 107 of the Copyright Act, for research purposes only. Any such content is copyrighted and not owned by CNA. All rights and credits go directly to content's rightful owner.

**Approved by:**



Colleen "Kelly" McCue, Acting Research Program Director  
Countering Threats and Challenges  
Strategy, Policy, Plans, and Programs Division

**February 2024**

Request additional copies of this document through [inquiries@cna.org](mailto:inquiries@cna.org).

## TABLE OF CONTENTS

Introduction..... 1

Defining Strategic Stability ..... 3

The Use of Advanced Conventional Weapons in Ukraine ..... 5

    Long-range strike weapons ..... 5

    Force employment and effectiveness ..... 7

    Missile defense..... 10

Implications for Strategic Stability ..... 15

    First-strike instability..... 15

    Credibility of Russian missile doctrine ..... 17

    Feasibility of conventional counterforce..... 19

Conclusion..... 23

References ..... 24

PAGE INTENTIONALLY BLANK

# INTRODUCTION

The Russia-Ukraine war marks the first instance of a major inter-state war involving the large-scale deployment and use of conventional ballistic and cruise missile technology. As a result, the Ukrainian theater has become a test bed for missile technology and strategy and has revealed the strengths and weaknesses of contemporary missile forces and doctrines. The implications of the deployment and use of offensive conventional missile capabilities and defenses against such capabilities in Ukraine extend beyond the battlefield and affect the broader strategic competition between Russia and the North Atlantic Treaty Organization (NATO). This paper explores those implications, asking how the deployment and use of long-range strike weapons and missile defense systems in Ukraine affects Russia-NATO strategic stability.



The implications of the deployment and use of offensive conventional missile capabilities and defenses against such capabilities in Ukraine extend beyond the battlefield and affect the broader strategic competition between Russia and the North Atlantic Treaty Organization (NATO).

In this analysis, long-range strike weapons include Russian, Ukrainian, and Western conventional cruise and ballistic missiles as well as conventional long-range drones that have been used by both sides to engage targets at standoff range, including deep inside the adversary's homeland territory. The

meaning of *standoff range* is context dependent and relates to the distance between adversaries. In the context of the Russia-Ukraine war (and in the broader European context), *standoff* implies the ability to engage targets several hundred kilometers behind the front line.<sup>1</sup> In terms of missile defense, this analysis considers Russian, Ukrainian, and Western nonstrategic air and missile defense forces that have been deployed around the front line and deeper inland to protect military and civilian targets.

The paper is structured as follows. In section one, we briefly discuss the concept of strategic stability, conceptualizing it in terms of crisis and arms race stability. We also draw attention to the effect of long-range strike weapons and missile defense on strategic stability and outline the implications that

the deployment and use of conventional missile technology in Ukraine can have for strategic stability. In section two, we analyze offensive and defensive developments in the missile domain in Ukraine. We then briefly describe the different long-range strike and missile defense systems that have been employed

<sup>1</sup> Fabian Hoffmann and William Alberque, *Non-Nuclear Weapons with Strategic Effect: New Tools of Warfare?*, International Institute for Strategic Studies, Mar. 2022, <https://www.iiss.org/research-paper/2022/03/non-nuclear-weapons-with-strategic-effect-new-tools-of-warfare/>.

by Ukraine and Russia and assess their effectiveness (and lack thereof) in the war so far. Section three analyzes the medium- to long-term implications of the deployment and use of long-range strike weapons and missile defense systems in Ukraine for strategic

stability. Demonstrated levels of effectiveness and ineffectiveness of these weapon systems shape the prospects of crisis and arms control stability as well as the general likelihood of strategic nuclear exchanges between NATO and Russia.

## CAVEATS

---



Two caveats follow. First, the Russia-Ukraine war is still unfolding. As such, this analysis represents a snapshot of the events up until January 2024. As the war continues and states adapt, assessments regarding the effectiveness of offensive and defensive missile technologies are subject to change. Second, this analysis relies exclusively on open-source information, which may lack accuracy or may be subject to misinformation and disinformation in a contested information space, especially when the source is one of the conflict parties and veracity cannot be independently verified. The report clearly states when this occurs.

# DEFINING STRATEGIC STABILITY

Strategic stability as a concept has been pervasive in theory and practice. In its broadest sense, strategic stability refers to the absence of armed conflict between states that possess nuclear weapons. More narrowly, the concept can be defined in terms of crisis stability and arms race stability. Crisis stability pertains to a state in which neither side of a nuclear conflict dyad is motivated to use nuclear weapons first. Arms race stability, in contrast, refers to a state in which neither side has an incentive to increase its nuclear arsenal in terms of quantity or quality.<sup>2</sup>

The concept of strategic stability has traditionally been centered on the nuclear dimension of great power competition, particularly the number of strategic nuclear warheads deployed by each side.<sup>3</sup> During the Cold War and especially in more recent times, the concept has been broadened to include a conventional dimension as well. Russian analysts and officials, in particular, have emphasized the role of offensive and defensive advanced conventional weapons for strategic stability.<sup>4</sup>

Offensive advanced conventional weapons encompass a range of long-range strike capabilities.



Because of substantial advancements in guidance, propulsion, and warhead technologies in recent years, these weapon systems now have the potential to pose a credible threat to critical nuclear infrastructure and nuclear assets, including nuclear missile silos and mobile missile launchers.

This category includes conventional cruise and ballistic missiles as well as conventionally armed hypersonic boost-glide vehicles. Because of substantial advancements in guidance, propulsion, and warhead technologies in recent years, these weapon systems now have the potential to pose a credible threat to critical nuclear infrastructure and nuclear assets, including nuclear missile silos

<sup>2</sup> James Acton, "Reclaiming Strategic Stability," in *Strategic Stability: Contending Interpretations*, ed. Elbridge A. Colby and Michael S. Gerson (Carlisle, PA: US Army War College Press, 2013), 117–146, <https://apps.dtic.mil/sti/pdfs/ADA572928.pdf>.

<sup>3</sup> Elbridge A. Colby, "Defining Strategic Stability: Reconciling Stability and Deterrence," in *Strategic Stability: Contending Interpretations*, ed. Elbridge A. Colby and Michael S. Gerson (Carlisle, PA: US Army War College Press, 2013), 47–84, <https://apps.dtic.mil/sti/pdfs/ADA572928.pdf>.

<sup>4</sup> James Acton, "Russia and Strategic Conventional Weapons: Concerns and Responses," *Nonproliferation Review* 22, no. 2 (2015), pp. 141–154, <https://doi.org/10.1080/10736700.2015.1105434>; Dennis M. Gormley, "US Advanced Conventional Systems and Conventional Prompt Global Strike Ambitions: Assessing the Risks, Benefits, and Arms Control Implications," *Nonproliferation Review* 22, no. 2 (2015), pp. 123–139, <https://doi.org/10.1080/10736700.2015.1117735>; Dmitry Stefanovich, "Proliferation and Threats of Reconnaissance-Strike Systems: A Russian Perspective," *Nonproliferation Review* 27, no. 1–3 (2020), pp. 97–107, <https://doi.org/10.1080/10736700.2020.1795370>.



and mobile missile launchers.<sup>5</sup> As such, long-range strike weapons can complement and upgrade the first-strike capability of existing nuclear arsenals. This interaction may undermine crisis stability by heightening incentives to preempt the adversary in a nuclear crisis and increase pressures to build up one's nuclear arsenal to retain sufficient survivability.<sup>6</sup>

Concerns surrounding defensive advanced conventional weapons have traditionally centered on strategic missile defense. Strategic missile defense can reinforce the counterforce capabilities of nuclear weapon states by threatening to intercept any warheads that may have survived the nuclear first strike. More recently, Russia has made the argument that not only strategic missile defense but also operational-tactical missile defense integrated into the broader missile defense network can undermine this stability.<sup>7</sup> Because strategic and nonstrategic missile defenses may undermine the guaranteed retaliatory capability of a nuclear weapon state, they may incentivize the state to quantitatively or qualitatively improve its nuclear arsenal in an effort to maintain a credible nuclear capability, thus driving arms race instability.<sup>8</sup> As such, from a strategic stability perspective, deployments of missile defense

have generally been considered controversial and not conducive to a stable nuclear balance.

The Russia-Ukraine war creates short-, medium-, and long-term implications for strategic stability. The short-term implications center on the likelihood of the war expanding to a broader conflict between Russia and NATO, which may eventually escalate to the use of nuclear weapons.<sup>9</sup> Although these risks are real, they appear to have been managed by both sides, and a broader NATO-Russia conflict as a result of accidental, inadvertent, or deliberate escalation—although not impossible—appears less likely.

The implications of the war for strategic stability in the medium to long term revolve around the lessons and insights that NATO and Russia can draw from the realities of the war regarding force posture and strategy development and the technological trajectories of weapon systems that the war helps predict. The following sections consider these medium- and long-term implications for strategic stability that result from the deployment of offensive and defensive advanced conventional weapons in Ukraine, in particular conventional long-range strike weapons and nonstrategic or tactical-operational missile defense.

<sup>5</sup> Fabian Hoffmann, *Cruise Missile Proliferation: Trends, Strategic Implications, and Counterproliferation*, European Leadership Network, Mar. 2021, <https://www.europeanleadershipnetwork.org/report/cruise-missile-proliferation-trends-strategic-implications-and-counterproliferation/>; Fabian Hoffmann, *Strategic Non-Nuclear Weapons and Strategic Stability – Promoting Trust Through Technical Understanding*, Fondation pour la Recherche Stratégique, Nov. 2021, <https://www.frstrategie.org/en/programs/npt-and-the-p5-process/strategic-non-nuclear-weapons-and-strategic-stability-promoting-trust-through-technical-understanding-2021>.

<sup>6</sup> Andrew Futter and Benjamin Zala, "Strategic Non-Nuclear Weapons and the Onset of a Third Nuclear Age," *European Journal of International Security* 6, no. 3 (2021), pp. 257–277, <https://doi.org/10.1017/eis.2021.2>.

<sup>7</sup> Nicholas Khoo and Reuben Steff, "'This Program Will Not Be a Threat to Them': Ballistic Missile Defense and US Relations with Russia and China," *Defense & Security Analysis* 30, no. 1 (2014), pp. 17–28, <https://doi.org/10.1080/14751798.2013.864869>.

<sup>8</sup> Andrew Futter and Benjamin Zala, "Advanced US Conventional Weapons and Nuclear Disarmament: Why the Obama Plan Won't Work," *Nonproliferation Review* 20, no. 1 (2013), pp. 107–122, <https://doi.org/10.1080/10736700.2012.761790>.

<sup>9</sup> For an analysis of these short-term implications, see Mary Chesnut, *US/NATO-Russian Strategic Stability and the War in Ukraine*, CNA, IOP-2023-U-035792-Final, June 2023, <https://www.cna.org/reports/2023/06/us-nato-russian-strategic-stability-in-ukraine>.



# THE USE OF ADVANCED CONVENTIONAL WEAPONS IN UKRAINE

Both Russia and Ukraine have employed substantial long-range strike and missile defense assets throughout the war. This section discusses the weapon systems used on both sides as well as their effectiveness in this war so far. The following section dives into the strategic stability implications of their use.

## Long-range strike weapons

Throughout the war, Russia has employed a breadth of long-range strike capabilities in Ukraine, including land-attack and anti-ship cruise missiles, ground- and air-launched ballistic missiles, and long-range drones.

The backbone of Russia's long-range strike arsenal is its land-attack cruise missile arsenal. This arsenal consists of older cruise missile systems, such as the Kh-555 (RS-AS-22 Kluge), as well as more modern and advanced capabilities, including the Kh-101 (RS-AS-23a Kodiak) and 3M-14 Kalibr (RS-SS-N-30a Sagaris).<sup>10</sup> These air- and sea-launched land-attack

cruise missiles reportedly have a range greater than 2,000 kilometers and carry a payload of several hundred kilograms. Russia has also employed repurposed anti-ship cruise missiles in land-attack roles. These missiles include the Cold War Kh-22 (RS-AS-4 Kitchen) anti-ship cruise missile and the more modern P-800 Oniks (SS-N-26 Strobile) supersonic anti-ship cruise missile that have been used to engage civilian and military targets on land.<sup>11</sup> Although these missiles are less accurate against land-based targets because of their lack of suitable terminal guidance, Ukraine has struggled to deal with them because of their supersonic terminal speed.<sup>12</sup>

In addition to cruise missiles, Russia's ground and air forces have employed ballistic and quasi-ballistic missiles in Ukraine. These weapons include the 9K729 Iskander-M (RS-SS-26 Stone) short-range ballistic missile with a range of 500 kilometers and the medium-range Kh-47M2 Kinzhal (RS-AS-24a Killjoy) air-launched ballistic missile with a range of

<sup>10</sup> "3M-14 Kalibr (SS-N-30A)," Missile Threat, CSIS Missile Defense Project, Aug. 11, 2016, last modified Mar. 7, 2022, <https://missilethreat.csis.org/missile/ss-n-30a/>; "Kh-55 (AS-15)," Missile Threat, CSIS Missile Defense Project, Aug. 10, 2016, last modified Aug. 2, 2021, <https://missilethreat.csis.org/missile/kh-55/>; "Kh-101/Kh-102," Missile Threat, CSIS Missile Defense Project, Oct. 26, 2017, last modified July 31, 2021, <https://missilethreat.csis.org/missile/kh-101-kh-102/>.

<sup>11</sup> "Russia's Kh-22 – the Missile Ukraine Has Yet to Shoot Down," *Kyiv Post*, Dec. 29, 2023, <https://www.kyivpost.com/post/26102>.

<sup>12</sup> Ivana Kottasová et al., "Ukrainian Air Defenses in Odesa Outgunned as Russia Targets Global Grain Supply," CNN, July 21, 2023, <https://edition.cnn.com/2023/07/20/europe/ukraine-air-defenses-odesa-russia-strikes-grain-intl/index.html>; "Ukraine Unable to Shoot Down Kh-22 Missiles, Says Air Force," *The New Voice of Ukraine*, Jan. 15, 2023, <https://english.nv.ua/nation/air-defense-cannot-shoot-down-russian-kh-22-missiles-ukraine-war-50297621.html>.

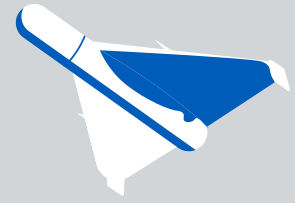
1,500 to 2,000 kilometers.<sup>13</sup> Russia has also employed repurposed S-300 air defense missiles in land-attack roles. Although comparatively inaccurate and lacking in firepower, these missiles have been used to saturate Ukraine's missile defense network.<sup>14</sup>

Finally, the war has seen the large-scale employment of Russian Geran-1 and Geran-2 one-way attack drones, which are rebranded and now license-produced versions of the Iranian Shahed-131 and Shahed-136 long-range drones.<sup>15</sup> These long-range drones with an official range of up to 2,000 kilometers are equipped with a 40-kilogram warhead that, although relatively small, has been able to cause substantial damage to Ukrainian civilian infrastructure facilities.<sup>16</sup>

Ukraine's long-range strike arsenal has largely consisted of Western-made long-range strike weapons and is complemented by a small but growing number of Soviet-legacy and domestically produced long-range strike weapons.

Ukraine first started to receive Western long-range strike weapons in May 2023 when the United Kingdom delivered British Storm Shadow air-launched cruise missiles.<sup>17</sup> In July 2023, France

Finally, the war has seen the large-scale employment of Russian Geran-1 and Geran-2 one-way attack drones, which are rebranded and now license-produced versions of the Iranian Shahed-131 and Shahed-136 long-range drones.



followed suit and supplied identical cruise missiles, known in Paris under the name SCALP-EG.<sup>18</sup> Storm Shadow/SCALP-EG are relatively modern long-range strike weapons that are in use in several air forces around the world. They have a range of around 560 kilometers and carry a powerful 450-kilogram multi-effect penetrator warhead.<sup>19</sup> Storm Shadow/SCALP-EG have been integrated with and launched from Ukrainian SU-24M (Fencer-D) aircraft.<sup>20</sup> More recently, Ukraine has started to receive MGM-140 M39 Block 1 ATACMS short-range maneuvering missiles

<sup>13</sup> "Kh-47M2 Kinzhal," Missile Threat, CSIS Missile Defense Project, Mar. 27, 2018, last modified Mar. 19, 2022, <https://missilethreat.csis.org/missile/kinzhal/>.

<sup>14</sup> Thomas Newdick, "Russia Now Firing S-300 Surface-to-Air Missiles at Land Targets in Ukraine: Official," The War Zone, July 8, 2022, <https://www.thedrive.com/the-war-zone/russia-now-firing-s-300-surface-to-air-missiles-at-land-targets-in-ukraine-official>.

<sup>15</sup> US Defense Intelligence Agency, *Iranian UAVs in Ukraine: A Visual Comparison*, Aug. 2023, [https://www.dia.mil/Portals/110/Documents/News/Military\\_Power\\_Publications/UAV\\_Book.pdf](https://www.dia.mil/Portals/110/Documents/News/Military_Power_Publications/UAV_Book.pdf).

<sup>16</sup> Howard Altman, "Russia's Shahed-136 Drones Now Feature Tungsten Shrapnel," The War Zone, Sept. 28, 2023, <https://www.thedrive.com/the-war-zone/russias-shahed-136-drones-now-feature-tungsten-shrapnel>.

<sup>17</sup> Jim Sciutto, "Britain Has Delivered Long-range 'Storm Shadow' Cruise Missiles to Ukraine Ahead of Expected Counteroffensive, Sources Say," CNN, May 12, 2023, <https://edition.cnn.com/2023/05/11/politics/uk-storm-shadow-cruise-missiles-ukraine/index.html>.

<sup>18</sup> Barbara Gabel, "'A Strong Gesture': French Delivery of SCALP Missiles to Ukraine Marks Shift in Western Strategy," France 24, July 13, 2023, <https://www.france24.com/en/europe/20230713-a-strong-gesture-french-delivery-of-scalp-missiles-to-ukraine-marks-shift-in-western-strategy>.

<sup>19</sup> "SCALP EG/Storm Shadow/SCALP Naval/Black Shaheen/APACHE AP," Missile Threat, CSIS Missile Defense Project, Dec. 2, 2016, last modified Sept. 20, 2023, <https://missilethreat.csis.org/missile/apache-ap/>.

<sup>20</sup> Thomas Newdick, "SU-24 Fencer Is Ukraine's Storm Shadow Missile Carrier," The War Zone, May 24, 2023, <https://www.thedrive.com/the-war-zone/su-24-fencer-is-ukraines-storm-shadow-missile-carrier>.

from the United States.<sup>21</sup> These ground-launched quasi-ballistic missiles have a range of around 165 kilometers and carry a cluster ammunition warhead capable of dispersing 950 bomblets over a target area.<sup>22</sup>

In addition to Western long-range strike weapons, Ukraine also possessed a relatively small arsenal of Soviet-legacy systems at the start of the war in the form of 9K79 Tochka-U short-range ballistic missiles, which have been employed against a range of Russian targets.<sup>23</sup> Ukraine has also used a small number of domestically produced Neptune anti-ship cruise missiles for both maritime and land-attack purposes.<sup>24</sup> Finally, Ukraine has achieved domestic production of long-range drones, which have been used in multiple instances to target locations deep inside Russia.<sup>25</sup>

## Force employment and effectiveness

The effectiveness of Russian and Ukrainian long-range strike weapons in the war has been a mixed bag on both sides. Russia's employment of long-range strike weapons has been plagued by several issues from the outset of the campaign, including poor force employment and mission

planning; qualitative deficiencies in Russian missiles; the inability to deploy a functioning missile kill chain by integrating actionable intelligence, surveillance, and reconnaissance (ISR) data; and an initial lack of sufficient stockpiles for a protracted missile campaign.

Russia began its invasion of Ukraine by launching a barrage of conventional cruise and ballistic missiles that targeted critical military infrastructure, in particular airfields and air defense sites, in an effort to establish air supremacy early in the conflict. Russian missiles managed to hit some targets but were unable to systematically degrade Ukraine's missile defense network at the outset of the conflict and unable to ground and destroy a substantial part of Ukraine's military aviation assets.<sup>26</sup> Reportedly, Russia was unable to retarget some of its long-range strike weapons after enemy air defense assets were moved at the last minute from previously known locations.<sup>27</sup> In addition, Russia's opening salvo revealed inaccuracies in Russian long-range strike weapons, with pictures indicating several near misses of Russian missiles.<sup>28</sup>

Russia initially employed long-range strike weapons with relative restraint, especially when compared to past high-intensity wars in which significant missile assets were used early to destroy crucial enemy

<sup>21</sup> "US-Supplied ATACMS Enter the Ukraine War," Reuters, Oct. 19, 2023, <https://www.reuters.com/world/atacms-us-may-send-ukraine-their-cluster-bomb-payloads-2023-10-19/>.

<sup>22</sup> "MGM-140 Army Tactical Missile System (ATACMS)," Missile Threat, CSIS Missile Defense Project, Nov. 30, 2016, last modified July 31, 2021, <https://missilethreat.csis.org/missile/atacms/>.

<sup>23</sup> David Axe, "After a Six-Month Lull, the Ukrainians Are Lobbing Tochka Ballistic Missiles Again," Forbes, Nov. 23, 2023, <https://www.forbes.com/sites/davidaxe/2023/11/23/after-a-six-month-lull-the-ukrainians-are-lobbing-tochka-ballistic-missiles-again/>.

<sup>24</sup> Mikhail Zhironov, "Ukraine Adopts Neptune Coastal Defence Missile," Janes, Aug. 27, 2020, <https://www.janes.com/defence-news/news-detail/ukraine-adopts-neptune-coastal-defence-missile>.

<sup>25</sup> Mark Jacobsen, "Ukraine's Drone Strikes Are a Window into the Future of Warfare," Atlantic Council, Sept. 14, 2023, <https://www.atlanticcouncil.org/blogs/new-atlanticist/ukraines-drone-strikes-are-a-window-into-the-future-of-warfare/>.

<sup>26</sup> Justin Bronk, "Is the Russian Air Force Actually Incapable of Complex Air Operations?," RUSI, Mar. 4, 2022, <https://www.rusi.org/explore-our-research/publications/rusi-defence-systems/russian-air-force-actually-incapable-complex-air-operations>.

<sup>27</sup> Paul Sonne et al., "Battle For Kyiv: Ukrainian Valor, Russian Blunders Combined to Save the Capital," *Washington Post*, Aug. 24, 2023, <https://www.washingtonpost.com/national-security/interactive/2022/kyiv-battle-ukraine-survival/>.

<sup>28</sup> William Alberque et al., *Russia's War in Ukraine: Ballistic and Cruise Trajectories*, International Institute for Strategic Studies, Oct. 2023, <https://www.iiss.org/research-paper/2023/10/russias-war-in-ukraine-ballistic-and-cruise-trajectories/>.

targets to facilitate the subsequent ground invasion.<sup>29</sup> This restraint is surprising considering that Russian doctrine, in principle, provides for the large-scale employment of long-range strike weapons against military and critical civilian targets early.<sup>30</sup> Russia's initial restraint may be explained by a lack of mission planning and target allocation, a potential desire to protect Ukrainian civilian and military infrastructure in the belief that Russia would soon administer that infrastructure itself, and the perceived need to retain a robust reserve stockpile for a NATO contingency in case the war escalates.

Despite an overall increase in the use of long-range strike weapons after the initial months of the war, Russia seems to have faced difficulties in orchestrating a coherent missile campaign and integrating its long-range strike assets into its broader warfighting strategy. In general, Russia appears to have assigned both tactical-operational and strategic functions to its missile forces. In their tactical-operational

role, Russian long-range strike capabilities have been employed to engage high-value military targets at tactical and operational depth. Although these strikes have complicated Ukraine's defensive and offensive efforts, they do not seem to have significantly contributed to Russian successes along the front line.<sup>31</sup> Other factors, such as close-range artillery superiority, terrain, and ground tactics, played a more crucial role in determining the outcome of individual battles.<sup>32</sup>

Starting in the fall of 2022, Russian long-range strike forces have been conducting large-scale attacks on critical civilian infrastructure in Ukraine as part of a strategic strike campaign.<sup>33</sup> This campaign has been aimed at undermining the morale of the Ukrainian population and weakening their resistance against the Russian attackers. Despite using thousands of long-range strike weapons, including land-attack cruise missiles, ballistic missiles, and long-range drones, the overall effect of



Despite an overall increase in the use of long-range strike weapons after the initial months of the war, Russia seems to have faced difficulties in orchestrating a coherent missile campaign and integrating its long-range strike assets into its broader warfighting strategy.

<sup>29</sup> Alberque et al., *Russia's War in Ukraine*.

<sup>30</sup> Michael Kofman, Anya Fink, and Jeffrey Edmonds, *Russian Strategy of Escalation Management: Evolution of Key Concepts*, CNA, DRM-2019-U-022455-1Rev, Apr. 2020, <https://www.cna.org/reports/2020/04/russian-strategy-for-escalation-management-key-concepts>.

<sup>31</sup> This is also because Ukraine excelled in the use of decoys to lure missile strikes against false targets. John Hudson, "Ukraine Lures Russian Missiles with Decoys of US Rocket System," *Washington Post*, Aug. 30, 2022, <https://www.washingtonpost.com/world/2022/08/30/ukraine-russia-himars-decoy-artillery/>.

<sup>32</sup> Randy Noorman, "The Russian Way of War in Ukraine: A Military Approach Nine Decades in the Making," *Modern War Institute*, June 15, 2023, <https://mwi.westpoint.edu/the-russian-way-of-war-in-ukraine-a-military-approach-nine-decades-in-the-making/>; Andreas Kluth, "Russia's 'Human Wave Attacks' Are Another Step into Hell," *Washington Post*, Feb. 14, 2023, [https://www.washingtonpost.com/business/russias-human-wave-attacks-are-another-step-into-hell/2023/02/14/574e7202-ac27-11ed-b0ba-9f4244c6e5da\\_story.html](https://www.washingtonpost.com/business/russias-human-wave-attacks-are-another-step-into-hell/2023/02/14/574e7202-ac27-11ed-b0ba-9f4244c6e5da_story.html).

<sup>33</sup> Marcel Plichta, "Ukraine Vows to Strike Back If Russia Resumes Energy Infrastructure Attacks," *Atlantic Council*, Nov. 16, 2023, <https://www.atlanticcouncil.org/blogs/ukrainealert/ukraine-vows-to-strike-back-if-russia-resumes-energy-infrastructure-attacks/>.

these attacks has been decisive.<sup>34</sup> The most critical moment of the strategic missile campaign was likely in December 2022, when initial damage had been dealt and Russia was expanding its attacks but Ukraine had not yet received the means to deal with the strategic missile threat. Once Western missile defense systems started to arrive in more substantial numbers, pressure on Ukraine's civilian infrastructure started to decrease. In hindsight, Russia likely would have been able to put these ammunitions to better use by employing them against frontline targets in Ukraine, similar to how the Russian air force successfully employed glide bombs against Ukrainian trenches throughout the second half of 2023 to pressure Ukrainian tactical positions.<sup>35</sup> Alternatively, Russia may have improved the outcome of the strategic missile campaign by attempting to systematically degrade and limit Ukraine's industrial capacity rather than focusing on civilian targets.

Ukrainian use of missiles, especially longer range assets, has been more reserved—not necessarily out of desire but because of necessity. Ukraine's long-range strike arsenal has never been substantial

enough to enable the large-scale use of these weapon systems, forcing the Ukrainian armed forces to carefully allocate available weapon systems to individual targets. Ukraine was still able to effectively engage several important logistic nodes and ammunition depots deep behind the front line.

Ukrainian use of missiles, especially longer range assets, has been more reserved—not necessarily out of desire but because of necessity.

This move likely aggravated Russia's already-strained logistical situation across the southern and eastern theaters but did not critically strain it.<sup>36</sup> Ukraine was also able to engage several high-value targets that carried important symbolic and military value. For example, Ukrainian forces successfully struck several

Russian naval vessels docked in Crimea<sup>37</sup> and destroyed the Black Sea Fleet Naval Headquarters with at least two Storm Shadow/SCALP-EG cruise missiles in September 2023, killing several high-ranking officers.<sup>38</sup> This counter-leadership strike was reportedly enabled by repurposed Neptune anti-ship cruise missiles that successfully engaged Russian S-400 air defense batteries to weaken Russia's air defense bubble around Crimea.<sup>39</sup> In October 2023, Ukraine launched several ATACMS maneuvering missiles with cluster ammunition

<sup>34</sup> "How Ukraine Tamed Russian Missile Barrages and Kept the Lights on," *Economist*, Mar. 12, 2023, <https://www.economist.com/europe/2023/03/12/how-ukraine-tamed-russian-missile-barrages-and-kept-the-lights-on>.

<sup>35</sup> Stefan Korshak, "Russian Glider Bombs Are Hitting Ukrainian Positions with Impunity," *Kyiv Post*, Oct. 10, 2023, <https://www.kyivpost.com/post/22570>.

<sup>36</sup> Michael Peck, "Storm Shadow Missiles Give Ukraine 'a Much Longer Stick,' but Russia Is Already Learning to Adapt, Expert Says," *Business Insider*, July 31, 2023, <https://www.businessinsider.com/ukraine-storm-shadow-effective-long-range-missile-but-russia-adapts-2023-7>.

<sup>37</sup> "Russia Salvages Landing Ship Hit by Ukraine Missile Fire," *BBC*, July 2, 2022, <https://www.bbc.com/news/world-europe-62022476>; David Axe, "A Ukrainian Cruise Missile with a Special Warhead Blew Up That Russian Submarine from the Inside," *Forbes*, Sept. 18, 2023, <https://www.forbes.com/sites/davidaxe/2023/09/18/a-ukrainian-cruise-missile-with-a-special-warhead-blew-up-that-russian-submarine-from-the-inside/>; Joseph Trevithick, "Full Devastation from Cruise Missile Attack on Russian Ship Comes into View," *The War Zone*, Dec. 27, 2023, <https://www.thedrive.com/the-war-zone/full-devastation-from-cruise-missile-attack-on-russian-ship-coming-into-view>.

<sup>38</sup> Thomas Newdick, "Black Sea Fleet Headquarters Takes Direct Hit from Cruise Missile," *The War Zone*, Sept. 22, 2023, <https://www.thedrive.com/the-war-zone/black-sea-fleet-headquarters-takes-direct-hit-from-cruise-missile>.

<sup>39</sup> Howard Altman, "Ukraine Using Land Attack Variant of Neptune Anti-Ship Missile," *The War Zone*, Aug. 29, 2023, <https://www.thedrive.com/the-war-zone/ukraine-now-using-land-attack-neptune-anti-ship-missile-variant>.



warheads to destroy dozens of Russian aviation assets across several air bases.<sup>40</sup>

Ukrainian use of Western long-range strike weapons has also revealed qualitative differences between Russian and Western missile systems. French-British Storm Shadow/SCALP-EG cruise missiles have proved more reliable and survivable than their Russian counterparts, meaning that they have a much higher chance of successfully reaching and hitting their targets. Furthermore, no reports have been made of systemic errors or low accuracy in the use of Western-made long-range strike weapons. On the contrary, satellite pictures taken for battle damage assessment purposes have repeatedly demonstrated the impressive accuracy with which Western long-range strike weapons are able to hit their intended targets.<sup>41</sup>

Unfortunately for Ukraine, the limited number of long-range strike weapons available to its armed forces has prevented it from achieving the types of effects that could decisively affect the war. In addition, the lack of quantity has hindered Ukraine's ability to consistently support offensive and defensive operations across the front line, limiting its strikes to individual high-value targets. Nevertheless, Ukraine's position is likely stronger today compared to the start of the war because of its access to Western-made long-range strike weapons and its growing arsenal of domestically produced missile capabilities. Notably, Ukraine's effective use of long-range strike weapons has been partially prevented by Western targeting restrictions attached to Western

missile deliveries.<sup>42</sup> For example, even though Storm Shadow/SCALP-EG cruise missiles equipped with potent penetrator warheads would almost certainly be capable of heavily damaging the Kerch Bridge connecting Crimea with mainland Russia, Ukraine has not yet engaged this critical target, likely because of Western targeting restrictions.<sup>43</sup> These restrictions also allowed Russia to partially adapt to Ukrainian long-range strikes by moving equipment and infrastructure outside of range, including by redeploying assets to internationally recognized Russian territory where Ukraine is likely not allowed to use Western missile systems.

## Missile defense

Initially, missile defense played a secondary role in the war compared with the broader objective of air defense. At the beginning of the conflict, Ukraine relied on various Soviet-legacy air and missile defense systems, including 9K330 Tor (SA-15 Gauntlet) short-range surface-to-air missile (SAM) systems, 9K37 Buk (SA-11 Gadfly) medium-range SAM systems, and S-300 (SA-10 Grumble) long-range SAM batteries.<sup>44</sup> Despite these air defense capabilities not representing the state of the art, they were able to deny Russia control of Ukrainian airspace.

Missile defense assumed a central role in fall 2022 when Russia started its large-scale long-range strike campaign against Ukrainian cities and critical civilian infrastructure. Initially Ukraine's air defense capabilities were unable to match the missile

<sup>40</sup> Joseph Trevithick and Tyler Rogoway, "Destruction from Ukraine's First ATACMS Strike Now Apparent," *The War Zone*, Oct. 18, 2023, <https://www.thedrive.com/the-war-zone/destruction-from-ukraines-first-atacms-strike-now-apparent>.

<sup>41</sup> For example, during the Black Sea Fleet Naval Headquarters engagement, Storm Shadow cruise missiles were able to accurately strike individual wings of the buildings. Newdick, "Black Sea Fleet."

<sup>42</sup> Thomas Spencer, "Can UK's Storm Shadow Missiles Change Ukraine's Fight Against Russia?," *BBC*, June 6, 2023, <https://www.bbc.com/news/world-europe-65813770>.

<sup>43</sup> Another reason may be that Ukraine is waiting for the most opportune moment to engage this target, potentially to coincide with a future ground offensive.

<sup>44</sup> Bronk, "Is the Russian Air Force?," Justin Bronk, "The Mysterious Case of the Missing Russian Air Force," *RUSI*, Feb. 28, 2022, <https://rusi.org/explore-our-research/publications/commentary/mysterious-case-missing-russian-air-force>.

onslaught, resulting in substantial damage to Ukrainian civilian infrastructure.<sup>45</sup> Once Ukraine began receiving modern Western air and missile defense capabilities, its track record in defending against Russia's strategic missile campaign improved. These capabilities included American-made MIM-104 Patriot batteries, German-made Iris-T SLM missile defense systems, the American-Norwegian NASAMS air and missile defense system, and self-propelled German Gepard anti-air guns.<sup>46</sup> Ukraine also received several so-called Franken-SAMs, which combine Soviet launchers with Western ammunition.<sup>47</sup>

According to official Ukrainian sources, Russia has launched more than 4,000 long-range strike systems since October 2022.<sup>48</sup> Most long-range strike ammunition launched toward Ukraine are subsonic cruise missiles and long-range drones. These weapons are complemented by a smaller

number of supersonic cruise missiles as well as air- and ground-launched ballistic missiles. Overall, Ukraine reports an interception rate of about 80 percent, meaning that 4 of every 5 long-range strike weapons launched at Ukrainian territory are shot down before they reach their target.<sup>49</sup> These numbers cannot be independently verified at this point and are likely exaggerated for strategic communication purposes. Nevertheless, videos and pictures on social media, as well as post-strike damage assessments, confirm that Ukraine manages to intercept a substantial number of Russian long-range strike weapons,<sup>50</sup> including in complex missile raids in which missile threats engage from multiple directions, at different speeds, and from various trajectories.<sup>51</sup>

The effectiveness of Ukrainian missile defense is somewhat unexpected, at least compared with



According to official Ukrainian sources, Russia has launched more than 4,000 long-range strike systems since October 2022.

<sup>45</sup> Hugo Bacheга and Yaroslav Lukov, "Ukraine War: Blackouts in 1,162 Towns and Villages After Russia Strikes," BBC, Oct. 18, 2022, <https://www.bbc.com/news/world-europe-63297239>; "Another Mass Attack on Monday Morning: Russia Hits Energy Infrastructure Across Ukraine," *Kyiv Independent*, Oct. 31, 2022, <https://kyivindependent.com/another-mass-attack-on-monday-morning-russias-hits-energy-infrastructure-across-ukraine/>; Luke Harding, Dan Sabbagh, and Isobel Koshiw, "Russia Targets Ukraine Energy and Water Infrastructure in Missile Attacks," *Guardian*, Oct. 31, 2022, <https://www.theguardian.com/world/2022/oct/31/russian-missiles-kyiv-ukraine-cities>.

<sup>46</sup> Adam Pemble, "US-Made Patriot Guided Missile Systems Arrive in Ukraine," Associated Press, Apr. 20, 2023, <https://apnews.com/article/russia-ukraine-war-patriot-missile-system-4c79f9110899ca1880a61f2d1f328179>; "The Arms and Military Equipment Germany Is Sending to Ukraine," German Federal Government, Jan. 4, 2024, <https://www.bundesregierung.de/breg-en/news/military-support-ukraine-2054992>; "Zelensky: Newly-Delivered NASAMS Systems Enter Service in Ukraine," *Kyiv Independent*, Nov. 7, 2023, <https://kyivindependent.com/zelensky-newly-delivered-nasams-systems-enter-service-in-ukraine/>.

<sup>47</sup> Lolita C. Baldor, "Pentagon's 'FrankenSAM' Program Cobbles Together Air Defense Weapons for Ukraine," Associated Press, Oct. 12, 2023, <https://apnews.com/article/ukraine-russia-war-military-missiles-16c344bdba2e0695a2286a55d9614ff4>.

<sup>48</sup> Author's assessment based on publicly released information by the Ukrainian Air Force via its Facebook social media page. "Командування Повітряних Сил ЗСУ/Air Force Command of UA Armed Forces," Facebook, <https://www.facebook.com/kpszsu>.

<sup>49</sup> "Командування Повітряних Сил ЗСУ/Air Force Command of UA Armed Forces," Facebook, <https://www.facebook.com/kpszsu>.

<sup>50</sup> Alberque et al., *Russia's War in Ukraine*.

<sup>51</sup> An example is the May 16, 2023, attack, which saw the use of air- and ground-launched ballistic missiles, cruise missiles, S-300 rockets, and long-range drones against Kyiv. No missile system appears to have reached its target. Shawn Johnson, "Defense Expert Says Russia's Position 'Never Looked Weaker' After Ukraine Downed Putin's 'Invincible' Missiles," *Business Insider*, May 20, 2023, <https://biz.crastr.net/defense-expert-says-russias-position-never-looked-weaker-after-ukraine-downed-putins-invincible-missiles/>.



the predictions of analysts who wrote about the prospects of effective missile defense before the war. Most previous reports and analyses on US missile defense in Iraq during the 1990s and early 2000s consistently suggested that missile defense, even against short-range and low-velocity threats, would remain challenging and not cost-effective.<sup>52</sup> The analysis of Saudi Arabia's more recent experience with missile defense also supported this pessimistic assessment. In recent years, Saudi Arabia came repeatedly under attack from Iranian-made cruise missiles, short- and medium-range ballistic missiles, and long-range drones fired by Houthi rebels from Yemen. Saudi Arabia's missile defense network, which largely consists of US air and missile defense capabilities (including Patriot, which is currently deployed in Ukraine), failed to provide adequate and reliable protection.<sup>53</sup>

Without access to more accurate data, explaining this discrepancy in the expected and actual effectiveness

of Ukrainian missile defense is difficult. Several factors likely play a role, including the impressive competence of Ukrainian servicemembers operating their systems, the lack of stealth features and countermeasures in Russian long-range strike weapons undermining their survivability, and the generally improved state of Western missile defense compared with previous conflicts.<sup>54</sup> Western engineers reportedly continue to improve their missile defense systems by adapting software algorithms based on empirical data from previous successful and failed missile intercepts to further optimize missile defense against different types of threats.<sup>55</sup>



Most previous reports and analyses on US missile defense in Iraq during the 1990s and early 2000s consistently suggested that missile defense, even against short-range and low-velocity threats, would remain challenging and not cost-effective.

Although Ukrainian missile defense has generally been effective, interception rates have differed by type of long-range strike weapon. For example, Ukraine reports interception rates of more than 70 percent and 80 percent for subsonic cruise missiles and long-range drones, respectively, but interception rates of only about 40 percent for

<sup>52</sup> Joe Cirincione, "In Ukraine, a New Chance to Judge the Patriot Missile," Defense One, May 5, 2023, <https://www.defenseone.com/ideas/2023/05/ukraine-another-chance-judge-patriot-missile/386036/>.

<sup>53</sup> Jeffrey Lewis, "Patriot Missiles Are Made in America and Fail Everywhere," Foreign Policy, Mar. 28, 2018, <https://foreignpolicy.com/2018/03/28/patriot-missiles-are-made-in-america-and-fail-everywhere/>; Max Fisher, "Did American Missile Defense Fail in Saudi Arabia?," *New York Times*, Dec. 4, 2017, <https://www.nytimes.com/interactive/2017/12/04/world/middleeast/saudi-missile-defense.html>.

<sup>54</sup> Russia has been confirmed to employ active countermeasures, such as integrated decoy flares, in its cruise missiles. Joseph Trevithick, "Russian Kh-101 Cruise Missile Filmed Firing-Off Decoy Flares," *The War Zone*, Dec. 29, 2023, <https://www.thedrive.com/the-war-zone/russian-kh-101-cruise-missile-filmed-firing-off-decoy-flares>. Although these are reported to be effective against relatively simple anti-air capabilities, such as handheld stingers, they provide limited protection against more advanced interceptors systems. "Ukraine's Mobile Air Defences Have Ammo for 'Few More Attacks:' Commander," *France 24*, Jan. 4, 2024, <https://www.france24.com/en/live-news/20240104-ukraine-s-mobile-air-defences-have-ammo-for-few-more-attacks-commander>.

<sup>55</sup> Chris Panella, "Shooting Down Russia's Overhyped Missiles with Patriots Is a Win for More Than Just Ukraine. The War Is an 'Intelligence Bonanza' for the West," *Business Insider*, Jan. 4, 2024, <https://www.businessinsider.com/western-weapons-wins-against-russia-are-intelligence-bonanza-2024-1>.

Russian ground- and air-launched ballistic missiles.<sup>56</sup> Interception rates for high-velocity cruise missiles, in particular P-800 Oniks and Kh-22 anti-ship cruise missiles flying at medium and high subsonic speeds, approach zero.<sup>57</sup> In general, Ukraine's ability to deal with more complex and higher velocity threats appears to depend on the geographical area of the attack. Ukraine has managed to establish a dense and multilayered missile defense network around Kyiv that is capable of defending against most types of missile attacks relatively reliably. Other cities and areas in Ukraine remain much more vulnerable.

Compared to Ukraine, Russia's experience with missile defense in this war is more limited, mainly because of Ukraine's limited capability to launch long-range strikes against Russian targets. However, when Russian missile defense systems have been employed, they have not met expectations. Although Russian subsonic cruise missiles and long-range drones have been vulnerable to Ukrainian air defense, the survivability of Ukrainian subsonic cruise missile systems has been high. Although Russia regularly claims to intercept Western and Ukrainian long-range strike weapons in large numbers, it has been unable to produce credible evidence to support these claims. In fact, no evidence exists that Russia has managed to intercept a single

French-British Storm Shadow/SCALP-EG land-attack cruise missile or Ukrainian-built Neptune anti-ship cruise missile.<sup>58</sup> There is also no evidence that Russian missile defense has managed to intercept any of the ATACMS short-range maneuvering missiles that have occasionally been launched against Russian airfields.

Russia has also struggled with protecting its capital from relatively small numbers of Ukrainian slow-flying long-range drones that occasionally attempt to penetrate Moscow's airspace.

Russia has also struggled with protecting its capital from relatively small numbers of Ukrainian slow-flying long-range drones that occasionally attempt to penetrate Moscow's airspace. Ukraine even managed to strike two Russian airbases hundreds of kilometers behind the front line with improvised long-range drone systems,

reportedly damaging multiple strategic bombers in the process.<sup>59</sup> This strike is not necessarily surprising, given that Russia's airspace has not undergone extensive militarization, at least compared to that of Ukraine. In addition, small and low-flying drones can be difficult to intercept even with defenses in place. Nevertheless, Russia's lack of preparedness for strikes on its homeland territory was somewhat unexpected.

In general, given that Russian air and missile defense systems were once considered among the world's best, their lack of success in the war is surprising, especially considering that Russian missile defense systems were specifically designed and built to

<sup>56</sup> Author's assessment based on publicly released information by the Ukrainian Air Force via its Facebook social media page. "Командування Повітряних Сил ЗСУ/Air Force Command of UA Armed Forces," Facebook, <https://www.facebook.com/kpszsu>.

<sup>57</sup> "Russia's Kh-22."

<sup>58</sup> In July 2023, pictures of a downed Storm Shadow emerged. However, there are no indications of a kinetic interception. The missile likely landed itself because of a systemic error. Fabian Hoffmann (@FRHoffmann1), "First pictures of a downed Storm Shadow," Post, X, July 4, 2023, 6:07 a.m. <https://twitter.com/FRHoffmann1/status/1676170771507433472>.

<sup>59</sup> Iryna Sitnikova, "The Ministry of Defense of the Russian Federation Acknowledged the Attacks on Its Military Airfields. Blames Ukraine" [Міноборони рф визнало удари по своїх військових аеродромах. Звинувачує Україну], Hromadske, Dec. 5, 2022, <https://hromadske.ua/posts/minoboroni-rf-viznalo-udari-po-svoyih-vijskovih-aerodromah-zvinuvachuye-ukrayinu>.

counter the types of missile threats that they are now facing. Note also that Ukraine has asserted that its Soviet-legacy S-300 batteries have effectively defended against Russian subsonic cruise missiles,<sup>60</sup> which indicates that Russian missile defense systems are capable, in principle, of handling this type of threat. The fact that Russia has been unable to do so suggests either that there are differences in terms of the training and competence between Ukrainian and Russian operators or that Western-made subsonic cruise missiles are more survivable than their Russian counterparts. A combination of both factors likely plays a role. One video on social media shows what appears to be a Russian Pantsir-S1

(SA-22 Greyhound) missile defense system having a clear target lock on an approaching Storm Shadow/SCALP-EG cruise missile. The system operator, however, launches the interceptor when the target is right above the Pantsir system, resulting in what looks like the interceptor's fuse not arming and the interceptor flying past the incoming missile without detonating.<sup>61</sup> Storm Shadow/SCALP-EG cruise missiles also incorporate several low-observability features, such as an S-ducted fan, that reduce the radar cross section quite substantially, especially compared with older Russian cruise missiles that carry drop-down fans.

---

<sup>60</sup> See the markings on this S-300. Fabian Hoffmann (@FRHoffmann1), "There is no reason to assume that Russian S-300s cannot intercept Storm Shadows," Post, X, May 11, 2023, 9:34 a.m. <https://twitter.com/FRHoffmann1/status/1656653906091573251>.

<sup>61</sup> Calibre Obscura (@CalibreObscura), "Pantsir-S1 can't even intercept a Storm Shadow even when it has it locked on thermals," Post, X, June 22, 2023, 3:35 p.m. <https://twitter.com/CalibreObscura/status/1671965086959673357>.

# IMPLICATIONS FOR STRATEGIC STABILITY

The Russia-Ukraine war has constituted a test bed for conventional missile technology and redefines our understanding of the use of long-range strike weapons and missile defense in modern warfare. This section outlines some implications for strategic stability. These implications, in the medium to long term, revolve around the lessons and insights that NATO and Russia can draw from the realities of the war regarding force posture and strategy development and the technological trajectories of weapon systems that the war helps predict. This section identifies three implications for strategic stability resulting from the use of conventional missile technologies in the Russia-Ukraine war relating to decreased first-strike stability, the credibility of Russian missile doctrine and strategy, and the feasibility of conventional counterforce strikes.

## First-strike instability

The Russia-Ukraine war demonstrates the enormous utility of long-range strike weapons in modern wars. Long-range strike weapons can perform a range of key tactical, operational, and strategic functions on both sides.<sup>62</sup> Similarly, missile defense is acquiring an elevated role in contemporary warfighting because of its ability to deny the adversary the benefits of conducting long-range strikes. The track record of

these weapon systems in the war so far—although not impeccable on either side—leaves little doubt that conventional missile technologies have become a core capability of modern war. Long-range strike weapons and missile defense facilitate offensive and defensive maneuvers on the battlefield and can, under certain circumstances, create the conditions of victory independently of the warfighting effort along the front line.

Therefore, that the war has spurred global efforts to acquire robust long-range strike arsenals and upgrade missile defense is unsurprising. In Europe, several states have recently signed contracts for the procurement of long-range strike weapons, most notably the Baltic states and Poland, which together have acquired hundreds of M-142 HIMARS rocket artillery launchers equipped with ATACMS maneuvering missiles, among others.<sup>63</sup> Other states, such as the Netherlands, will soon deploy a long-range strike triad consisting of ground-, air-, and sea-launched long-range strike capabilities.<sup>64</sup> European states have also made a more or less concerted effort to acquire additional missile defense capabilities, including through the European Sky Shield Initiative.<sup>65</sup>

Russia itself has doubled down on long-range strike weapons and has gone to great lengths to overcome

<sup>62</sup> Fabian Hoffmann, "Europe's Missile Conundrum," War on the Rocks, July 25, 2023, <https://warontherocks.com/2023/07/europes-missile-conundrum/>; Hoffmann and Albuquerque, "Non-Nuclear Weapons."

<sup>63</sup> "Joint Procurement Makes Baltic Defensive Capabilities More Robust," Ministry of National Defence, Republic of Lithuania, Mar. 28, 2023, <https://kam.lt/en/joint-procurement-makes-baltic-defensive-capabilities-more-robust/>.

<sup>64</sup> Emma Helfrich, "The Netherlands Is Going to Bet Big on Long-range Weapons," The War Zone, Apr. 3, 2023, <https://www.thedrive.com/the-war-zone/the-netherlands-is-going-to-bet-big-on-long-range-weapons>.

<sup>65</sup> "European Sky Shield – An Overview of the Initiative" [European Sky Shield – Die Initiative im Überblick], Federal Ministry of Defense Germany, <https://www.bmvg.de/de/aktuelles/european-sky-shield-die-initiative-im-ueberblick-5511066>.

Western sanctions aiming to curb its supply.<sup>66</sup> The Russian arms industry reportedly continues to scale up production of cruise and ballistic missiles and has invested in a new production facility east of Moscow to license-produce Iranian Shahed long-range drones.<sup>67</sup> Russia is well aware that its long-range strike arsenal grants it military advantages and coercive leverage that Ukraine currently cannot match. In any war termination scenario that does not result in the complete destruction of Russia's military capabilities, including its industrial capacity, Russia will likely be able to rapidly rearm in the missile domain and re-equip its forces with a substantial long-range strike arsenal.

Therefore, there is little doubt that long-range strike weapons and missile defense will play a critical role in any future confrontation between Russia and NATO. Given that long-range strike weapons can inflict rapid damage not only at tactical and operational depth but also extending into the adversary's homeland territory, attaining superiority in the missile domain will constitute a core objective of future militaries.<sup>68</sup> As a result, military officials will plan to quickly destroy an adversary's offensive and defensive missile forces

to achieve long-range strike superiority as early as possible. To counter this strategy, armed forces will require not only large but also survivable arsenals. As such, future long-range strike arsenals must ideally be not only able to threaten the adversary's missile

capabilities but also robust enough to survive an enemy first strike. At present, no European country, including Russia, deploys this kind of long-range strike arsenal.

Most European states rely on airborne delivery for their existing long-range strike weapons. As long as these aircraft remain grounded and are not on alert, they remain vulnerable to an adversary first strike.<sup>69</sup> Europe's ground-based launchers will likely remain

similarly vulnerable unless states invest in hardened infrastructure, including underground storage facilities, to protect them at the outset of a conflict. Submarines are the only truly survivable long-range strike platforms. At present, the United States, France, and the United Kingdom are the only NATO member states that deploy submarine-launched long-range strike weapons. Several other NATO member states are currently considering the acquisition or procurement of submarine-launched long-range



Most European states rely on airborne delivery for their existing long-range strike weapons. As long as these aircraft remain grounded and are not on alert, they remain vulnerable to an adversary first strike.

<sup>66</sup> Maria Shagina, "Why Can't the West Stop Supplying Technology for Russian Weapons?," *Foreign Policy*, Nov. 9, 2023, <https://foreignpolicy.com/2023/11/09/russia-sanctions-weapons-technology-exports-evasion-arms-production-missiles-chips/>.

<sup>67</sup> Ian Williams, "Russia Isn't Going to Run Out of Missiles," *Center for Strategic and International Studies*, June 28, 2023, <https://www.csis.org/analysis/russia-isnt-going-run-out-missiles>.

<sup>68</sup> Attaining superiority in the missile domain can be defined as the ability to strike the enemy from a distance while preventing or severely limiting the adversary's ability to do the same.

<sup>69</sup> David Blagden, "Strategic Stability and the Proliferation of Conventional Precision Strike: A (Bounded) Case for Optimism?," *Nonproliferation Review* 27, no. 1–3 (2020), pp. 123–136, <https://doi-org.ezproxy.uio.no/10.1080/10736700.2020.1799569>.



strike capabilities.<sup>70</sup> Until NATO's submarine-launched long-range strike arsenal grows, especially in Europe, and unless NATO member states invest in the survivability of their other long-range strike assets, they will remain vulnerable to a Russian first strike.<sup>71</sup>

Russia faces the same issues, and a large part of Russian long-range strike capabilities are vulnerable to a NATO conventional first strike. Russia's inflexibility and rigid command structures, as demonstrated in Ukraine, also raise doubts regarding Russia's ability to quickly move and relocate its launchers under attack. For example, following the delivery of HIMARS rocket artillery launchers in June 2022, Ukraine managed to destroy dozens of logistics hubs and ammunition depots through M30 and M30 GMLRS strikes before Russia adapted and moved its facilities farther from the front line. Similarly, even though US deliveries of ATACMS were announced several weeks before delivery, Russia failed to move its vulnerable assets in time and adapted to the possibility of ATACMS strikes only once initial damage was taken.<sup>72</sup> The future deployment of ground-based intermediate-range missile systems that were previously banned under the Intermediate-Range Forces Treaty will further reinforce the vulnerability of time-sensitive Russian targets.

Overall, NATO's and Russia's long-range strike arsenals will likely remain vulnerable. This vulnerability could introduce strong "use them or lose them" pressures into the calculations of decision-makers, leading to the early and large-scale employment of long-range strike weapons in an effort to achieve

superiority in the missile domain. Therefore, a conflict between Russia and NATO could escalate rapidly once the initial fighting has begun. Ultimately, being faced with a large-scale missile attack and losing a substantial part of a long-range strike arsenal may pave the way for earlier nuclear use, leaving less time to form and seize off-ramps.

## Credibility of Russian missile doctrine

Conventional long-range strike weapons play a key role in Russia's military strategy. In contrast to the missile doctrine of most NATO states, Russia's missile doctrine is widely debated inside Russia, and Russian experts have formulated a clear understanding of how they intend to use Russia's long-range strike arsenal in a conflict with NATO.<sup>73</sup> Russia's long-range strike weapons constitute a central component of its military strategy centered on the notion of escalation control and escalation management.<sup>74</sup> The track record of Russian long-range strike weapons in Ukraine and their relative vulnerability to Western air defense systems deployed by the Ukrainian armed forces call into question certain aspects of Russia's missile doctrine, with important implications for strategic stability.

Russia's military-political thinking is centered on the concept of "strategic deterrence." This concept encompasses both nonmilitary and military approaches and measures to contain the adversary, manage escalation, and terminate wars. These

<sup>70</sup> Helfrich, "The Netherlands Is Going to Bet Big;" Jaroslaw Adamowski, "Subs, Cruise Missiles to Drive Poland's Navy Modernization," *Defense News*, Aug. 28, 2017, <https://www.defensenews.com/smr/european-balance-of-power/2017/08/28/subs-cruise-missiles-to-drive-polands-navy-modernization/>; Maksymilian Dura, "Korean Submarine Capable of Carrying Cruise Missiles Offered to Poland," *Defence 24*, Dec. 4, 2023, <https://defence24.com/industry/korean-submarine-capable-of-carrying-cruise-missiles-offered-to-poland>.

<sup>71</sup> Blagden, "Strategic Stability."

<sup>72</sup> Jack Watling and Nick Reynolds, "Meatgrinder: Russian Tactics in the Second Year of its Invasion of Ukraine," pp. 11–14, Royal United Services Institute, May 2023, <https://static.rusi.org/403-SR-Russian-Tactics-web-final.pdf>.

<sup>73</sup> Kofman, Fink, and Edmonds, *Russian Strategy of Escalation Management*.

<sup>74</sup> Kofman, Fink, and Edmonds, *Russian Strategy of Escalation Management*.

measures are implemented during peacetime and war. In times of peace, they aim to prevent direct aggression or the use of military pressure against Russian interests. During wartime, their purpose is to manage escalation, deescalate conflicts, and bring the war to an early end on terms that benefit Russia.<sup>75</sup>

Russian leaders intend to use strategic deterrence to convey their capability to inflict progressively escalating damage on crucial targets. The goal is to signal to the adversary the need to refrain from further aggression, deescalate hostilities, and end the conflict to avoid unacceptable levels of damage. These actions also aim to limit the scope of the conflict and deter third-party intervention, preventing escalation into a large-scale war.<sup>76</sup> In this strategy, select nuclear and nonnuclear weapons capable of creating strategic-level effects, particularly conventional long-range strike weapons, play a key role.

Russian doctrine expects the use of demonstrative, individual, or grouped long-range strikes to systematically increase the inflicted damage on the adversary, forcing the adversary to back down.<sup>77</sup> Within this framework, Russian military theorists assert that long-range strike weapons afford Russia the flexibility to precisely engage key structural elements of the adversary with varying intensity for

escalation management purposes. The crucial aspect lies in the targeted nature of the inflicted damage.<sup>78</sup> Without the ability to carefully calibrate the pain that the adversary experiences, the perceived ability to control escalation gets lost.

The Russia-Ukraine war may render certain aspects of this strategy uncertain, most notably the ability to reliably inflict precise levels of damage to carefully control the speed of escalation and the intensity of conflict. Russian long-range strike weapons have proved less survivable than previously assumed. In particular, Russian subsonic land-attack cruise missiles, which constitute the backbone of Russia's long-range strike arsenal, have been shot down in substantial numbers.<sup>79</sup> To bring even a small number of land-attack cruise missiles to their targets, Russia has to launch large missile volleys. In addition, the Russia-Ukraine war demonstrates that missile defense even against large-scale missile attacks is possible if the defender invests in and deploys a sufficient concentration of relevant missile defense systems as part of an integrated and layered air and missile defense network.

This possibility has two implications regarding Russia's missile-based escalation management strategy. First, under the right circumstances, a



Russian leaders intend to use strategic deterrence to convey their capability to inflict progressively escalating damage on crucial targets.

<sup>75</sup> Kristin Ven Bruusgaard, "Russian Strategic Deterrence," *Survival* 58, no. 4 (2016), pp. 7–26, <https://doi-org.ezproxy.uio.no/10.1080/00396338.2016.1207945>.

<sup>76</sup> Kofman, Fink, and Edmonds, *Russian Strategy of Escalation Management*.

<sup>77</sup> Dave Johnson, *Russia's Conventional Precision Strike Capabilities, Regional Crises, and Nuclear Thresholds*, Lawrence Livermore National Laboratory – Center for Global Security Research, Feb. 2018, <https://cgsr.llnl.gov/content/assets/docs/Precision-Strike-Capabilities-report-v3-7.pdf>.

<sup>78</sup> Kofman, Fink, and Edmonds, *Russian Strategy of Escalation Management*.

<sup>79</sup> This also depends on the density of missile defense assets in the targeted geographical area.



defender might be able to deny the benefits of Russian missile strikes and completely escape the coercive conundrum they pose, especially if missile defense assets are prepared and in place. Second, the uncertain nature of the damage caused by missile attacks challenges the assumption that the damage inflicted can be carefully scaled and calibrated. In fact, Russian decision-makers may question the ability of single or demonstrative strikes to produce guaranteed effects against a peer competitor such as NATO, even while considering that NATO may be less casualty tolerant than wartime Ukraine.

This lack of guaranteed effects has consequences for strategic stability. First, as Western and even Russian analysts have pointed out, Russia's focus on escalating conflicts early for the sake of deescalating them is potentially destabilizing. There is no guarantee that Western European decision-makers would back down and sue for peace rather than attempt to match Russia's escalation. The ability to deny this highly destabilizing strategy by means of effective missile defense, therefore, offers stabilizing prospects. Sufficient missile defense may convince Russian decision-makers to forgo such "deescalation strikes" in favor of other, potentially less destabilizing, strategies. On the other hand, the inability to reliably dose the levels of damage inflicted may result in Russian decision-makers rejecting smaller scale strike options in favor of larger scale missile strikes early to achieve an appropriate level of damage. Russian officials may even learn from the Russia-Ukraine war that long-range strike weapons can no longer produce guaranteed effects, incentivizing early tactical nuclear use. Both aspects may undermine crisis stability and could lead to more rapid strategic nuclear use.

Finally, the effectiveness of missile defense in Ukraine may have additional long-term implications for strategic stability related to perceived survivability of strategic nuclear weapon systems. Undoubtedly, defending against incoming strategic nuclear warheads delivered by intercontinental ballistic missiles is significantly more challenging than engaging conventional warheads delivered by long-range drones, cruise missiles, or short-range ballistic missiles. Doing so requires specialized interceptor missiles and enabling ISR capabilities.<sup>80</sup> Nevertheless, the track record of nonstrategic missile defense assets in Ukraine will not be ignored by Russian (or Chinese, for that matter) nuclear strategists, who will take these developments into account when deciding on future force posture requirements. Amid a crumbling arms control architecture, the demonstrated effectiveness of missile defense in Ukraine may render future increases of deployed strategic nuclear warheads more likely, creating additional pressures on arms control stability.

## Feasibility of conventional counterforce

The war demonstrates that long-range strike weapons have become increasingly potent weapon systems that may be employed for a range of tasks. A major concern of Russian officials and analysts in recent decades has been the substitutability of nuclear weapons for conventional weapon systems in counterforce engagements.<sup>81</sup> According to this argument, the potential vulnerability of nuclear weapons and nuclear weapons-related infrastructure to conventional weapons may increase Russia's

<sup>80</sup> The only missile defense system remotely capable of fulfilling this task reliably is the US Ground-based Midcourse Defense System. "Ground-based Midcourse Defense (GMD) System," Missile Threat, CSIS Missile Defense Project, June 14, 2018, last modified July 26, 2021, <https://missilethreat.csis.org/system/gmd/>.

<sup>81</sup> Acton, "Russia and Strategic Conventional Weapons;" Gormley, "US Advanced Conventional Systems;" Stefanovich, "Proliferation and Threats of Reconnaissance-Strike Systems."

vulnerability in the nuclear domain and undermine its secured second-strike capability.

This fear is not necessarily novel, and the issue was already discussed during the later part of the Cold War when precision-guided weapons first emerged.<sup>82</sup> The issue came to the forefront in the context of US ambitions relating to the Conventional Prompt Global Strike program and more recently in the context of the deployment and sale of American AGM-158 Joint Air-to-Surface Standard Missiles (JASSMs) to US partners and allies around the world, including several NATO allies in Europe.<sup>83</sup> The development and deployment of a next generation of advanced conventional weapons, including hypersonic missiles, is aggravating existing conventional counterforce fears, especially when the weapons are considered not in isolation but in combination with increasingly effective strategic and nonstrategic missile defense.<sup>84</sup>

The Russia-Ukraine war is likely to compound preexisting Russian fears regarding the conventional counterforce potential of the United States and its allies. The principal long-range strike weapon employed by Ukraine in this war has been the British-French Storm Shadow/SCALP-EG cruise missile. This cruise missile is equipped with a powerful

penetrator warhead system capable of engaging and destroying hardened targets, including nuclear assets.<sup>85</sup> The missile was developed in the 1990s and entered into service in the early 2000s. As such, the technology behind the missile is some 30 years old, meaning it no longer represents the state of the art by any means. Nevertheless, Russia has proved largely incapable of dealing with this missile. As

outlined previously, no confirmed intercepts of the missile system have taken place. At the same time, Storm Shadow/SCALP-EG has been capable of reliably engaging and destroying a range of high-value targets with pinpoint accuracy.

The performance of Storm Shadow/SCALP-EG will cause Russian decision-makers to question what more advanced types of long-range strike weapons are able to do. The JASSM cruise missile largely constitutes a comparable

but more modern land-attack cruise missile, especially in terms of its low-observability features that likely make it even more difficult to intercept. In addition, in a broader confrontation with NATO, Russia will not be subjected to only individual and sequential cruise strikes as in Ukraine. Instead, it may face grouped and parallel missile strikes potentially targeting its nuclear infrastructure.

The Russia-Ukraine war is likely to compound preexisting Russian fears regarding the conventional counterforce potential of the United States and its allies.

<sup>82</sup> Carl Builder, *The Prospects and Implications of Non-Nuclear Means for Strategic Conflict*, International Institute for Strategic Studies, 1985, <https://doi-org.ezproxy.uio.no/10.1080/05679328508448692>; Carl H. Builder, *Strategic Conflict Without Nuclear Weapons*, RAND, 1983, <https://www.rand.org/pubs/reports/R2980.html>; Richard Burt, "Nuclear Proliferation and the Spread of New Conventional Weapons Technology," *International Security* 1, no. 3 (1977), pp. 119–139, <https://www.jstor.org/stable/2626661>.

<sup>83</sup> Acton, "Russia and Strategic Conventional Weapons;" Gormley, "US Advanced Conventional Systems;" Stefanovich, "Proliferation and Threats of Reconnaissance-Strike Systems."

<sup>84</sup> Dean Wilkening, "Hypersonic Weapons and Strategic Stability," *Survival* 61, no. 5 (2019), pp. 129–148, <https://doi-org.ezproxy.uio.no/10.1080/00396338.2019.1662125>; Tong Zhao, "Conventional Long-range Strike Weapons of US Allies and China's Concerns of Strategic Instability," *Nonproliferation Review* 27, no. 1–3 (2020), pp. 109–122, <https://doi-org.ezproxy.uio.no/10.1080/10736700.2020.1795368>.

<sup>85</sup> "SCALP EG/Storm Shadow/SCALP Naval/Black Shaheen/APACHE AP."

Russian decision-makers will also be increasingly concerned about substantial increases in allied long-range strike arsenals, as outlined previously. Essentially, Russia's war of aggression against Ukraine has manifested what Russian analysts and officials have long feared: large numbers of long-range strike weapons at Russia's doorstep that might be used for counterforce and decapitation purposes, as well as effective missile defense that may undermine the second-strike capability of its nuclear arsenal. Although an argument can be made that a quantitative expansion of long-range strike weapons and missile defense systems in Europe was inevitable in the medium to long term, the current pace at which it is proceeding would not have occurred without Russia's war of choice in Ukraine.

The Russia-Ukraine war also provides insights into the ability to defend conventional counterforce strikes. The war has proven that defending against conventional missile capabilities is possible, even under complex strike scenarios. This ability means that although long-range strike weapons may have become a more potent threat in recent years, including to the nuclear assets of a nuclear weapon state, there is growing potential to defend against conventional counterforce strikes. The war demonstrates that it should be possible, in principle,

to effectively defend nuclear silo fields and other types of nuclear assets by protecting them with a layered missile defense shield that protects against different types of conventional threats by means of medium, short, and point missile defense systems. Ukraine's success in intercepting long-range drones and land-attack cruise missiles with scrambled fighter jets also indicates that protecting nuclear targets with airborne assets is possible, especially if those assets are located deep inland, leaving ample time to scramble fighter jets and bring countermeasures into position.<sup>86</sup>

Although this possibility of defense may be reassuring for Chinese decision-makers who share Russian concerns about the conventional counterforce potential of the United States

and its regional allies, Russian decision-makers are unlikely to find it similarly comforting. Their likely continued discomfort is the result of their own experience with missile defense in the war and the challenges that they faced in intercepting Ukrainian and Western long-range strike weapons. In addition, given the substantial losses of air and missile defense systems after two years of fighting in Ukraine, Russia is largely incapable of redeploying missile defense assets from the Ukrainian theater.<sup>87</sup> Therefore, Russia will most likely not have the equipment necessary to expand protection of its nuclear infrastructure,



The Russia-Ukraine war also provides insights into the ability to defend conventional counterforce strikes. The war has proven that defending against conventional missile capabilities is possible, even under complex strike scenarios.

<sup>86</sup> Gerry Doyle and Mariano Zafra, "The Air War over Ukraine," Reuters, Dec. 14, 2023, <https://www.reuters.com/graphics/UKRAINE-CRISIS/FIGHTER-JETS/jnvwqyylw/>.

<sup>87</sup> Russia reportedly already had to redeploy air defense assets from Kaliningrad to backfill losses on the front line. Sofiia Syngaivska, "The UK Defense Intelligence: Russia Deploys Strategic Air Defense Systems from Kaliningrad to Ukraine," Defense Express, Nov. 26, 2023, [https://en.defence-ua.com/news/the\\_uk\\_defense\\_intelligence\\_russia\\_deploys\\_strategic\\_air\\_defense\\_systems\\_from\\_kaliningrad\\_to\\_ukraine-8680.html](https://en.defence-ua.com/news/the_uk_defense_intelligence_russia_deploys_strategic_air_defense_systems_from_kaliningrad_to_ukraine-8680.html).

even if it wanted to. At least in the short to medium term, Russian decision-makers will likely consider their nuclear weapons capabilities more vulnerable to conventional counterforce attacks.

This perception of threat may convince Russian decision-makers that their nuclear arsenal is increasingly vulnerable to both nuclear and

conventional attack, resulting in decreased crisis stability. In addition, such a threat perception may render future arms control talks with the United States more difficult or incentivize Russia to invest in the survivability of its arsenal, including by quantitative expansion.

## CONCLUSION

The Russia-Ukraine war marks the first instance of a major inter-state conflict involving the extensive deployment and utilization of long-range strike weapons and nonstrategic missile defense systems. Consequently, it has become a testing ground for advanced offensive and defensive missile technologies, showcasing both their capabilities and limitations.

As this paper indicates, aspects related to the deployment and use of offensive and defensive missile technologies in the Russia-Ukraine war may negatively affect NATO-Russia strategic stability. These aspects relate to the decreased first-strike stability resulting from the proliferation of long-range strike weapons; the credibility of Russian missile doctrine, which may suffer because of Russia's long-range strike track record in Ukraine; and the feasibility of successful conventional counterforce engagements, which Russian decision-makers may

deem more likely. Overall, these issues could put pressure on crisis and arms race stability in the medium to long term and increase the likelihood of strategic nuclear exchanges in future conflict.

Can adverse strategic stability implications related to the deployment and use of long-range strike weapons and missile defense systems in Ukraine be mitigated? Such mitigation will be difficult, at least in the near future. Long-range strike weapons and missile defense have emerged as core capabilities of modern war. NATO states will not want to forgo these critical weapon systems in favor of distant prospects related to increased strategic stability, nor should they. Nevertheless, retaining an awareness about how the proliferation, deployment, and use of new capabilities, including in the conventional realm, shape the conduct of nuclear strategy is important.

## REFERENCES

- "3M-14 Kalibr (SS-N-30A)." Missile Threat, CSIS Missile Defense Project. Aug. 11, 2016, last modified Mar. 7, 2022. <https://missilethreat.csis.org/missile/ss-n-30a/>.
- Acton, James. "Russia and Strategic Conventional Weapons: Concerns and Responses." *Nonproliferation Review* 22, no. 2 (2015): 141–154. <https://doi.org/10.1080/10736700.2015.1105434>.
- Acton, James. "Reclaiming Strategic Stability." In *Strategic Stability: Contending Interpretations*. Edited by Elbridge A. Colby and Michael S. Gerson. Carlisle, PA: US Army War College Press, 2013, 117–146. <https://apps.dtic.mil/sti/pdfs/ADA572928.pdf>.
- Adamowski, Jaroslaw. "Subs, Cruise Missiles to Drive Poland's Navy Modernization." Defense News. Aug. 28, 2017. <https://www.defensenews.com/smr/european-balance-of-power/2017/08/28/subs-cruise-missiles-to-drive-polands-navy-modernization/>.
- Alberque, William, Douglas Barrie, Zuzanna Gwadera, and Timothy Wright. *Russia's War in Ukraine: Ballistic and Cruise Trajectories*. International Institute for Strategic Studies. Oct. 5, 2023. <https://www.iiss.org/research-paper/2023/10/russias-war-in-ukraine-ballistic-and-cruise-trajectories/>.
- Altman, Howard. "Russia's Shahed-136 Drones Now Feature Tungsten Shrapnel." The War Zone. Sept. 28, 2023. <https://www.thedrive.com/the-war-zone/russias-shahed-136-drones-now-feature-tungsten-shrapnel>.
- Altman, Howard. "Ukraine Using Land Attack Variant of Neptune Anti-Ship Missile." The War Zone. Aug. 29, 2023. <https://www.thedrive.com/the-war-zone/ukraine-now-using-land-attack-neptune-anti-ship-missile-variant>.
- "Another Mass Attack on Monday Morning: Russia Hits Energy Infrastructure Across Ukraine." *Kyiv Independent*. Oct. 31, 2022. <https://kyivindependent.com/another-mass-attack-on-monday-morning-russias-hits-energy-infrastructure-across-ukraine/>.
- "The Arms and Military Equipment Germany Is Sending to Ukraine." German Federal Government. Jan. 4, 2024. <https://www.bundesregierung.de/breg-en/news/military-support-ukraine-2054992>.
- Axe, David. "After a Six-Month Lull, the Ukrainians Are Lobbing Tochka Ballistic Missiles Again." Forbes. Nov. 23, 2023. <https://www.forbes.com/sites/davidaxe/2023/11/23/after-a-six-month-lull-the-ukrainians-are-lobbing-tochka-ballistic-missiles-again/?sh=7d0cb22f7adb>.



# Strategic Stability and the Ukraine War

## *Implications of Conventional Missile Technologies*

- Axe, David. "A Ukrainian Cruise Missile with a Special Warhead Blew Up That Russian Submarine from the Inside." *Forbes*. Sept. 18, 2023. <https://www.forbes.com/sites/davidaxe/2023/09/18/a-ukrainian-cruise-missile-with-a-special-warhead-blew-up-that-russian-submarine-from-the-inside/?sh=64d95cc25efd>.
- Bachega, Hugo, and Yaroslav Lukov. "Ukraine War: Blackouts in 1,162 Towns and Villages After Russia Strikes." *BBC*. Oct. 18, 2022. <https://www.bbc.com/news/world-europe-63297239>.
- Baldor, Lolita C. "Pentagon's 'FrankenSAM' Program Cobbles Together Air Defense Weapons for Ukraine." *Associated Press*. Oct. 12, 2023. <https://apnews.com/article/ukraine-russia-war-military-missiles-16c344bdba2e0695a2286a55d9614ff4>.
- Blagden, David. "Strategic Stability and the Proliferation of Conventional Precision Strike: A (Bounded) Case for Optimism?" *Nonproliferation Review* 27, no. 1–3 (2020): 123–136. <https://doi-org.ezproxy.uio.no/10.1080/10736700.2020.1799569>.
- Bronk, Justin. "Is the Russian Air Force Actually Incapable of Complex Air Operations?" *RUSI*. Mar. 4, 2022. <https://www.rusi.org/explore-our-research/publications/rusi-defence-systems/russian-air-force-actually-incapable-complex-air-operations>.
- Bronk, Justin. "The Mysterious Case of the Missing Russian Air Force." *RUSI*. Feb. 28, 2022. <https://rusi.org/explore-our-research/publications/commentary/mysterious-case-missing-russian-air-force>.
- Builder, Carl. *The Prospects and Implications of Non-Nuclear Means for Strategic Conflict*. International Institute for Strategic Studies. 1985. <https://doi-org.ezproxy.uio.no/10.1080/05679328508448692>.
- Builder, Carl H. *Strategic Conflict Without Nuclear Weapons*. RAND. 1983. <https://www.rand.org/pubs/reports/R2980.html>.
- Burt, Richard. "Nuclear Proliferation and the Spread of New Conventional Weapons Technology." *International Security* 1, no. 3 (1977): 119–139. <https://www.jstor.org/stable/2626661>.
- Calibre Obscura (@CalibreObscura). "Pantsir-S1 can't even intercept a Storm Shadow even when it has it locked on thermals." Post. X. June 22, 2023, 3:35 p.m. <https://twitter.com/CalibreObscura/status/1671965086959673357>.
- Chesnut, Mary. *US/NATO-Russian Strategic Stability and the War in Ukraine*. CNA. IOP-2023-U-035792-Final. June 2023. <https://www.cna.org/reports/2023/06/us-nato-russian-strategic-stability-in-ukraine>.
- Cirincione, Joe. "In Ukraine, a New Chance to Judge the Patriot Missile." *Defense One*. May 5, 2023. <https://www.defenseone.com/ideas/2023/05/ukraine-another-chance-judge-patriot-missile/386036/>.



- Colby, Elbridge A. "Defining Strategic Stability: Reconciling Stability and Deterrence." In *Strategic Stability: Contending Interpretations*. Edited by Eldridge A. Colby and Michael S. Gerson. Carlisle, PA: US Army War College Press, 2013, 47–84. <https://apps.dtic.mil/sti/pdfs/ADA572928.pdf>.
- Doyle, Gerry, and Mariano Zafra. "The Air War over Ukraine." Reuters. Dec. 14, 2023. <https://www.reuters.com/graphics/UKRAINE-CRISIS/FIGHTER-JETS/jnvwqyylvw/>.
- Dura, Maksymilian. "Korean Submarine Capable of Carrying Cruise Missiles Offered to Poland." Defence 24. Dec. 4, 2023. <https://defence24.com/industry/korean-submarine-capable-of-carrying-cruise-missiles-offered-to-poland>.
- "European Sky Shield – An Overview of the Initiative" [European Sky Shield – Die Initiative im Überblick]. Federal Ministry of Defense Germany. <https://www.bmvg.de/de/aktuelles/european-sky-shield-die-initiative-im-ueberblick-5511066>.
- Fisher, Max. "Did American Missile Defense Fail in Saudi Arabia?" *New York Times*. Dec. 4, 2017. <https://www.nytimes.com/interactive/2017/12/04/world/middleeast/saudi-missile-defense.html>.
- Futter, Andrew, and Benjamin Zala. "Advanced US Conventional Weapons and Nuclear Disarmament: Why the Obama Plan Won't Work." *Nonproliferation Review* 20, no. 1 (2013): 107–122. <https://doi.org/10.1080/10736700.2012.761790>.
- Futter, Andrew, and Benjamin Zala. "Strategic Non-Nuclear Weapons and the Onset of a Third Nuclear Age." *European Journal of International Security* 6, no. 3 (2021): 257–277. <https://doi.org/10.1017/eis.2021.2>.
- Gabel, Barbara. "'A Strong Gesture:' French Delivery of SCALP Missiles to Ukraine Marks Shift in Western Strategy." France 24. July 13, 2023. <https://www.france24.com/en/europe/20230713-a-strong-gesture-french-delivery-of-scalp-missiles-to-ukraine-marks-shift-in-western-strategy>.
- Gormley, Dennis M. "US Advanced Conventional Systems and Conventional Prompt Global Strike Ambitions: Assessing the Risks, Benefits, and Arms Control Implications." *Nonproliferation Review* 22, no. 2 (2015): 123–139. <https://doi.org/10.1080/10736700.2015.1117735>.
- "Ground-based Midcourse Defense (GMD) System." Missile Threat, CSIS Missile Defense Project. June 14, 2018, last modified July 26, 2021. <https://missilethreat.csis.org/system/gmd/>.
- Harding, Luke, Dan Sabbagh, and Isobel Koshiw. "Russia Targets Ukraine Energy and Water Infrastructure in Missile Attacks." *Guardian*. Oct. 31, 2022. <https://www.theguardian.com/world/2022/oct/31/russian-missiles-kyiv-ukraine-cities>.
- Helfrich, Emma. "The Netherlands Is Going to Bet Big on Long-range Weapons." *The War Zone*. Apr. 3, 2023. <https://www.thedrive.com/the-war-zone/the-netherlands-is-going-to-bet-big-on-long-range-weapons>.

## Strategic Stability and the Ukraine War *Implications of Conventional Missile Technologies*

- Hoffmann, Fabian. *Cruise Missile Proliferation: Trends, Strategic Implications, and Counterproliferation*. European Leadership Network. Mar. 2021. <https://www.europeanleadershipnetwork.org/report/cruise-missile-proliferation-trends-strategic-implications-and-counterproliferation/>.
- Hoffmann, Fabian. "Europe's Missile Conundrum." *War on the Rocks*. July 25, 2023. <https://warontherocks.com/2023/07/europes-missile-conundrum/>.
- Hoffmann, Fabian. *Strategic Non-Nuclear Weapons and Strategic Stability – Promoting Trust Through Technical Understanding*. Fondation pour la Recherche Stratégique. Nov. 2021. <https://www.frstrategie.org/en/programs/npt-and-the-p5-process/strategic-non-nuclear-weapons-and-strategic-stability-promoting-trust-through-technical-understanding-2021>.
- Hoffmann, Fabian (@FRHoffmann1). "First pictures of a downed Storm Shadow." Post. X. July 4, 2023, 6:07 a.m. <https://twitter.com/FRHoffmann1/status/1676170771507433472>.
- Hoffmann, Fabian (@FRHoffmann1). "There is no reason to assume that Russian S-300s cannot intercept Storm Shadows." Post. X. May 11, 2023, 9:34 a.m. <https://twitter.com/FRHoffmann1/status/1656653906091573251>.
- Hoffmann, Fabian, and William Alberque. *Non-Nuclear Weapons with Strategic Effect: New Tools of Warfare?* International Institute for Strategic Studies. Mar. 2022. <https://www.iiss.org/research-paper/2022/03/non-nuclear-weapons-with-strategic-effect-new-tools-of-warfare/>.
- "How Ukraine Tamed Russian Missile Barrages and Kept the Lights on." *Economist*. Mar. 12, 2023. <https://www.economist.com/europe/2023/03/12/how-ukraine-tamed-russian-missile-barrages-and-kept-the-lights-on>.
- Hudson, John. "Ukraine Lures Russian Missiles with Decoys of US Rocket System." *Washington Post*. Aug. 30, 2022. <https://www.washingtonpost.com/world/2022/08/30/ukraine-russia-himars-decoy-artillery/>.
- Jacobsen, Mark. "Ukraine's Drone Strikes Are a Window into the Future of Warfare." Atlantic Council. Sept. 14, 2023. <https://www.atlanticcouncil.org/blogs/new-atlanticist/ukraines-drone-strikes-are-a-window-into-the-future-of-warfare/>.
- Johnson, Dave. *Russia's Conventional Precision Strike Capabilities, Regional Crises, and Nuclear Thresholds*. Lawrence Livermore National Laboratory – Center for Global Security Research. Feb. 2018. <https://cgsr.llnl.gov/content/assets/docs/Precision-Strike-Capabilities-report-v3-7.pdf>.
- Johnson, Shawn. "Defense Expert Says Russia's Position 'Never Looked Weaker' After Ukraine Downed Putin's 'Invincible' Missiles." *Business Insider*. May 20, 2023. <https://biz.crastr.net/defense-expert-says-russias-position-never-looked-weaker-after-ukraine-downed-putins-invincible-missiles/>.

- "Joint Procurement Makes Baltic Defensive Capabilities More Robust." Ministry of National Defence, Republic of Lithuania. Mar. 28, 2023. <https://kam.lt/en/joint-procurement-makes-baltic-defensive-capabilities-more-robust/>.
- "Kh-101/Kh-102." Missile Threat, CSIS Missile Defense Project. Oct. 26, 2017, last modified July 31, 2021. <https://missilethreat.csis.org/missile/kh-101-kh-102/>.
- "Kh-47M2 Kinzhal." Missile Threat, CSIS Missile Defense Project. Mar. 27, 2018, last modified Mar. 19, 2022. <https://missilethreat.csis.org/missile/kinzhal/>.
- "Kh-55 (AS-15)." Missile Threat, CSIS Missile Defense Project. Aug. 10, 2016, last modified Aug. 2, 2021. <https://missilethreat.csis.org/missile/kh-55/>.
- Khoo, Nicholas, and Reuben Steff. "'This Program Will Not Be a Threat to Them:' Ballistic Missile Defense and US Relations with Russia and China." *Defense & Security Analysis* 30, no. 1 (2014): 17–28. <https://doi.org/10.1080/14751798.2013.864869>.
- Kluth, Andreas. "Russia's 'Human Wave Attacks' Are Another Step into Hell." *Washington Post*. Feb. 14, 2023. [https://www.washingtonpost.com/business/russias-human-wave-attacks-are-another-step-into-hell/2023/02/14/574e7202-ac27-11ed-b0ba-9f4244c6e5da\\_story.html](https://www.washingtonpost.com/business/russias-human-wave-attacks-are-another-step-into-hell/2023/02/14/574e7202-ac27-11ed-b0ba-9f4244c6e5da_story.html).
- Kofman, Michael, Anya Fink, and Jeffrey Edmonds. *Russian Strategy of Escalation Management: Evolution of Key Concepts*. CNA. DRM-2019-U-022455-1Rev. Apr. 2020. <https://www.cna.org/reports/2020/04/russian-strategy-for-escalation-management-key-concepts>.
- Korshak, Stefan. "Russian Glider Bombs Are Hitting Ukrainian Positions with Impunity." *Kyiv Post*. Oct. 10, 2023. <https://www.kyivpost.com/post/22570>.
- Kottasová, Ivana, Olga Voitovich, Mick Krever, Alex Marquardt, Scott McWhinnie, and Sebastian Shukla. "Ukrainian Air Defenses in Odesa Outgunned as Russia Targets Global Grain Supply." CNN. July 21, 2023. <https://edition.cnn.com/2023/07/20/europe/ukraine-air-defenses-odesa-russia-strikes-grain-intl/index.html>.
- Lewis, Jeffrey. "Patriot Missiles Are Made in America and Fail Everywhere." *Foreign Policy*. Mar. 28, 2018. <https://foreignpolicy.com/2018/03/28/patriot-missiles-are-made-in-america-and-fail-everywhere/>.
- "MGM-140 Army Tactical Missile System (ATACMS)." Missile Threat, CSIS Missile Defense Project. Nov. 30, 2016, last modified July 31, 2021. <https://missilethreat.csis.org/missile/atacms/>.
- Newdick, Thomas. "Black Sea Fleet Headquarters Takes Direct Hit from Cruise Missile." *The War Zone*. Sept. 22, 2023. <https://www.thedrive.com/the-war-zone/black-sea-fleet-headquarters-takes-direct-hit-from-cruise-missile>.

## Strategic Stability and the Ukraine War *Implications of Conventional Missile Technologies*

- Newdick, Thomas. "Russia Now Firing S-300 Surface-to-Air Missiles at Land Targets in Ukraine: Official." *The War Zone*. July 8, 2022. <https://www.thedrive.com/the-war-zone/russia-now-firing-s-300-surface-to-air-missiles-at-land-targets-in-ukraine-official>.
- Newdick, Thomas. "SU-24 Fencer Is Ukraine's Storm Shadow Missile Carrier." *The War Zone*. May 24, 2023. <https://www.thedrive.com/the-war-zone/su-24-fencer-is-ukraines-storm-shadow-missile-carrier>.
- Noorman, Randy. "The Russian Way of War in Ukraine: A Military Approach Nine Decades in the Making." *Modern War Institute*. June 15, 2023. <https://mwi.westpoint.edu/the-russian-way-of-war-in-ukraine-a-military-approach-nine-decades-in-the-making/>.
- Panella, Chris. "Shooting Down Russia's Overhyped Missiles with Patriots Is a Win for More Than Just Ukraine. The War Is an 'Intelligence Bonanza' for the West." *Business Insider*. Jan. 4, 2024. <https://www.businessinsider.com/western-weapons-wins-against-russia-are-intelligence-bonanza-2024-1?r=US&IR=T>.
- Peck, Michael. "Storm Shadow Missiles Give Ukraine 'a Much Longer Stick,' but Russia Is Already Learning to Adapt, Expert Says," *Business Insider*, July 31, 2023, [https://www.businessinsider.com/ukraine-storm-shadow-effective-long-range-missile-but-russia-adapts-2023-7?utm\\_source=copy-link&utm\\_medium=referral&utm\\_content=topbar](https://www.businessinsider.com/ukraine-storm-shadow-effective-long-range-missile-but-russia-adapts-2023-7?utm_source=copy-link&utm_medium=referral&utm_content=topbar).
- Pemble, Adam. "US-Made Patriot Guided Missile Systems Arrive in Ukraine." *Associated Press*. Apr. 20, 2023. <https://apnews.com/article/russia-ukraine-war-patriot-missile-system-4c79f9110899ca1880a61f2d1f328179>.
- Plichta, Marcel. "Ukraine Vows to Strike Back If Russia Resumes Energy Infrastructure Attacks." *Atlantic Council*. Nov. 16, 2023. <https://www.atlanticcouncil.org/blogs/ukrainealert/ukraine-vows-to-strike-back-if-russia-resumes-energy-infrastructure-attacks/>.
- "Russia Salvages Landing Ship Hit by Ukraine Missile Fire." *BBC*. July 2, 2022. <https://www.bbc.com/news/world-europe-62022476>.
- "Russia's Kh-22 – the Missile Ukraine Has Yet to Shoot Down." *Kyiv Post*. Dec. 29, 2023. <https://www.kyivpost.com/post/26102>.
- "SCALP EG/Storm Shadow/SCALP Naval/Black Shaheen/APACHE AP." *Missile Threat, CSIS Missile Defense Project*. Dec. 2, 2016, last modified Sept. 20, 2023. <https://missilethreat.csis.org/missile/apache-ap/>.
- Sciutto, Jim. "Britain Has Delivered Long-range 'Storm Shadow' Cruise Missiles to Ukraine Ahead of Expected Counteroffensive, Sources Say." *CNN*. May 12, 2023. <https://edition.cnn.com/2023/05/11/politics/uk-storm-shadow-cruise-missiles-ukraine/index.html>.
- Shagina, Maria. "Why Can't the West Stop Supplying Technology for Russian Weapons?" *Foreign Policy*. Nov. 9, 2023. <https://foreignpolicy.com/2023/11/09/russia-sanctions-weapons-technology-exports-evasion-arms-production-missiles-chips/>.

- Sitnikova, Iryna. "The Ministry of Defense of the Russian Federation Acknowledged the Attacks on Its Military Airfields. Blames Ukraine" [Міноборони рф визнало удари по своїх військових аеродромах. Звинувачує Україну]. Hromadske. Dec. 5, 2022. <https://hromadske.ua/posts/minoboroni-rf-viznalo-udari-po-svoyih-vijskovich-aerodromah-zvinuvachuye-ukrayinu>.
- Sonne, Paul, Isabelle Khurshudyan, Serhiy Morgunov, and Kostiantyn Khudov. "Battle For Kyiv: Ukrainian Valor, Russian Blunders Combined to Save the Capital." *Washington Post*. Aug. 24, 2023. <https://www.washingtonpost.com/national-security/interactive/2022/kyiv-battle-ukraine-survival/>.
- Spencer, Thomas. "Can UK's Storm Shadow Missiles Change Ukraine's Fight Against Russia?" BBC. June 6, 2023. <https://www.bbc.com/news/world-europe-65813770>.
- Stefanovich, Dmitry. "Proliferation and Threats of Reconnaissance-Strike Systems: A Russian Perspective." *Nonproliferation Review* 27, no. 1–3 (2020): 97–107. <https://doi.org/10.1080/10736700.2020.1795370>.
- Syngaivska, Sofiiia. "The UK Defense Intelligence: Russia Deploys Strategic Air Defense Systems from Kaliningrad to Ukraine." *Defense Express*. Nov. 26, 2023. <https://en.defence-ua.com/news/the-uk-defense-intelligence-russia-deploys-strategic-air-defense-systems-from-kaliningrad-to-ukraine-8680.html>.
- Trevithick, Joseph. "Full Devastation from Cruise Missile Attack on Russian Ship Comes into View." *The War Zone*. Dec. 27, 2023. <https://www.thedrive.com/the-war-zone/full-devastation-from-cruise-missile-attack-on-russian-ship-coming-into-view>.
- Trevithick, Joseph. "Russian Kh-101 Cruise Missile Filmed Firing-Off Decoy Flares." *The War Zone*. Dec. 29, 2023. <https://www.thedrive.com/the-war-zone/russian-kh-101-cruise-missile-filmed-firing-off-decoy-flares>.
- Trevithick, Joseph, and Tyler Rogoway. "Destruction from Ukraine's First ATACMS Strike Now Apparent." *The War Zone*. Oct. 18, 2023. <https://www.thedrive.com/the-war-zone/destruction-from-ukraines-first-atacms-strike-now-apparent>.
- "Ukraine Unable to Shoot Down Kh-22 Missiles, Says Air Force." *The New Voice of Ukraine*. Jan. 15, 2023. <https://english.nv.ua/nation/air-defense-cannot-shoot-down-russian-kh-22-missiles-ukraine-war-50297621.html>.
- "Ukraine's Mobile Air Defences Have Ammo for 'Few More Attacks:' Commander." *France 24*. Jan. 4, 2024. <https://www.france24.com/en/live-news/20240104-ukraine-s-mobile-air-defences-have-ammo-for-few-more-attacks-commander>.
- US Defense Intelligence Agency. *Iranian UAVs in Ukraine: A Visual Comparison*. Aug. 2023. [https://www.dia.mil/Portals/110/Documents/News/Military Power Publications/UAV Book.pdf](https://www.dia.mil/Portals/110/Documents/News/Military%20Power%20Publications/UAV%20Book.pdf).

"US-Supplied ATACMS Enter the Ukraine War." Reuters. Oct. 19, 2023. <https://www.reuters.com/world/atacms-us-may-send-ukraine-their-cluster-bomb-payloads-2023-10-19/>.

Ven Bruusgaard, Kristin. "Russian Strategic Deterrence." *Survival* 58, no. 4 (2016): 7–26. <https://doi-org.ezproxy.uio.no/10.1080/00396338.2016.1207945>.

Watling, Jack, and Nick Reynolds. "Meatgrinder: Russian Tactics in the Second Year of its Invasion of Ukraine." pp. 11–14, Royal United Services Institute. May 2023. <https://static.rusi.org/403-SR-Russian-Tactics-web-final.pdf>.

Wilkening, Dean. "Hypersonic Weapons and Strategic Stability." *Survival* 61, no. 5 (2019): 129–148. <https://doi-org.ezproxy.uio.no/10.1080/00396338.2019.1662125>;

Williams, Ian. "Russia Isn't Going to Run Out of Missiles." Center for Strategic and International Studies. June 28, 2023. <https://www.csis.org/analysis/russia-isnt-going-run-out-missiles>.

"Zelensky: Newly-Delivered NASAMS Systems Enter Service in Ukraine." *Kyiv Independent*. Nov. 7, 2023. <https://kyivindependent.com/zelensky-newly-delivered-nasams-systems-enter-service-in-ukraine/#:~:text=The%20NASAMS%20systems%20have%20been,to%20deliver%20two%20more%20launchers>.

Zhao, Tong. "Conventional Long-range Strike Weapons of US Allies and China's Concerns of Strategic Instability." *Nonproliferation Review* 27, no. 1–3 (2020): 109–122. <https://doi-org.ezproxy.uio.no/10.1080/10736700.2020.1795368>.

Zhirohov, Mikhail. "Ukraine Adopts Neptune Coastal Defence Missile." *Janes*. Aug. 27, 2020. <https://www.janes.com/defence-news/news-detail/ukraine-adopts-neptune-coastal-defence-missile>.



PAGE INTENTIONALLY BLANK



## **This report was written by CNA's Strategy, Policy, Plans, and Programs Division (SP3).**

SP3 provides strategic and political-military analysis informed by regional expertise to support operational and policy-level decision-makers across the Department of the Navy, the Office of the Secretary of Defense, the unified combatant commands, the intelligence community, and domestic agencies. The division leverages social science research methods, field research, regional expertise, primary language skills, Track 1.5 partnerships, and policy and operational experience to support senior decision-makers.

Any copyright in this work is subject to the Government's Unlimited Rights license as defined in DFARS 252.227-7013 and/or DFARS 252.227-7014. The reproduction of this work for commercial purposes is strictly prohibited. Nongovernmental users may copy and distribute this document noncommercially, in any medium, provided that the copyright notice is reproduced in all copies. Nongovernmental users may not use technical measures to obstruct or control the reading or further copying of the copies they make or distribute. Nongovernmental users may not accept compensation of any manner in exchange for copies.

All other rights reserved. The provision of this data and/or source code is without warranties or guarantees to the Recipient Party by the Supplying Party with respect to the intended use of the supplied information. Nor shall the Supplying Party be liable to the Recipient Party for any errors or omissions in the supplied information.

This report may contain hyperlinks to websites and servers maintained by third parties. CNA does not control, evaluate, endorse, or guarantee content found in those sites. We do not assume any responsibility or liability for the actions, products, services, and content of those sites or the parties that operate them.

## **ABOUT CNA**

CNA is a nonprofit research and analysis organization dedicated to the safety and security of the nation. It operates the Center for Naval Analyses—the federally funded research and development center (FFRDC) of the Department of the Navy—as well as the Institute for Public Research. CNA develops actionable solutions to complex problems of national importance. With nearly 700 scientists, analysts, and professional staff, CNA takes a real-world approach to gathering data. Its unique Field Program places analysts on aircraft carriers and military bases, in squad rooms and crisis centers, working side by side with operators and decision-makers around the world. CNA supports naval operations, fleet readiness, and strategic competition. Its non-defense research portfolio includes criminal justice, homeland security, and data management.



Dedicated to the Safety and Security of the Nation

[www.cna.org](http://www.cna.org)