SEPTEMBER 2025

A REPORT OF THE CSIS DEFENSE AND SECURITY DEPARTMENT

War and the Modern Battlefield

Insights from Ukraine and the Middle East

EDITORS

Seth G. Jones and Seamus P. Daniels

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INTRODUCTION

How to Think About Modern Warfare

By Eliot A. Cohen

One of the great imponderables is what war will look like when all the dimensions, new and old, are woven together—information operations, irregular warfare, cyberattacks, space warfare, and even conceivably biological and nuclear warfare.

It is a long-standing habit of military historians to describe changes in warfare in terms of two biological paradigms: more or less steady evolution on the one hand and punctuated equilibrium on the other.[1] The messy truth is in between. Sometimes the practice of war—its art and science, the sources of military strength and weakness—advances by fits and starts, and sometimes it evolves at a steady pace.

It is reasonable to assert that the world is at a junction at which war is changing rapidly and that the pure evolutionary model no longer suffices. A confluence of political, social, and technological changes have collectively made war something very different than the practitioners and theorists of the Cold War expected and understood. That is why this collection of studies is so important: There are very large changes underway which have to be understood from multiple perspectives and which resist simple characterization.

The Cold War saw different forms of conflict: irregular wars, which characterized the end of the European empires and their sequels (as in Vietnam), and short, sharp conventional conflicts (as in the 1967, 1973, and 1982 Arab-Israeli wars, the 1971 India-Pakistan War, or the China-Vietnam war of 1979). These wars could be very costly, with casualties in the tens of thousands and possibly more, but by and large they were relatively brief and contained.

The conflicts occurring today in Ukraine and the Middle East have changed that paradigm. These have been two large and protracted wars, lasting not weeks or months but years. They have involved enormous damage to civilian infrastructure and opposed not individual actors but large coalitions of states assisting proxies or clients. Whereas the wars of the late twentieth century involved one-sided dominance of the air, in these wars, missiles, drones, and occasionally aircraft are able to penetrate deep into enemy territory. These wars are different.

Through them, the United States and its allies have rediscovered some old truths—chief among them the importance of industrial production of end

items and munitions. In 2022, the United States' entire monthly production of 155 mm artillery rounds amounted to only somewhat more than what Ukraine expended every day—and considerably less than Russia's daily rate of use. European allies were even worse off. Even Russia, which had retained an industrial mobilization model for war production, has not been able to meet the demands of the Ukraine war and depended on poorer but industrially deeper clients, like North Korea and Iran, to make up the shortfalls.

Similarly, the West has rediscovered the phenomenon of irregular—or as we now prefer to call it, hybrid—warfare. All wars, including the World Wars, have included the extensive use of propaganda, subversion, and proxy and guerrilla warfare. In no case were these factors sufficient to change the fundamental balance of power, but they played their part nonetheless. However, these elements are playing an increasing role in contemporary warfare.

The nuclear dimension of strategy has also reappeared after a hiatus of more than a generation. While fears of nuclear proliferation helped trigger the Second Gulf War in 2003 and concerns about the North Korean and Iranian nuclear programs have been important in U.S. foreign policy, nuclear weapons played only a minor role in the strategic thinking of the United States and other large powers from the end of the Cold War through the 2020s. That is no longer the case. The rise of China's nuclear arsenal is one reason for this: China had doubled its number of nuclear warheads in the last decade, and it looks to double them again by 2030. As a result, the United States now faces two potential nuclear opponents that equal or may even overmatch it. Even more troubling, the disruption of the United States' European alliances brought about by the Trump administration may very well launch a cascade of proliferation that will reshape geopolitics, for example, if countries like Poland and Finland feel they can no longer trust a U.S. deterrent.

There are, however, genuinely new developments in the *techne* of war. The widespread use of unmanned systems in the Ukraine war is a notable example. Some of the first drones appeared at the end of World War I—most notably the Kettering Bug—and they sporadically reappeared during World War II and in Vietnam. The first major use came in the 1982 Israel-Lebanon war. But the Russia-Ukraine war (like the Azeri-Armenian war of 2020) saw a massive development in drone warfare: a change in quantity that became a change in quality.

From a few hundred unmanned aircraft systems (UASs) at the beginning of the war, Ukraine began deploying thousands, then tens of thousands of drones, and is now manufacturing millions annually. Russia, of course, followed suit. The pattern of ground combat changed, as a UAS-saturated battlefield paralyzed vehicular movement, while an entire fleet—Russia's Black Sea Fleet—has suffered greater than 30 percent losses and was stopped in its tracks by the attacks of unmanned surface and subsurface systems.[2]

Unmanned ground-based systems have also begun to appear, which will no doubt evolve and proliferate as well.

The deployment of various forms of AI in a military context is also a genuine innovation that has become pervasive. Automatic target recognition and the processing of vast quantities of data has enabled Israel to conduct orders of magnitude more strikes in its wars with Hamas in Gaza and Hezbollah in Lebanon than it could have otherwise. Not only does AI enable the unmanned systems revolution, but it has increasingly transformed tactical- and even operational-level decisionmaking, with consequences for the degree of human control of combat in all of its domains.

It is reasonable to expect that soon enough even terrorist organizations will be able to launch swarms of drones that cooperate with each other to attack targets. Indeed, such a capability probably already exists. The use of sophisticated facial recognition and other targeting software means that the barriers to extensive assassination campaigns, once the prerogative only of the United States, will lessen. The planning and execution of long-range attacks enabled by AI will not completely level the playing field for war, but it will go a long way toward it.

War is changing in other respects as well. It has expanded to new realms, chiefly space and cyberspace. Space-based systems first played an important role in the 1991 Gulf War, but the consequences were one-sided and largely confined to reconnaissance, navigation, and communications. However, the recent explosion in satellite numbers is remarkable. In 2015, there were about 1,400 active satellites in orbit; in 2025, there are over 10,000, and the next decade may see that number quintupling.[3] Already, all countries can make some use of space for communications, navigation, and reconnaissance whether or not they possess their own satellites. Further, the potential now exists for actual warfare in and from space, including kinetic and non-kinetic attacks on satellite systems and the delivery of kinetic weapons from space to Earth. Compounding this spread of space-based capabilities is the increased (if murky) interest of great powers in the use of space as an area of combat; the temptation of blinding an opponent, or delivering unanswerable strikes from outer space, may be too much to resist in the next war.

Meanwhile, conflict in cyberspace is now constant—albeit with spikes at particular moments, such as during the first months of Russia's invasion of Ukraine in 2022 or in the Russian attack on Estonia in 2007. What remains to be seen (but will almost surely occur) is the use of cyberattacks to conduct lethal forms of sabotage.

For the United States, all of these changes come at a time when its strategic predicament has become more global and multifaceted. Three large geopolitical challenges have emerged. The first of these is a coalition of hostile powers—China, Russia, Iran, and North Korea—that collude in several respects and have a common objective of bringing U.S. predominance to

an end. Their collaboration across multiple domains—like the deployment of North Korean troops and Iranian drones to fight Ukraine, the sharing of advanced military technology and production, cooperation in disinformation campaigns, and probably sabotage operations against the West—is a challenge unparalleled since the early days of the Cold War.

The second challenge, which results from both geopolitics and technology, is the return of the threat of global war. Particularly after the Cold War, the U.S. military got into the habit of thinking about war as a regional matter, chiefly in the Middle East. Even as China rose, the United States continued to mostly conceptualize the challenge as a regional one in the Indo-Pacific. But because of the size of China's economy, the expanding nature of its forces, and the evolution of technology—as well as the emergence of the coalition described above—it is likely that a war with China would be global. Hypersonic missiles, space-based weapons, and long-range naval forces coupled with sabotage and covert action mean that even the U.S. mainland would be vulnerable for the first time since the nineteenth century.

Most troubling of all, the United States is no longer the dominant power it once was. To be sure, its relative decline has been exaggerated: Its military remains large and capable, and its share of global economic production (roughly one quarter) has been stable over a generation. Its research and development base remains unequalled, and its basic material ingredients of national power—geographical position, natural resources, and economic and financial strength—are substantial.

But with China, in particular, the United States faces a rival unlike any since Nazi Germany—and that confrontation occurred in a world where the next two leading powers, Great Britain and the Soviet Union, were U.S. allies. The Chinese economy is smaller than that of the United States, but not by an order of magnitude; increasingly, China's technological capabilities are comparable, and its manufacturing and shipbuilding base considerably superior. In such a world, the United States, with the many vulnerabilities created by its main source of strength—its open society—may be liable to receiving shattering surprises of a kind that have not occurred since Pearl Harbor.

One of the great imponderables is what war will look like when all the dimensions, new and old, are woven together—information operations, irregular warfare, cyberattacks, space warfare, and even conceivably biological and nuclear warfare. It would be unlike anything experienced before in scope and scale, even World War II.

In the essays that follow, CSIS scholars consider many dimensions of the changing character of war. Throughout, it is important to consider not just technology, which may evolve at tremendous speed, but also the relationship between the technical means of war, the politics that underly conflict, and the psychology of those who must direct it.

For example, historically it has been assumed that a large population of young people—and specifically young men—was essential for the waging of

war. It is reasonable to ask whether the vast proliferation of unmanned weapons systems, and the reversion of humans to their direction and control, reduces the significance of demographic disadvantage. Or consider how old modes of warfare waged with new techniques have different efficacy because of new conditions. At one level, information warfare is as old as war itself. Propaganda and disinformation played their roles in the eighteenth century as much as the twentieth. But in an age of fragmented media, deepfakes, and bots, they may have a significantly different and possibly larger role to play.

Finally, technology will affect how political and military leaders—whose essential human characteristics, after all, have not evolved—direct war. Since the middle of the nineteenth century, modern technology has made it ever easier for leaders to exercise direct supervision and control over forces on the battlefield. Yet the nature of war remains: chaos and confusion are generated (as Clausewitz pointed out) not by the physical smoke over the battlefield but by the pressures it generates. There is no guarantee that new technologies will improve the quality of wartime leadership. Indeed, they may actually serve to weaken it.

In sum, the world of war that may emerge in the remaining three-quarters of the twenty-first century is more extensive, less comprehensible, and possibly even more devastating than anything humanity has ever known. That alone should be enough to compel its study with the utmost care—and to that end, these essays are an excellent beginning.

Outline of the Report

This report is divided into three primary sections. The first addresses the implications of the conflicts in Ukraine and the Middle East on war at the strategic, political, and societal levels. Chapter 1 argues that there is likely to be a deepening of relations going forward among U.S. competitors and adversaries. Chapter 2 demonstrates that societal resilience is a critical and integrated aspect of national security, which strategic planners should not relegate to a secondary consideration. And modern warfare for allies and adversaries alike will increasingly rely on nuclear weapons, as Chapter 3 articulates.

The second section of the report assesses the future of warfare in operations, tactics, and technology, addressing the implications of the current wars on particular domains and capability areas. Chapter 4 provides an overview of the impact of battle networks on operations before Chapter 5 highlights the continued significance of landpower in war. Chapter 6 argues that the experiences in Ukraine and the Middle East show that reigns of fire will endure, as offensive and defensive fires remain critical to combined operations. Technological advances, massive data analysis, and open-source intelligence have changed the world of intelligence and spycraft, as depicted in Chapter 7, but they have also contributed to a blurring of lines between state, industry, and academic actors.

Chapter 8 argues that the war in Ukraine has been a turning point in the role of space in warfare, demonstrating how space capabilities can create an advantage over a more capable military power. Other emerging technologies will push future conflicts into a competition of who can evolve and innovate more quickly, according to Chapter 9. This may be particularly true in the air domain, where Chapter 10 argues that AI-enabled decisionmaking will play an increasingly important role in a challenging environment shaped by increasingly sophisticated and diverse sensors. In the naval domain, Chapter 11 identifies that the Ukraine and Middle East wars, despite being predominantly land campaigns, yield some notable insights for current action, including expanding munitions inventories, accelerating uncrewed systems, and hedging on major surface combatants. Chapter 12 argues that the ongoing wars demonstrate that irregular warfare is not a relic of the past but a defining feature of contemporary conflict.

The third section of the report addresses implications for defense budgets, logistics, and acquisition. Chapter 13 discusses the growth in global defense spending among allies and competitors and trends in procurement patterns. Chapter 14 argues that logistics is more critically important today than in the past, and Chapter 15 addresses how industry must evolve given the acquisition patterns in conflicts in Ukraine and the Middle East. The report concludes by discussing how prepared the United States is for competition, deterrence, and warfare in this new era of conflict.

PART I

Strategy, Politics, and Society

CHAPTER 01

Adversaries and the Future of Competition

Seth G. Jones

China, Russia, Iran, and North Korea are most likely headed toward deepening bilateral relations . . . which has significant implications for the future of warfare.

This chapter examines cooperation between China, Russia, Iran, and North Korea.[1] It asks several questions: How has cooperation evolved between China, Russia, Iran, North Korea, and other actors, including during the Ukraine war? How might cooperation evolve over the next three to five years? What are the implications for modern warfare?

This chapter outlines three possible security arrangements between China, Russia, Iran, and North Korea: (1) weakening engagement, (2) deepening bilateral relations, or (3) a multilateral alliance. Under *weakening engagement*, cooperation between one or more of these axis members wanes because of divisions and diverging interests. There is greater infighting among countries and a decline in the overall degree of cooperation. Under *deepening bilateral relations*, cooperation between the axis countries increases in such areas as the defense industrial base, though cooperation remains largely bilateral. Under a *multilateral alliance*, axis countries establish multilateral arrangements that include higher levels of cooperation, such as a multilateral treaty or other agreement that commits three or more signers to collective assistance in case of external attack.

This chapter concludes that China, Russia, Iran, and North Korea are most likely headed toward deepening bilateral relations. This arrangement would involve axis countries increasing military and dual-use exports and imports, expanding the scale and scope of bilateral and, potentially, multilateral exercises and training, deepening defense industrial cooperation, establishing bilateral treaties or pacts that commit the signatories to greater military cooperation and even mutual defense in case of attack, and deploying soldiers to fight in the wars of other axis countries.

There are still likely to be areas of disagreement and tension between these countries, as well as limits to their cooperation. But the overall trend is likely to be greater cooperation, which has significant implications for the future of warfare. For example, closer cooperation increases the possibility of inter-theater

PHOTO: SERGEI GUNEYEV/POOL/AFP/GETTY IMAGES

military aid among axis countries in case of war and raises the prospect that two or more major wars could occur simultaneously in different theaters. It is prudent for such countries as the United States to be prepared to fight two wars at the same time, rather than focus on one region such as the Indo-Pacific.

The rest of this chapter is divided into three sections. The first provides an overview of lessons from Ukraine and the Middle East regarding axis cooperation. The second examines the possible evolution of the axis. And the third outlines possible indications and warnings to help gauge whether cooperation between axis countries is strengthening or weakening.

Lessons from Ukraine and Other Wars

Security cooperation between two or more powers is a routine occurrence in international politics. China, Russia, Iran, and North Korea see aspects of the Western-led liberal order as a set of rules designed to benefit the United States and its allies while forestalling potential rivals. In addition, these countries believe U.S. and allied efforts to promote democracy, support a free and independent press, maintain a free market, and encourage the free flow of ideas directly conflict with their goals of regime stability.[2] All four powers are also revanchist. As the historian Philip Zelikow argued, they are "fundamentally revisionist powers. Their leaders regard themselves as men of destiny, with values and historical perspectives quite different from the consumerist or social metrics that suffuse much of the world." He continued that they "all feel boxed in by extensions of American power they regard as fragile, though formidable in parts. All have long been preparing for a great reckoning."[3]

In addition, each country has its own reasons for pursuing cooperation. China likely wants partners to help achieve what Chinese leader Xi Jinping called the "great rejuvenation of the Chinese nation."[4] China needs access to critical minerals, bases, ports, and markets. Russia has needed assistance following its February 2022 full-scale invasion of Ukraine to keep its economy afloat, energize its defense industrial base, and ensure it can continue waging war. Iran and North Korea both seek to circumvent international sanctions, are desperate for outside investment, and desire both great power diplomatic protection and military aid in the event of a conflict with the United States or their pro-U.S. neighbors, such as Israel and South Korea, respectively.

Beginning in 2022, China provided substantial aid to Russia's full-scale war in Ukraine, including tooling machines, semiconductors, microelectronics for use in Russian weapons systems, spare parts, drones, gunpowder, and military contractors. Chinese companies such as Xiamen Limbach helped design and develop Russia's Garpiya series long-range attack unmanned aircraft system, in collaboration with Russian defense firms like Joint Stock Company Aerospace Defense Concern Almaz-Antey.[5] China also provided satellite imagery analysis and aid to improve Russian satellite and other space-based capabilities for use in Ukraine.[6] Chinese companies even provided cotton cellulose, nitrocellulose, and critical ingredients for nitrocellulose (such as cotton pulp), which are explosive precursors that the Russian military uses to produce gunpowder, rocket propellants, and other explosives.[7]

This list of Chinese aid likely excludes many systems and components that are shipped clandestinely and whose status is not reported. China has apparently used cargo ships, trains, trucks, and aircraft to send material to Russia.[8] Several Chinese-based companies, such as Poly Technologies, Fujian Nanan Baofeng Electronic Company, China Taly Aviation Technologies Corporation, Juhang Aviation Technology Shenzhen, Finder Technology Limited, Tulun International Holding Limited, and many others, have likely exported material.[9] Although vital to Russia, some of the Chinese material, such as chips, is of low quality compared with more advanced chips from the United States, Europe, Japan, South Korea, and Taiwan.

Iran has exported drones to Russia, as well as artillery shells, ammunition, and short-range ballistic missiles.[10] Russia and Iran have strengthened industrial base ties and set up production of Iranian drones—especially the Shahed-136—in Russia's Tatarstan region.[11] Russia has supplied Iran with Su-35 multirole fighter jets and other weapons systems, as well

as aid to Iran's space and missile programs.[12] Finally, North Korea has provided artillery rounds (including 152 mm and 122 mm), multiple launch rocket systems, KN-23 and KN-24 solid-propellant short-range ballistic missiles, soldiers, and other defense materiel to Russia.[13] Table 1.1 provides an overview of some types of military cooperation between China, Russia, Iran, and North Korea.

Not all cooperation has centered on the Ukraine war. Chinese and Russian companies and agencies have also provided weapons components and intelligence (including satellite imagery) to Iran and the Houthis, an ally of Iran that conducted strikes against U.S. warships in the Red Sea and Israel.[14]

Despite these examples of cooperation, there have been some limitations. Chinese leaders have expressed concern about Russia's warming military relations with an erratic North Korea, including the strengthening of Pyongyang's missile capabilities.[15] Beijing has generally been reluctant to help Pyongyang with its nuclear program.[16] Iranian leaders have expressed dismay with Russia and China for their diplomatic positions in a spat between Iran and the United Arab Emirates over the sovereignty of islands in the Persian Gulf—including Greater Tunb, Lesser Tunb, and Abu Musa—which dominate the approach to the strategic Strait of Hormuz.[17] During Iran and Israel's 12-day war in June 2025, China, Russia, and

Table 1.1: Security Cooperation Between China, Russia, Iran, and North Korea

Country	Imports to Russia	Exports from Russia
China	• Navigation equipment for M-17 military transport helicopters • Machine tools for ballistic missiles and other weapons systems • Parts for fighter jets • Antennae for military vehicles used for communication jamming • Drones, drone parts, and engines for drones and cruise missiles • Optical components for Russian tanks and armored vehicles • Military helmets and body armor • Global navigation satellite system boards for Russian attack drones • Electronic integrated circuits for Russian drones, infrared detectors, communications equipment, and pressure sensors and microcontrollers used in Russian missile systems and drones • Satellite imagery analysis and aid to improve Russian satellite and other space-based capabilities for use in Ukraine • Cotton cellulose, nitrocellulose, and critical ingredients for nitrocellulose (such as cotton pulp), which are used to produce gunpowder, rocket propellants, and other explosives	• Aircraft engines • Helicopter systems • Space and counterspace cooperation
Iran	• Shahed-136 (Geran-2), Shahed-131 (Geran-1), Mohajer-6, and possibly Shahed-101 and Shahed-107 drones • Drone production facilities • Artillery shells • Ammunition • Fateh-110 short-range ballistic missiles • Fath-360 (BM-120) short-range ballistic missiles	• Yak-130 pilot training aircraft • Su-35 multirole fighter jets • Mi-28 attack helicopters • Space cooperation
North Korea	• Artillery rounds (including 152 mm and 122 mm) • Rockets • KN-23 and KN-24 short-range ballistic missiles • Other munitions and components for munitions • Soldiers to fight in the Ukraine war	• Technology for satellites • Technology for nuclear-powered submarines • Technology for ballistic missiles

Source: CSIS analysis.

North Korea did not provide substantial aid to Iran as Israel and the United States gained air dominance and struck targets across the country. China and Russia issued *pro forma* denunciations of U.S. actions, but they did not provide significant military assistance.

Future Evolution of the Axis

Several factors are likely to impact the type of security arrangement among the axis countries in the future. First is the degree of common threat. Since countries tend to increase cooperation to prevent stronger powers from dominating them, axis countries facing a growing external power or threat will likely increase security cooperation. The severity of the threat could be affected by the military power of an adversary country or alliance, including its offensive military capabilities; geographic proximity, since closer adversaries likely pose a greater threat; and the assessed intentions of the adversary country or alliance, which could vary from benign to malign intentions.[18] Second is the level of ideological solidarity, including shared political, cultural, or other traits or interests.[19] The more interests countries share in common, the likelier they are to want to cooperate.[20] Third is domestic politics, including the preferences and decisions of leaders.[21] Regime change—including the death of a leader—could impact the degree of cooperation and the type of security arrangement. Alternatively, leaders could develop stronger bonds that increase the prospect for cooperation.

Table 1.2 provides an overview of the three possible security arrangements: weakening engagement, deepening bilateral relations, and a multilateral alliance. These possibilities are not meant to be exhaus-

Table 1.2: Overview of Axis Security Cooperation

Security Arrangement	Summary	Type of Arrangement	Examples of Security Cooperation
Weakening engagement	Security cooperation weakens between axis countries.	Bilateral	• Limited exports and imports of military and dual-use items • Joint exercises and training
Deepening bilateral relations	Cooperation deepens, though remains largely bilateral.	Bilateral	• Increase in exports and imports of military and dual-use items • Growth in the scale and scope of joint exercises and training • Rise in bilateral defense industrial cooperation, including codevelopment, coproduction, and co-sustainment of key weapons components and systems; joint ventures; and mergers and acquisitions • Creation or deepening of bilateral treaties or other agreements that commit signers to collective assistance in case of external attack • Deployment of soldiers to fight in wars with other axis members
Multilateral alliance	Cooperation deepens and becomes multilateral.	Multilateral	• Notable growth in multilateral joint exercises and training, especially for a joint or multifront war • Significant rise in defense industrial cooperation across three or more countries • Creation of a multilateral treaty or other agreement that commits signers to collective assistance in case of external attack • Establishment of a multilateral military structure that includes a military committee, develops joint war plans, and includes other committees to cooperate at the strategic, operational, and tactical levels

Source: CSIS analysis.

tive but rather serve to illustrate plausible future security arrangements.

Weakening Engagement

In this scenario, bilateral relations between China, Russia, Iran, and North Korea become more tenuous, though axis countries might continue to cooperate in some form. This scenario assumes a weakening of bilateral security arrangements and declining levels of cooperation. Examples include decreasing exports and imports of military and dual-use items, as well as conducting joint exercises and training that are more symbolic than substantive. There are already periodic disagreements between the countries that could worsen over time.[22]

In sum, weakening engagement would include a general fraying of military and security ties between axis countries. Several factors could lead to such an outcome. First is a declining threat environment, which would reduce the need for aggregating power.[23] The end of the war in Ukraine or between Israel and Iran (including Iranian-linked groups), a substantial weakening of NATO, or a significant decrease in defense spending among major powers in Europe or Asia could weaken the impetus for cooperation by decreasing the threat. A second factor is fraying common interests. Examples include growing divisions on such issues as territorial disputes (such as a flaring up of Sino-Soviet border disputes or the sovereignty of islands in the Persian Gulf), diplomatic détentes that create fissures, and even warming relations between some axis countries that threaten others (such as between Russia and North Korea, raising concerns in China). Third, domestic challenges could weaken bilateral relations. The death or removal of a leader—including Xi Jinping, Russian President Vladimir Putin, Iranian Supreme Leader Ayatollah Ali Khamenei, or North Korean leader Kim Jong Un—could lead to a shift in foreign policy and a decision to decrease axis cooperation.

Deepening Bilateral Relations

Under deepening bilateral relations, cooperation between axis countries increases. The anchor of the relationship is likely Beijing because of its size and military, economic, and technological power, though relations between Beijing and Moscow are likely the core of the axis. Overall, axis countries continue to develop closer bilateral ties in defense industrial production, including emerging technologies that have significant military capability, such as AI and quantum computing. A deepening coalition could include growing cooperation in several areas.

The anchor of the relationship is likely Beijing because of its size and military, economic, and technological power, though relations between Beijing and Moscow are likely the core of the axis.

Arms exports and imports among axis countries continue under deepening bilateral relations, but they increase in scale and scope. Axis countries also expand arms sales to the Global South, continuing recent trends. Between 2020 and 2024, for example, the main suppliers of arms to Africa were Russia (which accounted for 21 percent of total African imports of major arms) and China (18 percent).[24]

Axis countries might broaden the scope, frequency, and geographic location of exercises and training missions to improve joint warfighting, intelligence sharing, command and control arrangements, and interoperability. Between January 2019 and July 2025, China and Russia conducted nearly a dozen combined strategic aerial patrols, including with Russian Tu-95 and Chinese H-6N and H-6K bombers capable of carrying nuclear weapons.[25] These patrols could increase in number and geographic scope, including in the western Pacific and off the U.S. coast. While many of these exercises and training missions could be bilateral, there might also be an increase in multilateral exercises and training missions. In March 2025, for example, Iran, Russia, and China conducted a joint naval exercise—called Marine Security Belt 2025—in the Gulf of Oman, marking the fifth year of joint drills.[26] Several other countries, including Azer-

baijan, Iraq, Kazakhstan, Oman, Pakistan, Qatar, Sri Lanka, South Africa, and the United Arab Emirates, observed the exercise.

In addition, axis countries could deepen bilateral defense industrial base cooperation. A modern-day defense industrial base involves the production of defense and dual-use items by commercial companies and state-owned enterprises across multiple domains. Key domains include maritime, air, ground, space, cyber, and nuclear. Axis countries could increase cooperation in areas such as unmanned and autonomous platforms, integrated air and missile defense, space and counterspace, submarines, missiles, and emerging technologies such as AI and quantum.[27] Cooperation could take several forms: the codevelopment, coproduction, and co-sustainment of weapons systems or components involving industrial firms from two or more axis countries, joint ventures, or transnational mergers and acquisitions.

Next, axis countries could increase their commitment to defend each other in case of external attack through a deeper bilateral treaty or other agreement that commits signers to collective assistance. The most important relationship is likely between China and Russia, which agreed to a "no limits" friendship in February 2022 and reaffirmed it in February 2025.[28] Chinese-Russian relations could deepen if their leadership committed to collective assistance in the case of an armed attack. In addition, bilateral relations have strengthened between other axis countries, except Iran and North Korea, which do not have a formal alliance. In March 2021, for example, China and Iran agreed to a 25-year strategic partnership, which included Chinese investment in Iran and imports of discounted Iranian oil to China.[29] In June 2024, Russia and North Korea signed the Treaty on Comprehensive Strategic Partnership, which commits the countries to mutual military and other assistance if the other is invaded.[30] In January 2025, Russia and Iran signed a 20-year pact that formalized close ties between the two countries.[31] However, the pact did not constitute a military alliance and required no direct obligations from either party. Overall, a future development that deepens bilateral relations would likely involve building and expanding these commitments.

Finally, a deepening coalition could include increased combat assistance—including the deployment of soldiers—to other axis members engaged in wars. There have already been several examples. China, Iran, and North Korea have provided military assistance to Russia for its war against Ukraine. In late 2024, North Korea sent approximately 12,000 combat forces to Russia's Kursk Oblast, where Ukraine seized Russian territory. In early 2025, North Korea deployed roughly 3,000 additional soldiers for combat against Ukrainian forces.[32] Future examples could include growing Chinese and Russian security and intelligence assistance to Iran and its partner forces in the Middle East, Russian and Chinese aid to North Korea in a conflict on the Korean Peninsula, or Russian and North Korean assistance to China in a conflict in the Taiwan Strait, South China Sea, or East China Sea.

Several factors could lead to deepening bilateral relations. First is an increased threat, such as an arms race with the United States, European countries, or Asian countries such as Australia, Japan, and South Korea. Significant increases in defense spending and potential offensive capabilities—such as fifth- and sixth-generation aircraft, nuclear weapons, bombers, submarines, and ballistic, cruise, and hypersonic missiles by the United States, Europe, and Asian countries—could increase the threat perception in Beijing, Moscow, Tehran, and Pyongyang. An escalating conflict in the Middle East, a protracted war in Ukraine, or an escalating crisis in the South China Sea, East China Sea, or Taiwan Strait could also increase the perception of threat among axis countries. A second factor is growing common interests, including those against the West. As Stephen Hadley, President George W. Bush's national security adviser, wrote, "There is a shared anti-Westernism, opposition to democracy, and embrace of authoritarian alternatives. What truly binds the axis is not ideology but a common opposition to U.S. power and the international system it sustains."[33] Third is the persistence or deepening of strong ties between axis leaders. Most significant would be a deepening of ties between Xi and Putin, whose relationship could serve as the lynchpin of axis relations.

Multilateral Alliance

A final scenario is a multilateral alliance. In this case, axis countries begin to establish multilateral arrangements and include high levels of cooperation, such as an agreement that commits signers to collective assistance in case of external attack.[34] A multilateral alliance would likely involve strengthened relations in several areas, such as multilateral joint exercises and training and integrated defense industrial cooperation across three or more countries. There would be several differences from previous scenarios.

Axis countries could establish a multilateral arrangement—such as a treaty, defense pact, nonaggression pact, entente, or other agreement—committing signers to collective assistance in case of external attack or other types of arrangements. The agreement could be overt or covert. Historical examples include the Treaty of the Holy Alliance of 1815 between Austria, Prussia, and Russia; the Atlantic Charter of 1941, which established NATO; and the Warsaw Pact during the Cold War, which included the Soviet Union and Soviet satellite countries in Eastern Europe.[35] Axis countries could also establish a multilateral military structure that includes a military committee, joint war plans, and other committees to cooperate at the strategic, operational, and tactical levels. The Warsaw Pact had a unified command under Soviet leadership. The command structure included a Combined Armed Forces Command, located in Moscow, which comprised military officers from all the Warsaw Pact countries.[36]

Several factors could lead to a multilateral alliance. The first is a major increase in the nature or scope of the threat, such as the outbreak of war between an axis member and the United States, Japan, Taiwan, South Korea, or one or more European countries. Another cause could be nuclear proliferation to South Korea, Japan, Poland, or another country, which could increase the perception of threat in one or more axis members. A second factor is growing ideological solidarity or other common interests between axis countries. Third is domestic politics. Regime change in one or more axis countries could bring to power a leader who is willing to expand axis cooperation for their own interests. Strong, ambitious, and expansionist leaders in Beijing or Moscow could push for greater multilateral collaboration to aggregate power among axis countries.

Conclusion

The most likely future security arrangement is deepening bilateral relations. Under this arrangement, axis countries might increase military and dual-use exports and imports, expand the scale and scope of bilateral and potentially multilateral exercises and training, integrate defense industrial cooperation, deepen bilateral treaties or pacts that commit the signatories to greater military cooperation and even mutual defense in case of attack, and deploy soldiers to fight in the wars of other axis countries. This scenario is likely for several reasons.

First, the degree of common threat is likely to increase. European and Asian countries—such as France, Germany, Japan, and South Korea—are likely to raise defense spending and strengthen their defense industrial bases. Defense spending is rising among these countries and across the globe more broadly, with global defense spending increasing from $2.23 trillion in 2023 to $2.46 trillion in 2024.[37] Defense budgets across the European Union are likely to rise by as much as $84 billion by 2027, equivalent to approximately 0.5 percent of GDP.[38] In June 2025, NATO Secretary General Mark Rutte called for a 400 percent increase in Europe's air and missile defense budget.[39] Defense budgets in Asia are also rising. As one analysis concluded, "strategic drivers—such as China's military modernization and increasing assertiveness, and North Korea's advancing nuclear weapons program—galvanize threat perceptions in the region."[40]

Consequently, an arms race is more likely than a détente. In addition, war involving Russia is likely to continue in Eastern Europe, and conflict is likely to persist between Israel and Iran (including Iranian partners) in the Middle East, with China and Russia providing some assistance to Iran and its partners. Further, there is a significant risk of conflict in the Taiwan Strait, South China Sea, and Korean Peninsula. Consequently, security competition between axis countries and democratic countries in Europe, Asia, and the Middle East is likely to remain significant and could increase in intensity.

Second, there is likely to be a deepening of common interests between axis countries, which aim to undermine democracy and increase their power and influence in multilateral institutions such as the United Nations and other international and regional institutions.[41] A particular focus may be balancing against what they view as U.S. imperialism or hegemony.

Third, domestic factors will likely increase security cooperation among axis countries. Whereas Khamenei's health has been the subject of speculation, Xi and Putin—the lynchpins of the axis—are unlikely to step down in the next three to five years, and their relationship has strengthened, not weakened.[42] There is also little evidence that Putin will curb his revanchist interests in Ukraine or other areas, such as Eastern Europe, Central Asia, the Middle East, and Africa; that Iran will walk away from its partners and proxies in the Middle East; or that Xi will curb his expansionist ambitions in Asia and other areas.

Growing collaboration between axis countries would have significant implications for the future of warfare. For example, cooperation could increase the possibility of multi-theater war. Would Russia take advantage of a U.S.-China war in the Taiwan Strait or South China Sea to move into the Baltics or other regions? Would China or Russia take advantage of a war in the Korean Peninsula that pulls in North Korea, South Korea, the United States, and other countries? Between World War II and 2012, the United States sized its military to fight two wars at the same time.[43] But that changed with the Defense Strategic Guidance, which altered the two-war standard to "secur[ing] territory and populations and facilitat[ing] a transition to stable governance" in one region, while "denying the objectives of--or imposing unacceptable costs on--an opportunistic aggressor in a second region."[44] However, this force construct is likely inadequate for tomorrow's challenges that could require fighting two wars simultaneously.

Looking forward, there are several indications and warnings that could provide clues to the future evolution of the axis and the implications for the future of warfare:

- **Arms Exports and Imports:** Is there an increase or decrease in exports and imports of military and dual-use items between axis countries? Are axis countries shipping more or fewer military and dual-use items by ship, rail, truck, or air? Is the scope of trade expanding or shrinking, including in sensitive areas such as nuclear weapons, space, stealth, hypersonics, quantum, and emerging technology?
- **Joint Exercises and Training:** Are exercises and training efforts primarily bilateral or multilateral? Do exercises and training efforts prepare for large-scale combat against the United States and European and Asian countries, including across land, air, maritime, space, and cyber domains? Do they include closer command and control arrangements and sensitive intelligence sharing?
- **Defense Industrial Base:** Is there an increase or decrease in bilateral or multilateral defense industrial cooperation between axis companies and state-owned enterprises, including codevelopment, coproduction, co-sustainment, joint ventures, and mergers and acquisitions? If there is greater cooperation, in what areas is it occurring? And what is the scope of cooperation?
- **Treaties and Defense Pacts:** Do axis countries create or deepen bilateral or multilateral treaties or other agreements that commit signers to collective assistance in case of external attack? Or is there a weakening of commitments? Are agreements formal or informal? Are they overt or covert? Are there indications of warming or cooling relationships between the leaders of axis countries?
- **Military Aid During War:** Do countries provide military assistance—such as weapons, troops, and intelligence—to other axis countries during wars? Or do they refrain from providing aid, especially for short wars? What types of aid are they willing to provide? Are axis countries willing to shed blood for each other, including through combat deployments?
- **Military Structure:** Do axis countries establish a military organizational structure, develop

joint war plans, or create other types of cooperative arrangements at the strategic, operational, or tactical levels? Or is there insufficient trust or interest to establish a multilateral military structure?

In addition, there are several indications and warnings that might cause axis relations to strengthen or weaken:

- **Arms Buildup:** Is there an arms race, including a significant increase in defense spending, between axis countries and their competitors in Europe, Asia, and the United States? Are countries building offensive military capabilities?
- **Nuclear Proliferation:** Is there a proliferation of nuclear weapons, including in such countries as South Korea, Japan, and even Iran? Or do potential nuclear states refrain from building nuclear weapons?
- **War:** Does war persist in Europe and the Middle East? Is there a new outbreak of war involving an axis country? Is there an end to a major war, such as a ceasefire or peace agreement in Ukraine? Is there a major decrease in the intensity of conflict, such as between Israel and Iran (including Iranian partners and proxies)?
- **Regime Change:** Is there a change in leadership in one or more axis countries? Is a new leader more or less inclined to strengthen axis relations or to expand territory? Or is there continuity of leadership in core axis countries, especially China and Russia?
- **Domestic Instability:** Is there significant domestic economic, social, or political instability in one or more axis countries that could impact axis relations? Or is there relative stability within axis countries?
- **Future of Security Institutions:** Does NATO grow stronger or weaker over the next three to five years? Is there a deepening of security ties—including a multilateral security institution—between the United States and countries in Asia such as Australia, Japan, and South Korea?
- **Divisions and Fissures:** Are there increases or decreases in policy fissures between axis countries? How serious are the differences and in what areas?

Answers to these questions will provide useful and timely indicators of the strength or weakness of axis relations. They will also have significant implications for the future of warfare, including the possibility of multi-theater wars involving more than one axis country. Growing cooperation increases the possibility that a war with one axis country could expand to multiple fronts, causing simultaneous demands for such countries as the United States.

CHAPTER 02

Will, Cohesion, Resilience, and the Wars of the Future

Daniel Byman

Societal resilience is vital for countries to stand up to aggression; when it is strong, it enhances deterrence. In future conflicts, aggressors such as China and Russia are likely to try to undermine resilience as an alternative or prelude to war.

Wars involve not only a clash of forces but also a clash of national wills. The great theorist of war Carl von Clausewitz stressed the importance of "moral" factors in war, such as the people's will to fight, levels of support for the cause, and national unity.[1] Adversaries seek to shatter the cohesion and resilience of the United States and its allies through varied means. Russia uses disinformation to polarize U.S. and European societies and has supported extreme-right opposition parties and even motorcycle gangs to increase violence and polarization.[2] The Hamas attack on Israel on October 7, 2023, and various Russian attacks on Ukraine, including the 2022 all-out invasion, also sought to shatter resilience by killing and threatening civilians and imposing widespread suffering.

This chapter argues that societal resilience is vital for countries to stand up to aggression; when it is strong, it enhances deterrence. In future conflicts, aggressors such as China and Russia are likely to try to undermine resilience as an alternative or prelude to war. Both Ukraine and Israel have proved resilient, drawing on their populations and civilian sectors to sustain long, grueling fights. Russia and Hamas have also proved resilient. Information campaigns have been vital for all these actors; some, notably Ukraine but also Hamas, have sold their narrative effectively. Hamas's hostage taking, while not destroying Israeli resilience, has created significant fissures in Israeli society.

This chapter first defines resilience and explains why it matters in both the Ukraine and Middle East wars. It then draws lessons from these two conflicts and details the implications for the future of war.

What Is Resilience and Why Does It Matter?

From a national security perspective, a country is resilient if it has both the will and ability to resist and recover from external pressure, ranging from influence campaigns to an invasion. In practice, resilient societies can protect their civilians, ensure basic services like electricity and medical care continue, stand

PHOTO: LES KASYANOV/GLOBAL IMAGES UKRAINE/GETTY IMAGES

up to coercion, and build a will to resist and fight a foreign invader.

Ukraine demonstrated resilience in February 2022 when it rallied against a full-on invasion while facing Russian cyberattacks, a barrage of propaganda, leadership assassination attempts, the promotion of puppet governments, and other threats. Ukrainians signed up to fight Russia in droves, kept electricity and power plants going, and conducted assassinations and sabotage in Russian-occupied parts of Ukraine that made it hard for Russia to administer and stage from these areas. All of this bought valuable time for Ukraine's allies, especially the United States, to pour billions of dollars of military aid into the country, helping it survive multiple years of a grinding war against a much larger aggressor.

Resilience is also vital to sustain forces in a conflict. The Ukraine conflict has been relentless, with Ukrainian leaders claiming they have lost over 45,000 soldiers since 2022, with hundreds of thousands wounded. The former is almost certainly a gross understatement, with the real figure probably more than double.[3] In addition, Ukraine has suffered over 10,000 civilian deaths and over 30,000 civilian injuries.[4] Israel, for its part, lost more people on one day—almost 1,200—than any day in its history. In the months after October 7, it sustained a war on multiple fronts, drawing heavily on reservists despite the social strain and cost to the country's economy.

Resilience's greatest benefit, however, often comes before a crisis occurs. Resilience is vital to deterrence. Countries that lack resilience may seem easy to invade, whereas those with resilience require more resources and are more difficult to occupy. As Finnish scholars argue, "Even the biggest bear will not eat a porcupine."[5]

Lessons from Ukraine and the Middle East

Israel's enemies—Iran, Hamas, Hezbollah, and the Houthis—and Russia have tried to undermine the resilience of Israeli and Ukrainian societies, respectively. Much of Russia's conventional and irregular war effort, including cyber and missile attacks on power infrastructure and hospitals, assassination attempts, and propaganda, has sought to break the population's will to resist and decrease support for Kyiv's war effort. In addition, Moscow has created puppet governments in parts of Ukraine it has occupied and otherwise tried to undermine the legitimate government there. Meanwhile, Hamas sought to shatter Israeli morale at a time when the country was highly divided politically and believed that large-scale hostage taking would force the country to its knees. Hezbollah and Houthi leaders hoped their attacks in solidarity with Hamas would force Israel to stop operations in Gaza, believing it could not sustain a long, draining war.

Russia has also tried to use sabotage and economic pressure to coerce Ukraine's European allies into withdrawing their support by targeting the resilience of their civilian populations. Russian sabotage attacks have primarily targeted critical infrastructure such as pipelines, fiber-optic cables, and power cables, as well as rail lines and aviation, especially arms manufacturers and suppliers (a breakdown of categories is provided in Figure 2.1). Although such incidents are not new, Russia's invasion of Ukraine in February 2022 accelerated the number of attacks: There were 3 in 2022, 12 in 2023, and 34 in 2024. These forms of attack, occurring in tandem with political interference and disinformation campaigns, amount to a hybrid warfare campaign.[6]

To resist attacks intended to undermine domestic morale, both Israel and Ukraine have drawn on deep wells of resilience. Ukraine's army had 196,000 soldiers before the attacks; by early 2025, it maintained almost 900,000 soldiers, including reservists.[7] In Israel, national security is normalized through compulsory military service at the age of 18; after this, individuals stay in the reserves until age 40 with continued training.[8] The October 7 attacks brought the largest mobilization in Israel since the 1973 Yom Kippur War, and Israelis outside of the age range for reservists have still volunteered for military service.[9] Many reservists have reported for duty before any official call-up, eager to volunteer when their country is under attack. Immediately after October 7, Israel called up 360,000 reservists. As of January

Figure 2.1: Targets of Russian Attacks in Europe, 2022–25

Source: CSIS analysis.

2024, between 200,000 and 250,000 reservists were still mobilized.[10] As of November 2024, 34 percent of reservists had served more than 150 days, and 54 percent had served more than 100 days.[11]

Israel and Ukraine have also drawn heavily on their civilian sectors, which is vital for resilience. In 2022, Ukraine produced seven drone models. By 2024, it was producing 67 models, with about 200 domestic companies involved in the production.[12] In an October 2024 speech, Ukrainian President Volodymyr Zelensky stated that Ukraine could produce 4 million drones annually.[13] With these drones, Ukraine has struck Russian energy facilities and other infrastructure deep inside Russia and has used drones to fight Russian military forces.[14] After October 7, the Israeli Ministry of Defense worked with technology startups to deploy new capabilities.[15] For example, 50 percent of the anti-drone technology the Israeli military has used comes from startups.[16] Between the start of the war and the end of 2024, Israel awarded orders to 101 startups or small companies to assist the war effort.[17]

Civilian sectors, however, can easily become overtaxed, especially in longer wars. In Israel, 10 to 15 percent of the technology workforce has been called to the reserves.[18] The tech sector is critical for Israel's economy, accounting for 16 percent of employment, half of the country's exports, and 20 percent of economic output.[19] Much of Ukraine's ability to defend itself against Russia's cyberattacks has similarly been due to support from the private sector. Following the invasion, Microsoft alerted Ukrainian authorities of malware designed to target government ministries and financial institutions and worked with Ukrainian officials to combat it.[20] Microsoft has also allowed the Ukrainian government to utilize its cloud services for free.[21]

Israel's prewar preparedness has also served it well. Israeli residential and industrial buildings are required to have air defense shelters. Government funding is often allocated to building shelters in older buildings, addressing the 28 percent of Israelis who do not have close access.[22] In addition, early warning systems provide civilians with notice to seek shelter.[23] As a result, the Israeli population has been well protected and has not panicked in the face of Iranian and Houthi missile, rocket, and drone attacks.

Information campaigns have been important parts of both conflicts, and Ukraine has fared better than Israel in this regard. Although Israel stressed Hamas's aggression and hostage taking and has sought to justify its war as self-defense, much of the world has rejected the legitimacy of Israel's ongoing operations in Gaza, and the International Criminal Court has issued warrants for Prime Minister Benjamin Netanyahu and other Israeli leaders for war crimes.[24] Global opinion of Israel dropped by 18.5 percent from September to December 2023.[25] In the United States, disapproval of Israeli military action increased from 45 percent in November 2023 to 55 percent in March 2024, with 33 percent of young Americans reporting they sympathized entirely or mostly with the Palestinian people.[26] Around one-third of young Americans believe that Hamas's reasons for fighting Israel are valid, indicating the challenges facing Israeli information campaigns.[27]

Ukraine has not face similar informational challenges, as it has the support of NATO countries and Russia is widely seen as the aggressor, particularly after U.S. intelligence detected the invasion in advance and "prebunked" Russian propaganda. The Ukrainian government has advanced its cause effectively, largely via social media, focusing on the resilience of Ukrainian citizens and giving thanks to international supporters.[28] Ukraine also appealed to the United Nations following the outbreak of war, with the UN General Assembly holding an emergency special session in February 2022 and overwhelmingly supporting a resolution demanding that Russia stop its invasion.[29]

However, Russia has scored many propaganda victories, which are especially impressive given the overt nature of its aggression and the brutal behavior of its forces. Russian narratives in Africa capitalize on European colonial history, with over 178,000 Russia-linked tweets in the first two weeks of Russia's invasion accusing Ukrainians and Europeans of racism.[30] According to the Africa Center for Strategic Studies, Russia has also sought to increase its general support of the continent, sponsoring 80 documented campaigns in over 22 countries.[31] Russian propaganda has often been successful, with 84 percent of the population in Mali reporting positive opinions of Russia.[32] Russia has also used propaganda within Europe. Germany, Ukraine's second-largest weapons supplier, has reported an increase in Russian disinformation in an attempt to decrease support for Ukraine.[33]

Hamas's taking of hostages has proved a challenge for Israeli resilience. The question of whether to continue the fight against Hamas or to seek a ceasefire as part of a hostage release divided Israel for many months. In January 2024, the war cabinet largely supported a ceasefire, but lawmakers in the governing Likud party supported continued military operations.[34] On June 2, 2024, two far-right ministers threatened to quit if Prime Minister Netanyahu agreed to the ceasefire proposal, a move that would have collapsed the governing coalition.[35] Israel has at times pursued negotiations but in other cases pursued aggressive military operations that have made a ceasefire and negotiated end to the conflict less likely.

Measuring resilience within authoritarian states is difficult. Opinion polls, media criticism, political disagreements, and other standard ways to measure popular will and support for fighting all are inaccurate or muted in authoritarian states, and accuracy is usually even more skewed regarding support for substate groups. A month after the Ukraine war began in 2022, Pentagon Press Secretary John F. Kirby claimed, "We certainly have indications that morale is a growing problem inside the Russian forces that are fighting in Ukraine."[36] A 2023 Cambridge study reported that "levels of Russian financial and life satisfaction may be near their lowest levels in a decade, while levels of online dissent have spiked in response to failures in the prosecution of the war."[37] Russia still faces shortages of soldiers and, despite having a much larger population than Ukraine, has been forced to draft large numbers of convicts, offer large bonuses to recruits, and bring in North Korean forces to bolster its ranks. Nevertheless, despite sustaining staggering losses on the battlefield as well as Ukrainian attacks on Russian energy and military infrastructure, Russia has stayed in the fight.

Measuring Hamas's morale is even more difficult. It is reasonable to conclude that the devastation of Gaza, the loss of many fighters, and the decimation of Hamas's leadership hindered morale, but the organization has not collapsed. Even after the ceasefire, Hamas remains the strongest Palestinian power and does not seem to face significant popular unrest.[38]

Conclusion

In both Ukraine and Israel, the story of resilience is not only about battlefield endurance but also the mobilization of society—military, civilian, technological, and psychological—to resist aggression and maintain national cohesion. Their experiences underscore the critical importance of preparing societies for long-term conflict, including safeguarding infrastructure, cultivating civilian readiness, and maintaining the credibility of national narratives in the global information space. Resilience in this broader sense serves both defensive and deterrent functions: It helps nations absorb shocks without collapse and signals to adversaries that occupation or coercion will not yield easy gains.

Mobilizing the population is necessary to resist foreign efforts to undermine resilience. Both the Ukraine and Gaza wars have been long and have required Ukraine and Israel to mobilize reservists and parts of their population outside the military. It is difficult to know how long a conflict between the United States and China or another major war would last, but it is plausible that such a conflict would require a sustained effort in which success would depend, in part, on which side could best mobilize its population for the long term.

Authoritarian states can use coercion and propaganda to suppress dissent. Like other regimes, they can also draw on nationalism and antiforeign sentiment to stay in power. Nevertheless, their resilience can be undermined, and it is often more brittle than it appears. Indeed, as the December 2024 fall of Bashar al-Assad's Syrian regime suggests, seemingly solid authoritarian regimes can collapse quickly. Offensive information operations against authoritarian states could focus on unpopular regime policies, human rights abuses, economic problems, corruption, or domestic political and societal divisions.

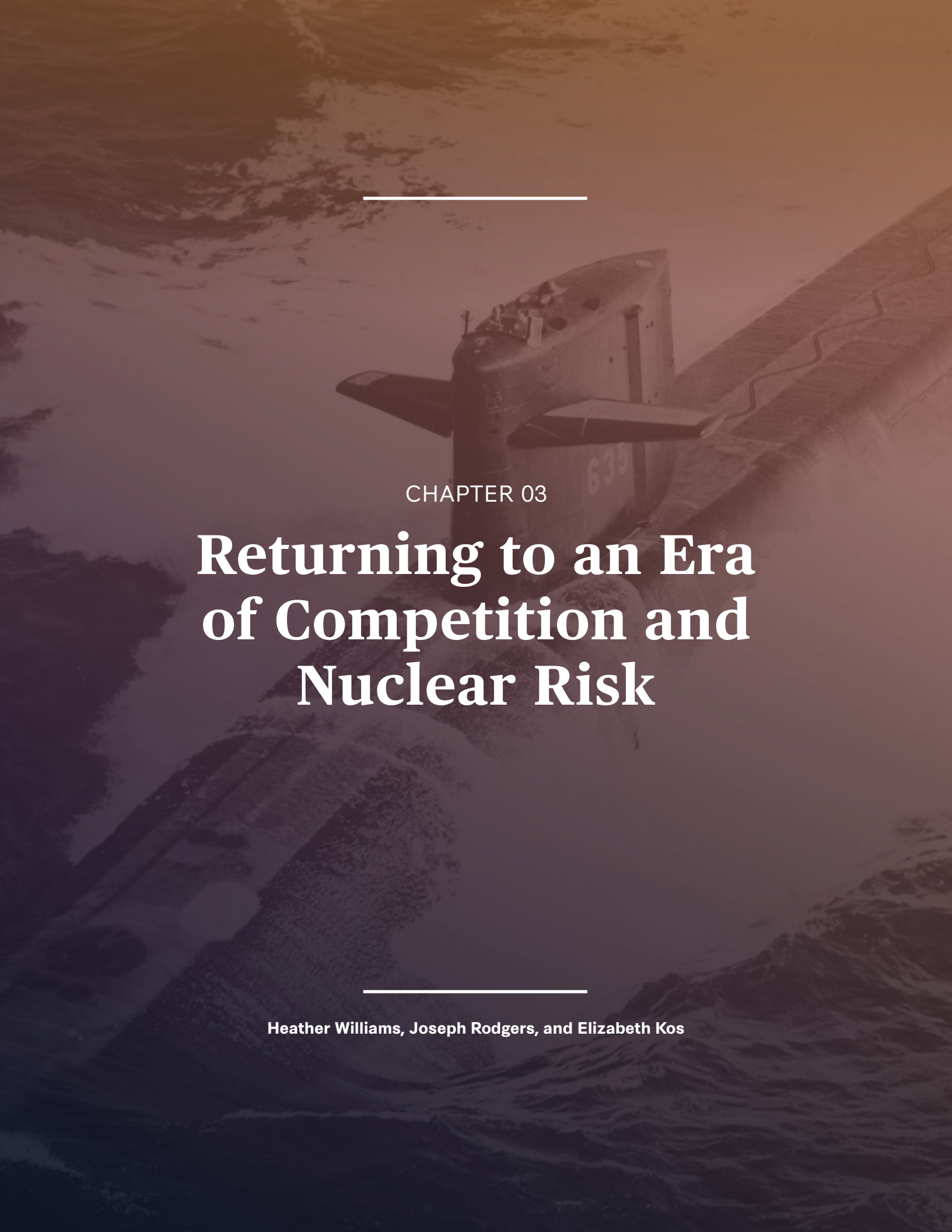
Future conflicts could see large-scale hostage taking, forced assimilation of captured populations, and other illegal, but nonetheless quite real, anti-civilian actions that might divide popular opinion. Countering this requires developing an information strategy for domestic and foreign audiences, developing communications with occupied parts of a country, and ensuring special operations forces are well prepared for hostage rescue missions.

Ensuring cohesion and resilience depends, in part, on defending civilian infrastructure and national security assets controlled by private sector companies, many of which do not focus on national security or regularly interact with the government in peacetime. Much of this activity will occur in the cyber realm, requiring close cooperation with a range of private technology companies.

Societal divisions undermine resilience, and adversary propaganda tries to play on these. Such divisions are difficult to overcome, often stemming from broader societal problems due to discrimination and social change. Political leaders can worsen or ameliorate these divisions through their rhetoric and policies, and they must recognize that playing up divisions provides openings for adversaries.

Resilience . . . serves both defensive and deterrent functions: It helps nations absorb shocks without collapse and signals to adversaries that occupation or coercion will not yield easy gains.

Strategic planners must view societal resilience as an integrated element of national security, not a secondary consideration. The wars in Ukraine and the Middle East illustrate that the contest over will and cohesion is not merely an adjunct to military conflict—it is central to victory or defeat.



CHAPTER 03

Returning to an Era of Competition and Nuclear Risk

Heather Williams, Joseph Rodgers, and Elizabeth Kos

The erosion of the global nuclear order—fueled by adversarial nuclear expansionism, the proliferation of theater-range nuclear forces, growing adversary collusion, and the weakening of U.S. alliance credibility—demands change.

U.S. strategic thinking in the Cold War was dominated at various points by fears of adversarial collusion, the erosion of U.S. alliances, and the collapse of U.S. global leadership. Today, all three of those fears are simultaneously coming to fruition.

Russia, China, and North Korea have all ramped up their nuclear threats, with the goal of gaining territory in Europe, the Indo-Pacific, and East Asia, respectively. In October 2022, for example, Kremlin officials initiated large-scale nuclear exercises and threatened nuclear use to further Putin's goal of illegally annexing Ukraine.[1] Meanwhile, all three countries have worked to rapidly upgrade, expand, and diversify their nuclear arsenals. The Department of Defense (DOD)'s 2024 report on China's military power warns that Beijing is accelerating its buildup of nuclear weapons, including those with theater-range dual-capable delivery systems.[2] In the past few years, Russia, China, Iran, and North Korea have expanded cooperation in military, economic, and political spheres, including with respect to nuclear issues. Adversary nuclear collusion has included joint exercises, transfers of fissile material, and mutual support in international diplomatic forums.[3] In July 2024, Russia and China carried out a joint bomber patrol exercise near Alaska using dual-capable bombers and approaching U.S. sovereign airspace.

U.S. global leadership in the defense arena is also facing growing skepticism from key allies. In March 2025, French President Emmanuel Macron declared that Europe may need to adopt a defense posture less reliant on the United States, potentially signaling a shift away from the long-standing NATO framework.[4] France is even considering extending its nuclear deterrent to cover the defense of Europe, a significant departure from its traditional focus on national defense. This development, coupled with growing calls within the Trump administration to reduce European dependence on U.S. security guarantees, highlights changes in transatlantic relations and the potential for a reconfiguration of the global security

architecture. Coinciding with these threats, U.S. allies are increasingly anxious about the credibility of U.S. nuclear commitments. In April 2024, Polish President Andrzej Duda urged NATO to deploy nuclear weapons to Poland in response to Russia's deployment of nuclear weapons in Belarus.[5] Additionally, a February 2024 poll by the Chey Institute for Advanced Studies revealed that over 70 percent of the South Korean public supports the development of an indigenous nuclear weapons program to counter the threat posed by North Korea.[6]

This chapter argues that the future of modern warfare will feature increased reliance on nuclear weapons by adversaries and allies alike. During the Cold War, the United States responded to adversary nuclear coercion by making judgments about Soviet red lines and signaling resolve to defend allies in the face of crisis. The United States addressed threats to regional deterrence from expanding Soviet nuclear capabilities and possible collusion with other adversaries by strengthening its own nuclear capabilities and alliance networks. Doubling down on U.S. alliances through demonstrations of resolve and nuclear sharing arrangements had the additional effects of reassuring U.S. allies and stemming incentives for nuclear proliferation. For example, during the Cold War, the United States stored nuclear weapons in Europe as part of a broader effort to quell fears of allied proliferation.[7]

The rest of this chapter is divided into three main sections. The first outlines nuclear risks that have emerged from the wars in Ukraine and the Middle East. The second analyzes new challenges and implications, such as the need for nuclear modernization. The third concludes by highlighting the need to develop a strategically nuanced approach to prevent miscalculation and maintain stability in an era of heightened competition and nuclear risk.

The Resurgence of Nuclear Risks

Conflicts in Ukraine and the Middle East, alongside escalating tensions across the globe, point to trends in the evolving role of nuclear weapons in international politics. Four related trends stand out: (1) adversaries relying on nuclear weapons to support expansionist objectives, (2) the proliferation of theater-range nuclear forces, (3) increased cooperation among adversaries, and (4) the erosion of U.S. credibility with allies.

These trends are underpinned by major investments in nuclear modernization by all nuclear-armed states. The United States is currently undertaking a $1.7 trillion nuclear modernization effort to upgrade all three legs of its nuclear triad—land-based intercontinental ballistic missiles, submarine-launched ballistic missiles, and strategic bombers.[8] This program, initiated by the Obama administration, seeks to ensure the continued credibility and effectiveness of the U.S. nuclear deterrent. Simultaneously, U.S. adversaries are rapidly expanding and modernizing their nuclear arsenals, posing a direct challenge to U.S. strategic dominance. The DOD's 2024 report on China's military power estimates that China may possess as many as 1,000 nuclear warheads by 2030, a significant increase from its current arsenal.[9] Meanwhile, Russia is fielding advanced weapons such as hypersonics capable of countering U.S. missile defenses, and North Korea is developing tactical nuclear weapons designed for battlefield use.

Nuclear Expansionism by Adversaries

Nuclear-armed states are leveraging their arsenals to pursue territorial ambitions and redraw international borders. Following Russia's illegal invasion of Ukraine in February 2022, Moscow has used a variety of nuclear threats and signals in apparent attempts to deter Western intervention in the war.[10] Recently, President Trump announced on social media that the United States would order two nuclear submarines "to be positioned in the appropriate regions" after former Russian President Dmitry Medvedev mocked what he termed U.S. "ultimatums" for Russia to end the war in Ukraine.[11] Similarly, North Korea continues to issue nuclear threats against South Korea, aiming for reunification on its own terms. For example, in October 2024, North Korean leader Kim Jong-un threatened to destroy South Korea with "all the offensive forces it [possesses], including nuclear weapons," if provoked.[12] Furthermore, U.S. defense experts have expressed concern that China might employ similar

tactics in a future Taiwan Strait crisis, threatening nuclear escalation to compel concessions.[13]

While the United States faced similar nuclear threats from the Soviet Union during the Cold War, the addition of China's and North Korea's nuclear expansionism multiplies these risks and demands that the United States divide its attention among multiple adversaries at once. In the past, Washington helped thwart nuclear expansionism by making judgments about Soviet red lines and signaling resolve to defend allies in the face of crisis. Today, however, the United States must provide these judgments for multiple adversaries, each of whom has unique nuclear doctrines and attitudes surrounding nuclear weapons. At the same time, adversaries, to calculate activities in their own regions, observe the actions the United States has taken (or not taken) to signal resolve in other theaters. Moreover, Russia, China, and North Korea are far less transparent than the United States in their doctrines and attitudes and the makeup of their nuclear forces. These new challenges of anticipating adversary red lines and signaling resolve to multiple adversaries at the same time raise the overall risks of nuclear use.

Proliferation of Theater-Range Nuclear Forces

Russia, China, and North Korea are all working to upgrade, expand, and diversify their nuclear arsenals, including with theater-range nuclear capabilities. The 2023 Annual Threat Assessment of the U.S. Intelligence Community, produced by the Office of the Director of National Intelligence (ODNI), claimed that Russia is developing nonstrategic nuclear forces "because Moscow believes such systems offer options to deter adversaries, control the escalation of potential hostilities, and counter U.S. and allied conventional forces."[14] China is also rapidly expanding its theater-range nuclear capabilities, exemplified by the DF-21 dual-capable "carrier killer" missile and the H6-N nuclear-capable bomber.[15] North Korea, as acknowledged by the ODNI threat assessment, has explicitly stated its intention to develop tactical nuclear weapons for battlefield operations.[16]

In the late 1970s and early 1980s, the United States faced similar challenges as the Soviet Union developed and deployed intermediate-range nuclear weapons that could reach U.S. allies overseas. In 1976, the Soviet Union deployed its new SS-20 intermediate-range ballistic missiles to Europe.[17] This move allowed Moscow to hold European capitals at risk of nuclear attack and undermined Washington's extended deterrence guarantees in the region. To resolve this dilemma and strengthen regional deterrence, NATO decided to modernize and deploy its intermediate-range nuclear forces to Europe, holding the Soviet Union at risk with a parallel set of capabilities.[18] The United States also began deploying nuclear-armed sea-launched cruise missiles, known as TLAM-Ns, on naval vessels to strengthen regional deterrence in both Europe and the Asia Pacific.

The proliferation of theater-range nuclear weapons is particularly concerning today, however, as the bulk of the U.S. nuclear arsenal consists of strategic systems designed to deter large-scale nuclear attacks, not battlefield use. In 1987, the United States and Soviet Union agreed to remove all intermediate-range ground-launched ballistic and cruise missiles from the arsenals of both sides through the Intermediate-Range Nuclear Forces (INF) Treaty.[19] Additionally, the United States removed TLAM-Ns from its surface combat ships and submarines in 1991 and officially retired the capability in 2010.[20] In 2014, however, Russia moved beyond limits set by the INF Treaty by developing a ground-launched cruise missile in violation of the agreement's parameters.[21] While the United States is seeking to close the gap by developing a nuclear-tipped sea-launched cruise missile (SLCM-N), this capability will be difficult to field before 2034.[22]

Increased Adversary Collusion

The current security environment is also marked by growing collusion between Russia, China, North Korea, and Iran. Russia is exporting nuclear reactors to China, which DOD assesses will play a vital role in Chinese plutonium production for nuclear weapons.[23] Similarly, China and Russia are conducting joint strategic bomber drills. For example, in November 2024, China flew an H6-N nuclear-capable bomber in a joint drill with Russia.[24] In January 2025, Secretary of

State Antony Blinken stated there is "reason to believe that Moscow intends to share advanced space and satellite technology with Pyongyang."[25] Advanced space and satellite technologies are often dual-use, and advances in space technology contribute to advances in long-range ballistic missile programs. Similarly, in September 2024, Secretary Blinken claimed, "Russia is sharing technology that Iran seeks—this is a two-way street—including on nuclear issues as well as some space information."[26]

During the Cold War, U.S. officials feared the Soviet Union could work with other powers, such as China and North Korea, to achieve its expansionist aims. In March 1950, Secretary of State Dean Acheson testified to Congress that the United States must ensure "that whoever runs China, even if the devil himself runs China, that he is an independent devil. That is infinitely better than if he is a stooge of Moscow or China comes under Russia."[27] These fears became acute, as Chinese intervention in the Korean War in October 1950 yielded speculation over collusion among communist leadership in Beijing, Pyongyang, and Moscow.[28] The Truman administration developed a robust response by building up conventional and nuclear forces in the United States.[29] In later years, National Security Advisor Henry Kissinger tried to drive a wedge between the Soviet Union and China with a diplomatic strategy that enabled the United States to "maintain closer relations with each side than they did with each other."[30] This historical lesson underscores the enduring imperative for the United States to prevent the formation of a unified bloc of nuclear-armed adversaries and highlights the strategic value of fostering divisions among them. In today's multipolar landscape, characterized by increasingly intertwined yet distinct national interests, the United States must proactively seek to discourage deeper, irreversible security alignments between Russia, China, North Korea, and Iran.

Erosion of U.S. Alliance Credibility

Threats from adversary nuclear expansionism, theater-range nuclear forces, and adversary collusion have produced doubts among U.S. allies over the ability of the United States to maintain its extended deterrence commitments. As adversaries increasingly rely on nuclear weapons to achieve their expansionist goals, allies have sought greater nuclear assurances for themselves. According to recent reports by news sources and think tanks, some allies, such as Poland, have pushed for greater roles in U.S. nuclear sharing arrangements.[31] Others, such as South Korea, have faced public pressure to consider developing indigenous nuclear weapons capabilities.[32] Citing the possibility that the United States will not "remain by [Europe's] side," President Macron has suggested that France could step in to provide extended nuclear deterrence guarantees.[33]

In the late 1950s, concerns over growing Soviet capabilities and doubts over U.S. commitments to European defense also caused several allies to consider developing nuclear weapons.[34] In response, U.S. President Dwight D. Eisenhower proposed a plan to establish a NATO nuclear stockpile, whereby allies would operate nuclear delivery systems but the United States would retain primary control over nuclear warheads.[35] Through engaging allies in nuclear sharing arrangements, the United States bridged its nuclear force commitments to Europe while reducing risks of allied proliferation.[36] The United States also facilitated the negotiation of several arms control agreements, such as the Limited Test Ban Treaty and the Nuclear Non-Proliferation Treaty, that helped restrict further proliferation.[37] These agreements established global norms around nuclear nonproliferation and provided incentives, such as access to peaceful uses of nuclear technology, for countries to refrain from developing their nuclear weapons capabilities.

Today, the future of arms control is increasingly precarious. The last remaining bilateral arms control agreement between the United States and Russia, the New START Treaty, will expire in February 2026. The demise of other crucial agreements, such as the Intermediate-Range Nuclear Forces Treaty, the Open Skies Treaty, and the Anti-Ballistic Missile Treaty, further underscores the erosion of the arms control architecture. Russia's recent de-ratification of the Comprehensive Nuclear Test Ban Treaty has further eroded the heel of the global nonproliferation regime. Compounding these challenges, the United States is

now demanding more from its allies while seeming to scale back its own commitments. Taking a more transactional approach, Washington seeks increased financial and security contributions from its partners. The prospects for achieving meaningful progress on arms control and strengthening alliance cohesion appear increasingly dim.

New Challenges and Implications

These converging challenges—renewed threats of territorial expansion backed by nuclear threats, theater nuclear forces, adversary collusion, and degrading U.S. alliance credibility—have several implications for the future of warfare and competition. It is likely that there will be an increase in nuclear threats and risk-taking in future regional conflicts, a lack of escalation management tools during crises, and a greater need for increased knowledge of nuclear issues at every echelon of military command. These trends demand a reassessment of nuclear strategy and challenge some key prevailing deterrence assumptions of the past eight decades.

Increased Risk-Taking in Regional Conflicts

Other nuclear possessors are likely watching Russia's actions in Ukraine. If they draw the conclusion that nuclear bullying delayed Western intervention, they may be more prone toward risk-taking and risk manipulation in future regional conflicts. Adversaries may come to believe that the United States and its allies have less at stake in distant theaters, thus validating the utility of nuclear coercion as a tool to achieve strategic objectives.

This trend may result in the perceived reduction of the nuclear threshold, altering the way conflicts are initiated and controlled. Opponents may increasingly try to take advantage of this perceived change, blending nuclear threats and coercive signaling into different stages of conflict, ranging from pre-crisis intimidation to bids for escalation control in the course of a conflict. The purpose of nuclear threats would be to achieve asymmetric benefit or nullify superior conventional capabilities. This sets up a situation where conventional actions are continuously overshadowed by nuclear potential, requiring an acute awareness of possible escalatory ladders and adversary red lines.

This dynamic inherently alters the calculus of future conventional wars between nuclear-armed states, where the specter of nuclear weapons could be placed over each decision. It implies that future opponents may use nuclear threats not only as a last resort but as a part of their early coercive campaigns to extract concessions, discourage third-party intervention, or even cover conventional aggression. This openness to such high-risk action naturally elevates the danger of miscalculation and accidental escalation, making conflict management much more complicated and risky for the United States and its allies.

Lack of Escalation Management Tools Could Exacerbate Crises

The evolving nature of warfare, characterized by the blurring of lines between conventional and nuclear conflict, necessitates the development of robust escalation management tools. Russia's increasing reliance on hostile rhetoric and nuclear saber-rattling in Ukraine demonstrates a willingness to employ nuclear coercion to achieve its objectives.[38] Moscow's use of nuclear threats to seize territory and redraw borders in Europe represents a dangerous escalation that challenges fundamental norms of international security. Furthermore, the development of tactical nuclear weapons by U.S. adversaries poses a challenge to escalation control. These weapons, designed for battlefield use against a limited number of targets, lower the threshold for nuclear use and complicate traditional notions of deterrence.

This asymmetry creates a potential "deterrence gap" and necessitates the development of a more flexible and nuanced approach to escalation management. The United States needs a broader array of capabilities to deter—and, if necessary, respond to—limited nuclear use by adversaries. This could include developing conventional weapons with enhanced precision and destructive power, modernizing existing nuclear capabilities to provide more flexible options, and exploring non-kinetic tools such as cyber warfare and electronic warfare to disrupt and degrade an adversary's ability to escalate conflict.

Unfamiliar Deterrence Challenges, Learning Delays

While some underlying aspects of the new nuclear landscape are similar to the Cold War era—such as the dynamics of great power rivalry, high-stakes games of chicken, the balance between offense and defense, and the nuances of alliance management—the modern environment also features a plethora of new challenges. These include unprecedented technological change, the growing frequency and intensity of nuclear-backed crises in regional contexts, and an expanding network of proliferation threats that go well beyond traditional state actors.

Along with the implications of a deterrence gap, wherein U.S. capabilities and the range of adversary threats may not be perfectly matched, there may also be an acute knowledge gap in twenty-first-century warfare. Modern military strategists must know how various technologies and complex technological systems interact in warfare, be aware of how to deter effectively in regional crises, and understand how the United States should contend with the complexity of deterring two peer competitors—China and Russia—simultaneously across separate theaters. Future warfighters will need to closely calibrate managing escalation and signaling resolve in a multipolar nuclear landscape where intentions and doctrines are less openly advertised.

Filling this knowledge gap and elevating overall "deterrence IQ" will be a long-term and multifaceted endeavor, requiring intellectual effort well beyond the traditional nuclear policy community. There needs to be an increase in nuclear knowledge across the entire defense establishment. Warfighters, even those who work almost exclusively in the conventional sphere, will need to gain a much deeper appreciation of the prospective effects of nuclear weapons on conventional conflict. This means coming to terms with the psychological and physical effects of nuclear employment, appreciating adversary escalation ladders, and developing the skills and procedures needed to fight and win in a nuclear-contaminated battlefield environment. Warfighters will need new training regimens, revised operational concepts, and a renewed focus on nuclear literacy within the armed forces.

Future warfighters will need to closely calibrate managing escalation and signaling resolve in a multipolar nuclear landscape, where intentions and doctrines are less openly advertised.

Conclusion

The resurgence of great power competition, coupled with the evolving nature of nuclear threats, presents a complex challenge to the role that nuclear weapons play in the future of modern warfare. The erosion of the global nuclear order—fueled by adversarial nuclear expansionism, the proliferation of theater-range nuclear forces, growing adversary collusion, and the weakening of U.S. alliance credibility—demands change. All nine nuclear-armed states are currently modernizing their nuclear forces, underscoring the increasing role that nuclear weapons will play in future conflicts.

The challenges facing the security environment today bear some similarities to those of the Cold War, but in many ways the current threats are different and more diverse. The contemporary security environment presents unique complexities requiring innovative solutions and a willingness to adapt to new realities.

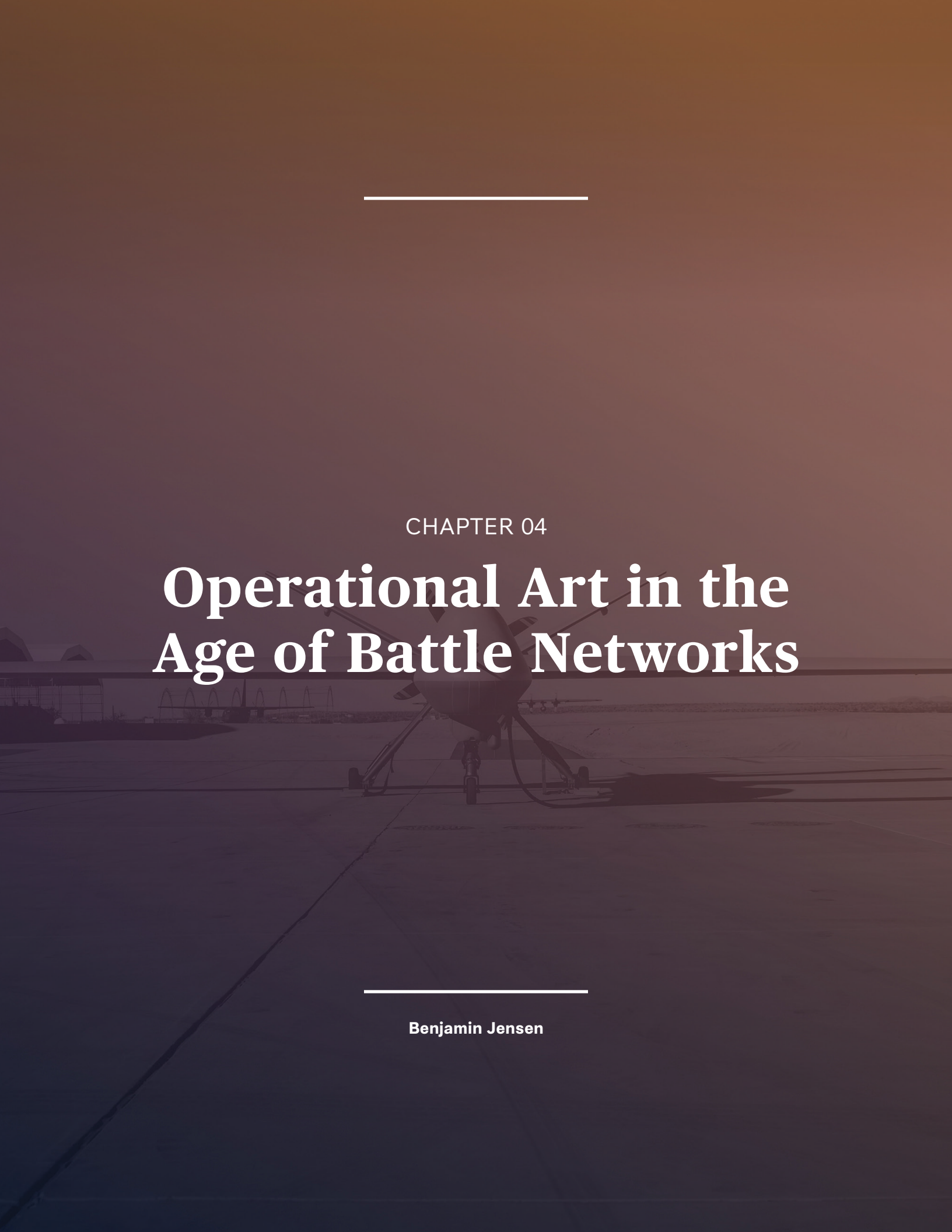
By examining the confluence of rising nuclear threats, eroding alliance credibility, and increasing adversarial collusion, this chapter paints a concerning picture of the future of modern warfare. The demonstrated willingness of nuclear-armed states to employ coercive nuclear signaling in pursuit of territorial gains, coupled with the proliferation of more usable theater-range nuclear weapons, suggests a lowering of the nuclear threshold in future conflicts. Furthermore, growing security cooperation among

U.S. adversaries creates a complex web of threats, demanding new and sophisticated approaches to deterrence and conflict management.

The erosion of U.S. alliance credibility risks further destabilizing the international order and potentially incentivizing proliferation among concerned partners. These trends collectively point to a future where nuclear considerations will be more present and the risks of escalation more acute in the management of modern warfare. Ultimately, navigating this era of heightened competition and nuclear risk will require a strategically nuanced approach to prevent miscalculation and maintain stability in an increasingly dangerous world.

PART II

Operations, Tactics, and Technology



CHAPTER 04

Operational Art in the Age of Battle Networks

Benjamin Jensen

Combat power is increasingly defined by the ability to fuse intelligence, orchestrate synchronized actions, and generate affordable mass through dynamic kill webs.

On the morning of October 29, 2022, a swarm of Ukrainian naval drones, controlled remotely and connected via a shared targeting network, struck Russia's Black Sea Fleet at Sevastopol.[1] While the concept of swarming is an old one, the attack represented something new—a demonstration of modern operational art, where distributed platforms, intelligence fusion, and autonomous systems create asymmetric effects against a conventionally superior adversary.[2] The battle turned emerging ideas of war, often associated with terms like "replicator" and "mosaic warfare," into a reality.[3] The strike forced Russia to reconsider its naval posture, highlighting that successful operational art in the age of battle networks is contingent on integrating effects across domains while leveraging information as a force multiplier.[4]

War is a continuation of politics by other means, but its form and manifestation on the battlefield are directly linked to the intersection of ideas and changing material conditions.[5] In the past, materials for wartime economies focused on iron, gunpowder, and the government research and development infrastructure that created nuclear weapons. However, today, well into the age of information, bytes cross global networks and increasingly integrate the private sector to change the character of war and, through it, operational art.[6]

New technologies generate new ideas about war, a cycle of discovery and experimentation often compressed by the demands of battle. That pattern is on display from the vast steppes of Ukraine to the deserts of the Middle East.

This chapter explores what these battles say about the future of war. Through examining crucial case studies in Ukraine and conflicts in the Middle East, it charts how operational art is changing based on the rapid advancement of networked sensors, data-driven command and control, and precision fires, including information effects in the electromagnetic spectrum and cyberspace. These developments realize the visions of future war imagined in the 1990s by army leaders like General Gordon Sullivan in Force

PHOTO: U.S. MARINE CORPS PHOTO BY LANCE CPL. COLTON BROWNLEE

XXI and even earlier by Soviet theorists dreaming of precision strike complexes.[7] The resulting networked formations represent the defining trend in modern war. These scalable networks invert the relationship between fire and maneuver to create entire campaigns predicated on moving sensors into place to deny adversary courses of action through a mix of long-range strikes, information effects, and drone swarms along the forward line of troops. This transparent battlefield is unforgiving.[8] To use an old army phrase from General William DePuy, "What can be seen can be hit, what can be hit can be destroyed."[9]

There is a new character of combined arms where information is more than a combat multiplier.[10] The ability to collect, fuse, and disseminate information is a defining feature of military power and calls for new ways of thinking about the correlation of forces and means in modern war.[11]

Combat power is increasingly defined by the ability to fuse intelligence, orchestrate synchronized actions, and generate affordable mass through dynamic kill webs.[12] The formations that master this approach generate operational tempo, imposing dilemmas on adversaries and forcing self-defeating decisions. This evolution marks a movement away from traditional linear strategies focused on mass and objectives (i.e., decisive points) toward a more dynamic hunt for asymmetries, exploiting weak points and overloading adversary decision cycles. Operational art becomes the ability to disrupt, disorient, and out-cycle the adversary by designing ways to integrate domains and sequence tactical actions.

Technology drives change but only through the people who use it and imagine new ways of war. The underlying assumption is that there are transnational learning communities at play in the transmission of military art across national boundaries. Professionals including career officers, civilian appointees, entrepreneurs, and scientists learn from each other through a process of emulation and adaptation.[13]

This chapter proceeds by establishing an analytical framework for analyzing how the emergence of information-centric battle networks is changing operational art using the concept of the principles of war. Next it applies this framework to two case studies, both harbingers of the new ways of combat: (1) the Ukrainian campaign in Kursk and (2) Israeli retaliatory air strikes against Iran's air defense network in October 2024. While additional cases—such as the 2020 Second Nagorno-Karabakh War, the May 2025 India-Pakistan standoff, and Israel-Iran clashes in June 2025—further illustrate the trend, this chapter focuses on these crucial air and ground cases in order to link observed operational behavior to foundational military theory. The chapter concludes with reading across these cases to catalogue how the emergence of modern battle networks and long-range effects alter the character of warfare.

Charting Change in Operational Art: The Principles of War

There is a long history across cultures of using law-like principles to guide the design of military campaigns. Both Sun Tzu (ca. 400–301 BCE) in *The Art of War* and the Indian philosopher Kautilya (ca. 300 BCE) in the *Arthashastra* outlined key factors associated with mobilizing and deploying combat power.[14] In the fourth century CE, Flavius Vegetius Renatus wrote *De re militari* for Emperor Valentinian II, including a section on maxims (i.e., principles) of war. This work proved influential for over a thousand years and shaped Niccolò Machiavelli's ideas in books like *The Art of War*.[15] The concept of principles and guides to war extended from the Renaissance into early modern Europe through key works by Henri, duke de Rohan, and Marquis de Silva's 1778 work *Principles*, which, alongside ideas by English thinker Henry Lloyd, became the foundation of Napoleonic warfare.[16] The modern usage of the concept draws from both Lloyd's work and *The Art of War* by Henri, baron de Jomini, through British military officer and theorist J. F. C. Fuller.[17]

The enduring concept is that military practitioners use these principles to help analyze and plan campaigns. The principles provide the underlying logic in the search for a theory of victory, guiding commanders and staff as they confront the dual pressures of allocating resources and translating intent into schemes of maneuver. Current U.S. joint doctrine lists 12 principles (Table 4.1).[18]

Table 4.1: Twelve Principles of War

Principle	Definition
Objective	Direct military action toward a clearly defined and achievable goal.
Offensive	Seize, retain, and exploit the initiative.
Mass	Concentrate the effects of combat power at the most advantageous place and time to produce results.
Maneuver	Place an adversary or enemy in a position of disadvantage.
Economy of force	Expend minimum essential combat power (lethal and nonlethal) on secondary efforts to allocate the maximum possible combat power on primary efforts.
Unity of command	Ensure unity of effort under one responsible commander for every objective.
Security	Prevent the enemy from acquiring an unexpected advantage.
Surprise	Strike at a time or place where the enemy is unprepared.
Simplicity	Increase the probability of success in execution by preparing clear, uncomplicated plans and concise orders.
Restraint	Prevent the excessive use of force.
Resilience	Withstand and recover from disruptions from internal and external factors.
Legitimacy	Maintain legal and moral authority.

Source: U.S. Department of the Army, *ADP 3-0: Operations* (Washington, DC: Department of the Army, July 2019), https://armypubs.army.mil/epubs/DR_pubs/DR_a/ARN18010-ADP_3-0-000-WEB-2.pdf.

The central idea is that these principles help assess crucial cases in recent wars and, in the process, illustrate the emerging importance of information effects and battle networks to modern operational art. A battle network is the fusion of sensors, shooters, and decisionmakers into a dynamic system capable of synchronizing effects across domains.[19] These networks aim to shorten kill chains, increase survivability through dispersal, and maximize cross-domain fires. Unlike traditional force structures that emphasize mass formations, battle networks prioritize speed, precision, and adaptability, shifting from a platform-centric to a data-centric approach to warfare.

Battle networks encompass two key complementary concepts: (1) command, control, communications, computers, combat systems, intelligence, surveillance, and targeting (C5ISRT) and (2) kill chains/webs. C5ISRT networks are the backbone of modern operations, enabling real-time data fusion to match weapons with targets faster than the enemy can react. The core concept is that the faster a side can fuse data and allocate resources, the higher the tempo and more prudent the expenditure of resources becomes. This effect, in turn, allows states with robust C5ISRT networks, like Ukraine, to fight outnumbered by vectoring in small drones, such as first-person view (FPV) drones, and artillery fire to attrit assaults and even spoil attacks before they begin. This logic is also why the U.S. Department of Defense, despite ongoing struggles, has prioritized both combined joint all-domain command and control (CJADC2) and software-driven approaches to acquisition.[20]

The concept of kill chains, increasingly called "webs," reflects the lethal application of fused data from a battle network.[21] The term "webs" identifies the importance of more scalable and resilient networks consistent with earlier Defense Advanced Research Projects Agency (DARPA) concepts of mosaic warfare.[22] This idea has diffused rapidly through the international system, including references in the People's Liberation Army (PLA) *Science of Military Strategy* and Russian doctrine before the war in Ukraine.[23] This concept, in turn, reflects the maturation of an earlier idea of reconnaissance-strike complexes, which has dominated Russian military thought for decades.[24] Kill

webs support operational targeting through concepts like kill boxes, which define geographic areas where forces have deconflict engagement authority. This accelerates tempo, including rapidly shifting authorities and attack guidance based on feedback loops analyzed at machine speed. In other words, increasing tempo requires a robust network, structured data, and analysis—including AI-driven analysis—to create advantage, a dynamic on display in Ukrainian innovations like the Delta common operating picture and multiple fires applications.[25] It also speaks to the logic of pulsed operations and other core concepts in the U.S. Joint Warfighting Concept.[26]

Information, Operational Art, and the Changing Character of War

Modern warfare is undergoing a transformation in which information is no longer just a combat multiplier—it is the battle space. The ability to collect, fuse, and disseminate information now defines military power, shaping how forces mass, maneuver, and achieve surprise. On increasingly transparent battlefields where commercial satellites, drones, signals intelligence, and human networks operate in real time, the traditional calculus of force ratios and firepower must be reimagined.

Two recent campaigns illustrate this shift. In July and August 2024, Ukraine launched its boldest cross-border operation of the war, penetrating deep into Russia's Kursk region using a combination of reconnaissance-strike networks, mobile brigades, and electronic warfare to fracture Russian battle networks. Months later, Israel executed a meticulously sequenced campaign against Iran's missile infrastructure and regional proxies, blending airpower, cyber operations, and psychological warfare to target not just enemy systems but also enemy perception. In both cases, operational success depended not on overwhelming force alone but on the ability to shape the information environment, degrade adversary coherence, and achieve tempo through decision dominance. Together, these cases point to a new theory of combined arms—one in which intelligence, surveillance, and reconnaissance (ISR), cyber, electromagnetic operations, and influence campaigns are not supporting fires but central to the correlation of forces and means in twenty-first-century conflict.

Maneuver on a Transparent Battlefield: The 2024 Kursk Offensive

One of the core challenges of modern war is how to conduct large-scale maneuvers—whether by ground, air, or sea—when the adversary has access to constant intelligence feeds fusing commercial satellite imagery with classified signals and human intelligence. This dynamic has been characterized elsewhere as a "transparent battlefield," implying that massing forces has diminishing marginal returns, essentially a self-defeating proposition.[27] The first challenge of modern operational art is therefore how to align surprise, maneuver, mass, and objective on a transparent battlefield. Ukraine's initial push into Kursk offers a crucial case.

In the late summer of 2024, Ukraine launched its largest cross-border assault into Russia since the start of the 2022 war in an effort to point Moscow on the horns of a dilemma. A mix of Ukrainian special operations and elements of the 80th Air Assault Brigade infiltrated the front line, conducting special reconnaissance that complemented larger intelligence operations and combined a mix of commercial satellite imagery analysis, signals intelligence, and extensive human intelligence networks. These infiltration operations made extensive use of drones and electronic warfare—both attack and collection—to map adversary battle networks and weak points along the front line.

Combined, these operations created a new operational picture that maneuver commanders could use to visualize the battlespace and identify when and where to launch their initial assault. This assault consisted of mobile groups conducting armed reconnaissance designed to identify and exploit gaps in the Russian line based on intelligence reporting. Once a mobile group had attacked in depth, Ukrainian forces could commit entire brigades to exploit the advantage. The case was a textbook example of maneuver warfare but was conducted in a manner consistent with emerging trends in drone and electromagnetic spectrum warfare.

Turning to the principles of war, the campaign highlighted key features of modern conflict: rapid mechanized thrusts, electronic warfare, and deliber-

ate surprise against a more numerous but potentially slower-to-adapt adversary. In terms of the principles of offense and mass, Ukraine transitioned from a largely defensive posture to a fast, deep penetration based on infiltration that exposed gaps. The high tempo of mechanized thrusts and the swift capture of Russian territory reflect a desire to stun the Russian command structure—what military theorist John Antal calls "battleshock."[28] Instead of using brute-force numbers, Ukraine is using "affordable mass" via FPVs and other drones to support mechanized brigades maneuvering based on real-time intelligence and electronic warfare. By synchronizing multiple brigades in at least two axes of advance, Ukraine seeks to overload Russian response efforts rather than simply present a large, static force.

In terms of the principles of maneuver and security, the Kursk campaign demonstrated how to place the enemy in a position of disadvantage through the flexible application of combat power. Ukraine's deep incursion—potentially tens of kilometers into Russian territory in the opening stages—enabled them to keep Russian forces off-balance. Maneuver encompassed not only physical envelopment but also electromagnetic and cyber elements. Ukraine jammed Russian communications and integrated intelligence from multiple sources to target Russia's weak points. This ability to rapidly identify and exploit gaps in the Russian line was related to Ukrainian operational security measures. Ukraine's success underscored how effective security in planning can achieve operational surprise. By masking intent, ensuring tight operations security, and possibly feeding deceptive indicators to Russian intelligence, Ukraine prevented Russia from reinforcing Kursk quickly. In withdrawing from Kursk, Ukraine also demonstrated the impost of securing its long supply lines and flanks within Russian territory—a key tactical vulnerability.

Battle Shock and Broken Networks: How Israel Fused Conventional and Unconventional Operations to Rewire Deterrence

In the early hours of October 25, 2024, over 100 Israeli aircraft launched Operation Days of Repentance, a coordinated multi-wave strike on Iranian military targets across the country.[29] The operation, unprecedented in scale and precision, hit over 20 high-value sites, including solid-fuel missile production facilities, long-range radar systems, and key components of Iran's integrated air defense network.[30] Although framed publicly as retaliation for Iran's massive October 1 missile and drone salvo, the strikes were far more than a proportional response. Rather, these complex attacks were the visible climax of a meticulously sequenced campaign—months in the making—that fused airpower, cyber operations, electronic warfare, and covert action into an integrated operational design. Israel did not just strike infrastructure; it targeted the logic of Iran's battle networks, disrupted proxy coordination, and used information as a weapon to generate psychological shock across the enemy system. What looked like an air strike was, in reality, a campaign to undermine Tehran's confidence in its ability to withstand future strikes and launch retaliatory strikes, a reality brought to fruition in Israeli's punishing 12-day campaign in June 2025. In other words, the campaign targeted the enemy's sense of coherence and leaders' perception of survivability while setting conditions for follow-on operations.

Israel's 2024 campaign against Iran and its proxy network was not a single air strike or even a week of bombardment. It was the culmination of a phased multidomain operation that fused conventional precision, unconventional disruption, and psychological warfare into a coherent effort to degrade Iran's capacity to project power and force its leaders to question their networks, decisions, and security.

At its core, this was a campaign against battle networks, which for Tehran consist of command and control systems, sensor architectures, and proxy infrastructure that allow Iran and its regional allies to operate as a distributed but connected strike complex. Israel took an indirect, sequential approach, opting to generate effects over time as opposed to seeking one decisive knockout blow that was almost certain to draw it into a larger war. By conducting a series of shaping activities targeting Iranian networks over months, striking them with precision and sowing cognitive dislocation among their operators, Israel

demonstrated how information is no longer just about passing data across systems; it is about how leaders *perceive the world around them*—and whether they still believe their systems will hold.

This campaign began not with a missile, but with a message. In late July 2024, a senior Hamas official was assassinated in central Tehran—one of the most secure areas in the Islamic republic.[31] The strike was not random; it was symbolic and surgical. It punctured the idea that Iran could protect key nodes in its regional proxy network, and it forced senior officials in Tehran to ask a dangerous question: If they got him, who is next?

This covert action was followed by escalating strikes in southern Lebanon, including a September attack on a Hezbollah command site and a sabotage campaign that took thousands of fighters off the battlefield by blowing up their communications devices (i.e., pagers, radios).[32] These operations reflected a deliberate focus on battle networks—degrading not just shooters or missiles but also the communication and coordination layers that allow Iranian and proxy forces to act as a system.

This shaping phase—covert, psychological, and electromagnetic—laid the foundation for what came next. And it was not just about killing leaders or destroying assets; it was about fragmenting adversary situational awareness. In modern war, battle networks are the central nervous system. Israel was not trying to defeat a massed army; it was disabling a distributed brain to gain a position of advantage over its much larger rival, Iran.

When Israeli aircraft launched a multi-wave strike on October 25, 2024, targeting 20 Iranian military sites across the country, it was the kinetic crescendo of a campaign designed to change Iran's decision calculus. The targets included missile production facilities essential to Iran's solid-fuel ballistic missile arsenal and high-end radar systems like the S-300.[33] This shaping would prove critical in the June 2025 campaign in which Israel demonstrated its ability to attack targets across Iran.

From an operational perspective, the campaign aligned with key principles of war, adapted to an area of war by and through battle networks. First, consider the principle of objective and the need to ensure every military action is directed toward a clearly defined and achievable end. In the campaign, the objective appeared to be eroding Iran's ability to mass and launch precision missiles at Israel. By degrading missile production nodes and battle network infrastructure, Israel reduced near-term threats without widening the war.

Two additional principles help frame the campaign: offensive and maneuver. Israel seized and retained the initiative through a three-wave strike campaign, using air-launched standoff munitions to force Iran into a reactive posture.[34] And this strategy was not just geographic. Israel maneuvered in the electromagnetic spectrum—jamming, spoofing, and disabling radar systems—and in cognitive space by compelling Iranian leaders to question the integrity of their command networks and the accuracy of their information picture. Rather than strike symbolic or escalatory targets (e.g., oil infrastructure, nuclear sites, or regime leadership), Israel concentrated advanced munitions and assets in the October campaign on key enablers of Iran's strike complex, essentially reducing its viability and signaling its ability to hold other targets at risk. This preserved missile defense reserves, ensured strategic restraint, and sustained readiness for follow-on operations. Perhaps the most profound aspect is that Israel did not just protect its forces, it made Iranian commanders feel *insecure*. By striking deep targets without warning, disrupting early warning networks, and demonstrating the ability to kill leaders in the heart of Tehran, Israel demonstrated its ability to impose costs.

Taken as a whole, Israel's campaign demonstrates that modern battle networks exist not just in servers, satellites, or sensor arrays but also in the *minds of their operators*. Israeli planners understood that disrupting data links and radar systems would go only so far. The real target was perception, which is why Israel likely integrated cyber operations to delay enemy reaction time, degrade command coordination, and injected doubt into decision chains. Israeli Air Force F-35Is, with their suite of passive sensors and electronic warfare capabilities, likely mapped and disrupted Iranian air defense systems in real time. Paired with standoff

jamming platforms and coordinated decoy operations, these actions rendered Iran's most advanced radar systems functionally blind.

But even more important, the campaign created informational fog for Iran's leadership. In a regime where trust is already precarious and decisionmaking centralized, the sudden loss of awareness—combined with fear of further targeted assassinations—frayed coherence across Tehran's national security apparatus. This is the modern adaptation of battle shock: not just sudden violence but calculated disorientation; a break in trust, not just a break in infrastructure; a feeling that no network is safe, no command center secure, no bunker deep enough.

As a result, Israel's 2024 campaign was more than a response to missile salvos. It was a case study in how operational art adapts to an age of systems warfare and cognitive contestation. By attacking the connective tissue of Iran's battle networks, Israel degraded not only strike capabilities but also the belief that those capabilities could function under fire. These effects set the conditions for the deeper campaign Israel launched in June 2025 that significantly set back Iran's missile inventory, nuclear sites, air defenses, and even military leadership.

This is the essence of modern deterrence: not just the ability to retaliate but also the ability to create persistent *uncertainty*—a psychological edge that makes adversaries hesitate. In this campaign, Israel did not just pass data faster or fire further. It weaponized perception, shattered battle networks, and rewrote the strategic calculus in Tehran—not through occupation but by eroding confidence from the inside out.

Conclusion

From the campaign in Kursk and the skies of Tehran, contemporary military operations reveal a world in which the decisive terrain is not just geographic—it is digital, electromagnetic, and psychological. The integration of sensors, shooters, and decisionmakers into fused battle networks is redefining how states generate combat power. These cases show that operational art in the twenty-first century is no longer about massing forces at a decisive point. It is about generating converging dilemmas at speed across domains and denying adversaries the ability to process what is happening until it is too late. The campaigns examined here reflect more than adaptation in real time; they offer blueprints for the future of warfare.

From the campaign in Kursk and the skies of Tehran, contemporary military operations reveal a world in which the decisive terrain is not just geographic—it is digital, electromagnetic, and psychological.

Implication 1: Future campaigns will be built around adaptive kill webs.

Ukraine's battlefield innovation demonstrates that modern campaigns will be increasingly defined by software-defined kill webs that can be rapidly reconfigured under fire. In Kursk, Ukraine combined drone reconnaissance, open-source targeting, and decentralized command nodes to fracture Russian battle networks. These operations were not linear. They were modular, pulsed, and responsive to real-time intelligence. Future military formations, particularly for smaller or outnumbered states, will need to emulate this model by fusing civilian and military ISR, applying real-time analytics, and pushing decision authority down to frontline echelons. In this world, survivability is not just about armor; it is about adaptation at the speed of relevance.

Implication 2: Strategic effects will come from information-driven shock.

Israel's 2024 air campaign revealed that the most powerful strike is not always kinetic. It is the one that fractures an adversary's perception of control. From the assassination in Tehran to coordinated cyber and electronic warfare attacks, Israel targeted not just radar sites and missile factories but also the cognitive coherence of Iran's battle network. The lesson

for future deterrence and coercion campaigns is clear. The side that can inject uncertainty into decisionmaking loops, fracture trust in systems, and make leaders feel personally vulnerable will shape strategic outcomes long before a single brigade deploys. Information is not just a force multiplier; it is a weapon of war.

Implication 3: Multidomain operations will prioritize tempo.

Israel's multidomain campaign—synchronizing F-35 sensor fusion, cyber operations, decoys, and standoff munitions—demonstrates that the future of operational art is about shaping time more than terrain. Maneuver now happens across the electromagnetic spectrum, cyberspace, and strategic narrative, all while creating tempo that overloads adversary systems. In this vision, "seizing the initiative" means disrupting adversary kill chains, fragmenting their information picture, and making their battle rhythm irrelevant. Tomorrow's campaigns will succeed by making adversaries hesitate, misallocate resources, and react to illusions until their networks and confidence collapse.

CHAPTER 05

The Evolution of Landpower

Benjamin Jensen

Landpower remains indispensable as the hub that sustains and integrates operations across air, sea, space, and cyber domains. There is no airpower without airports. There is no seapower with major ports. There is no cyber or space power without digital infrastructure, ground stations, and launch platforms.

In late February 2022, Russian forces launched a full-scale invasion of Ukraine. Within hours, columns of tanks rolled across borders, missiles launched from the air and sea struck airfields, and cyberattacks targeted communication systems. Yet amid these varied assault vectors, the defining struggle in the war's early phase—Russia's attempt to encircle Kyiv and seize critical lodgments like the Hostomel airport—was for land.[1]

Despite Russia's initial multidomain salvo, comprising long-range fires, cyberattacks, and electronic warfare, the Ukrainian defense hinged on organized ground resistance. Soldiers and territorial volunteers held the capital's outskirts and prevented Russian paratroopers from establishing a key air bridge at Hostomel. A mix of former tech executives turned drone operators and special forces teams launched ambushes along Russian armored columns reminiscent of Finnish *motti* tactics from the Winter War.[2] These activities at the tactical level denied Moscow's operational objective of rapidly seizing Kyiv in a lightning 10-day campaign. In other words, strategy hinged on the value of territory in the land domain. Great battles remain fought by people over land, and the domain plays a central role at every level of war.

But land is not just the object of campaigns, it is the medium through which adversaries access other domains. In a world of satellites, precision munitions, and networked warfare, the initial campaign of the war in Ukraine underscored an enduring reality: Landpower remains indispensable as the hub that sustains and integrates operations across air, sea, space, and cyber domains. There is no airpower without airports. There is no seapower with major ports. There is no cyber or space power without digital infrastructure, ground stations, and launch platforms.

Landpower in the twenty-first century is neither eclipsed by technology nor rendered obsolete by distant-strike capabilities and the increasing importance of other domains. It evolves with new doctrines, and technology, such as artificial intelligence and machine learning (AI/ML) and cyber integration. Yet it endures in its fundamental role. Cyberspace

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relies on servers and fiber-optic cables housed on the ground. Ultimately, political and strategic outcomes still hinge on who holds which territory, for how long, and at what cost.

The chapter proceeds by adapting naval theory to reconceptualize twenty-first-century landpower. Using Sir Julian Corbett's ideas as a guide, it proposes seeing land as a hub connecting other domains. This perspective is then illustrated through a series of vignettes analyzing how Ukraine, China, and the United States are using land-based forces to generate effects in other domains. The chapter concludes by drawing three implications about the future of war. First, future campaigns will need to focus on securing strategic ground-based infrastructure that includes not just air and naval ports but space-based hubs and data infrastructure. Second, combined arms now means combined domains where land serves as a gateway to effects in air, sea, cyberspace, and space. Last, there is a larger competition over critical infrastructure likely to define both competition and warfighting in the coming decades.

What Has Changed: Depth and Domains

A persistent theme in the evolution of modern land warfare is disrupting adversaries across the depth of battlespace to enable maneuver. If a force can move, it can threaten adversary centers of gravity, thus compelling surrender or inviting destruction. Early twentieth-century Soviet theorist Georgii Isserson charted the changing character of war in relation to how politics and technology create new epochs.[3] His notion of successive "epochs of warfare" predicted that once continuous fronts became the norm (as in World War I), future battles would require deep operations to bypass linear defenses. This thinking inspired Soviet deep battle doctrine, which remains relevant in the twenty-first century.[4] It also provides a larger conceptual foundation for modern combined arms maneuver and writings from Liddell Hart and Mikhail Tukhachevsky about how to break static fronts.[5] And since the late Cold War, concerns about combined arms maneuver have had to grapple with the challenge of how precision weapons and modern battle networks complicate massing forces.[6] This condition has become increasingly acute with the rise of the transparent battlefield, where even small or medium-sized countries can network drones to deny maneuver.[7]

Modern multidomain operations seek to use long-range fires to change battlefield conditions and enable maneuver. Multidomain operations revolve around penetrating layered defenses, such as anti-access/area denial (A2/AD) networks, to disrupt an adversary's depth and create exploitable corridors.[8] The concept is consistent with the "pulse attacks" envisioned by the Joint Warfighting Concept, which will increasingly rely on coordinated effects across space, cyberspace, and more traditional land, air, and maritime domains.[9] At the same time, modern landpower has to increasingly contend with how information changes politics and puts a premium on understanding human terrain.[10] Long-range strikes happen alongside computational propaganda campaigns, creating a new form of political warfare.[11] Seen in this light, Isserson's key insight—that changes in technology (e.g., mechanization, long-range fires) drive doctrinal evolution but never negate the human requirement to seize ground—continues to inform contemporary landpower debates.

The political utility of landpower remains its role in adding credibility to strategic deterrence through forward-deployed forces ranging from trip wires to large coalition formations designed to prevent a conventional fait accompli attack and provide options to seize key terrain.[12] Traditionally, the seat of power has been on land, defined by both political and economic points. These hubs—such as capital cities, mountain passes, and ports located on critical sea lines of communication—provided the aimpoints for campaigns for centuries.

Yet, increasingly, there is a new logic to landpower. Hubs on land anchor how militaries connect their forces to project combat power across multiple domains. In other words, landpower anchors the entire warfighting architecture.[13] As highlighted above, ports supply navies, runways host and maintain airpower, ground stations control satellites, and fiber-optic cables house the internet's spine. Absent secure territorial footholds, domain capabilities

wither. Joint all-domain warfare and the "symphony of capabilities" called for in the Joint Warfighting Concept require fusing effects across multiple domains. This logic suggests a need to revisit how soldiers, policymakers, and analysts conceptualize the utility of landpower.

The Land-Sea Interaction as a Model for Multidomain Warfare

Sir Julian Corbett (1854–1922) is remembered as a leading naval theorist, but his ideas help understand the centrality of land as a gateway to joint all-domain operations. His seminal work, *Some Principles of Maritime Strategy* (1911), challenged conventional naval thought by emphasizing that maritime power is inherently tied to operations on land.[14] Unlike American naval theorist Alfred Thayer Mahan (1840–1914), who championed decisive naval engagements and total sea control, Corbett argued that true strategic success required the integration of sea and landpower.[15]

Over the last generation, scholars and practitioners have applied this insight to new domains, including space and cyberspace.[16] This chapter expands Corbett's original insight even further.[17] The land is no longer just a strategic objective, with naval forces serving as a supporting element. It becomes a hub for connecting domains and waging joint all-domain operations.[18]

Just as Corbett emphasized that naval forces must influence events on land to be strategically decisive, modern joint forces must integrate land, sea, air, space, and cyber capabilities to achieve operational success. At the operational level, landpower serves as a means of both generating and denying effects in other domains in support of a larger campaign. Corbett's logic dictates that airpower, like naval power, is fundamentally dependent on ground-based logistical support, radar stations, and air defense systems.[19]

Modern naval forces cannot operate effectively without land-based resupply.[20] Furthermore, modern naval campaigns operate as part of a network of coastal sensors and missile batteries central to modern concepts of sea denial.[21] They also rely on satellites launched from ground sites to provide everything from intelligence updates to positioning, navigation, and timing (PNT) support to targeting. Even space and cyberspace depend on land-based infrastructure ranging from downlink stations and fiber-optic cables to data centers and launch platforms. Corbett's land-sea integration model should be expanded into a land-centric model for multidomain operations, where control of ports, airports, cyber hubs, and space infrastructure determines the ability to conduct effective military operations across all domains.

How Land Hubs Shape Modern Military Competition and Campaigns

Corbett's concept of "disputed command"—the idea that no force can achieve total dominance at sea and must instead focus on controlling key areas—applies directly to modern multidomain operations. In this framework, seizing and holding at risk key land-based infrastructure such as ports, space launch sites, and data centers determines the flow of effects across domains. Three cases, laid out in the sections below, demonstrate this logic.

China's Infrastructure Strategy

Contrary to much of the scholarship, China's militarization of artificial islands in the South China Sea is not just a maritime gray zone tactic.[22] Rather, it reflects an enduring truth about war: Land remains the hub through which great powers generate and sustain cross-domain advantage. Drawing from Corbett's theory of limited maritime command, Beijing's strategy is not singularly about coercion beneath the threshold of war. Instead, these activities shape the theater and set conditions by extending Beijing's A2/AD bubble and creating opportunities for power projection. Seen in this light, beyond coercion, militarized islands help Beijing generate the air and maritime power required to support future sea control operations that complicate U.S. and allied planning.[23]

These artificial island hubs serve as forward operating bases, sensor nodes, and logistics platforms—critical nodes in China's evolving battle network. They enable the People's Liberation Army (PLA) to extend surveillance and strike reach far beyond the

mainland, fusing land-based radar, ship-borne sensors, and airborne early warning into an integrated architecture for command, control, communications, computers, cyber, intelligence, surveillance, and reconnaissance (C5ISR).[24] From these positions, China can deploy drones, patrol aircraft, naval militia vessels, and coast guard cutters in coordinated maritime domain operations. This forward basing enables the PLA to sustain presence, monitor traffic, and hold at risk key chokepoints like the Bashi Channel and the Strait of Malacca—contested sea lines of communication vital to both global commerce and regional military mobility.

At the strategic level, these land hubs function as platforms for power projection and political warfare. They support not only A2/AD operations but also economic and legal gray zone tactics—enabling Beijing to expand illegal fishing operations, intimidate rival claimants, and lay de facto claim to undersea resources, including hydrocarbons, gas fields, and mineral deposits beneath the South China Sea.[25] These actions mirror a broader trend: the use of land-based infrastructure to enable multidomain operations that blur the line between conventional force projection and peacetime coercion. China's artificial islands are not just concrete symbols of sovereignty—they are multidomain launchpads from which Beijing contests both physical access and legal norms in the Indo-Pacific. In this context, landpower becomes not just the foundation of military operations, but the platform for strategic influence.

Second, China's Belt and Road Initiative (BRI) is not just about trade routes or economic corridors. It is a global strategy to reshape the physical and digital terrain through which power is projected. BRI reflects a modern understanding of landpower as the connective tissue for multidomain influence. By building, financing, or leasing key infrastructure around the globe—from ports and railways to data centers and satellite ground stations—Beijing is establishing positional advantage to shape maritime access, cyberspace architecture, and space operations.[26] The strategic logic mirrors Corbett's foundational claim that the sea alone does not win wars; control over land is required to influence outcomes at sea and beyond.

In the maritime domain, the BRI has enabled China to construct a web of dual-use logistics nodes that support the evolution of the People's Liberation Army Navy (PLAN) into a blue-water force. China's first overseas base in Djibouti and key BRI-linked ports like Gwadar (Pakistan), Hambantota (Sri Lanka), and Doraleh (Djibouti) offer refueling, surveillance, and maintenance infrastructure for PLAN deployments in the Indian Ocean and Red Sea. These ports are not simply commercial. They are "strategic strongpoints" designed to extend the reach of Chinese seapower while providing platforms for intelligence, surveillance, and reconnaissance (ISR) collection and coercive diplomacy in times of crisis. During a Taiwan contingency, these positions could support PLAN surface action groups or submarines imposing a distant blockade, placing pressure on U.S. and allied resupply routes.

Equally important is China's Digital Silk Road (DSR), a pillar of the BRI aimed at exporting Chinese telecommunications technology, including 5G infrastructure, fiber-optic networks, smart-city surveillance systems, and undersea cables.[27] Companies like Huawei and ZTE dominate many of these projects, often bundled with surveillance and facial recognition systems that mirror China's domestic "digital authoritarianism" model.[28] Elements of this technology are already installed in more than 80 countries, providing China with not only soft power but also potential access to foreign data and signals intelligence. In strategic terms, China is creating digital terrain dependencies that allow Beijing to shape or even disrupt the information environment through technical infrastructure and software backdoors.

The export of Chinese telecommunications systems dovetails with the rise of the Space Silk Road.[29] Under the larger "Space Information Corridor" initiative, China is building and operating satellite ground stations and launch facilities in key partner countries, such as Argentina, Namibia, and Pakistan. These facilities support China's growing satellite constellations, including the Beidou navigation system and remote-sensing platforms capable of supporting PLA C4ISR and precision strike operations. Beidou now offers global PNT services and is marketed as a

GPS alternative. By extending space infrastructure abroad, China ensures redundancy and global coverage for its space assets, giving the PLA an advantage in a future blockade or counter-intervention scenario.

The larger family of BRI initiatives thus provides China with a global network of land-based infrastructure nodes that connect sensors, shooters, and decisionmakers—the essence of a modern battle network. In a Taiwan contingency, China may never need to encircle Taiwan directly. Instead, it can leverage this infrastructure to isolate the island digitally and economically. PLA doctrine, including exercises like Joint Sword-2024, points to the use of cyberattacks, electronic warfare, and space-based ISR to sever Taiwan's communications and raise the costs of U.S. intervention. Ground stations in the Middle East or Africa can relay data in support of operations in East Asia, while telecommunications dependencies can be used to shape the decisionmaking of foreign governments hesitant to side with Washington in a crisis.

Ultimately, the BRI is not a traditional military alliance or a treaty network. It is a system of territorial dependencies through infrastructure. China is building a multidomain campaign plan through roads, cables, ports, and satellites, all anchored on land. In this new logic of combined arms, land is not just the objective. It is the access point, the enabler, and the global amplifier of Chinese influence. Understanding how larger strategic initiatives like BRI generate "land power in being" in the age of battle networks is essential for U.S. strategists thinking about denial, disruption, and resilience in long-term competition.

Killing Planes, Ships, and Satellites with Ground-Launched Effects

One of the defining features of Ukraine's evolving campaign is its ability to use land-based strikes to fracture Russian multidomain operations. From the outset of the war, Ukraine has demonstrated that long-range fires—whether delivered by ballistic missiles, drones, or cruise missile systems—can create strategic effects when precisely targeted at key airfields, naval ports, and satellite communications centers. These operations reveal how land serves not merely as a battlespace, but as a hub, essentially an anchor point, from which forces can shape air, sea, space, and cyber operations. Whether striking strategic bomber bases deep inside Russia, sinking the *Moskva*, or disabling satellite communications links in Crimea, Ukraine has exposed how control of terrain and infrastructure enables the projection of power across all domains. This is a war fought not only over territory, but over the systems that connect, sense, and strike across that territory.

On February 25, 2022, Ukraine launched a Tochka-U ballistic missile strike on Russia's Millerovo air base in Rostov Oblast, about 20 km from the border.[30] The attack set hangars ablaze and destroyed at least one Russian Su-30SM fighter on the ground. This early cross-border strike signaled Kyiv's willingness and capability to target Russian military infrastructure from the outset. The surprise attack forced Russia to recognize its vulnerability at home, complicating Russian air operations near the front and foreshadowing a broader Ukrainian strategy of hitting deep targets to disrupt Russian multidomain operations.

On August 9, 2022, explosions rocked the Saky (Novofedorivka) airbase in Russian-occupied Crimea.[31] The blasts, which Ukraine later implied were its doing, obliterated ammo depots and wrecked multiple Russian warplanes. Western intelligence assessed that over half of the Black Sea Fleet's naval aviation combat jets were put out of use by the Saky strike. In its aftermath, Russia had to disperse or relocate remaining aircraft, degrading its ability to project airpower over the Black Sea and southern Ukraine.

In another unprecedented long-range attack, Ukraine targeted the Dyagilevo airfield (over 450 km from Ukraine) on December 5, 2022, using modified Soviet-era drones.[32] The strike, aimed at disabling Russia's strategic bombers, caused a fuel truck explosion that killed three personnel and injured others, and it reportedly damaged a Tu-22M3 nuclear-capable bomber. The ability of Ukraine to hit an airbase so deep in Russian territory underscored gaps in Russia's air defenses and threatened its multidomain operations by potentially limiting the sortie rate of strategic bombers used for cruise missile attacks on Ukraine.

Whether striking strategic bomber bases deep inside Russia, sinking the Moskva, or disabling satellite communications links in Crimea, Ukraine has exposed how control of terrain and infrastructure enables the projection of power across all domains.

On August 19, 2023, a Ukrainian drone strike hit Soltsy-2 air base in northwestern Russia (about 650 km from Ukraine), which hosts Tu-22M3 "Backfire" bombers.[33] This strike again highlighted Russia's struggles to protect strategic assets deep inside its territory—a vulnerability that undermines its air domain supremacy. Following the strike, Russia hurriedly relocated the remaining Tu-22M3 fleet to more remote airfields, revealing how Ukrainian deep strikes were steadily eroding Russia's freedom of action in the air. The attack also served as a harbinger for even bolder attacks that would occur in 2025 like Operation Spider Web and using special forces and drones to attack long-range bombers deep inside Russia.[34]

In addition to using ground-launched, long-range drones, Ukraine has used U.S.-supplied ATACMS missiles to strike Russian airfields. On October 17, 2023, Ukrainian missiles struck the helicopters staged in Berdyansk and Luhansk.[35] The twin strikes forced Russia to temporarily relocate surviving helicopters farther from the front, blunting its ability to support ground troops. Collectively, the ATACMS strikes demonstrated a significant evolution in Ukraine's multidomain operations, combining precision missiles and special forces targeting to neutralize key Russian aviation assets in one coordinated blow.

While the use of naval drones and air-launched cruise missiles have captured the headlines, Ukraine has also illustrated how to integrate ground-launched ballistic and antiship cruise missile strikes into sea denial operations. In the early weeks of the war, Ukraine targeted Russian naval forces using occupied ports as forward bases. On March 24, 2022, a Ukrainian Tochka-U ballistic missile struck a port on Ukraine's Sea of Azov coast, where Russian Black Sea Fleet landing ships were unloading supplies.[36] The strike caused a massive explosion and fire, sinking the Alligator-class landing ship *Saratov* and heavily damaging two other Russian amphibious vessels docked nearby. This attack eliminated a key asset for Russia's planned amphibious operations and forced an abrupt withdrawal of the remaining landing ships from Berdiansk. In effect, Ukraine's missile strikes foiled Russia's seaborne resupply efforts on that front and demonstrated that port facilities under Russian control were not safe from attack, disrupting Russia's joint land-sea logistical operations in southern Ukraine.

On April 13, 2022, Ukraine achieved a landmark naval victory by striking Russia's Black Sea Fleet flagship, the cruiser *Moskva*.[37] Ukrainian Neptune antiship cruise missiles hit the *Moskva* off the Ukrainian coast, igniting a fire and eventually sinking the 12,000-ton warship. The loss of the *Moskva*—the largest Russian warship sunk in combat since World War II—was a major symbolic and operational blow to Russia's navy . As the fleet's primary air defense ship, its sinking left Russian naval forces at greater risk from Ukrainian aircraft and missiles. After this incident, Russian warships pulled farther away from Ukraine's coast.

Last, Ukraine attacked Russian targets on land to try and degrade Moscow's access to space. In December 2023, Ukrainian forces targeted a Russian satellite communication hub in Yevpatoriya, Crimea. Of note, this site was associated with coordinating GLONASS (i.e., Russian GPS) and a wide range of orbital activities.[38] The attack involved a mix of drones and cruise missiles. In June 2024, Ukrainian forces hit the facility again. Ukrainian sources identified the attack as the "second Ukrainian strike on [Russia's] space warfare infrastructure" in Crimea.[39] The attack likely compounded the damage to satellite dishes and communication equipment from the first strike. Each of these blows further degrades Russia's ability to use Crimea as a secure node for command and control via satellite. By targeting ground-based satellite links and

over-the-horizon radars, Ukraine is directly contesting Russia's space and electronic dominance. These operations have implications beyond immediate battlefield effects. They challenge Russia's strategic situational awareness and precision warfare capabilities (which rely on satellite guidance), thereby influencing the multidomain balance (land, air, sea, and space) in favor of Ukraine.

Occupying Key Maritime Terrain

Emerging littoral rotational forces like the U.S. Army's Multi-Domain Task Force (MDTF) and the U.S. Marine Corps' Marine Littoral Regiment (MLR) represent a significant shift in operational art. These formations emphasize the integration of capabilities across multiple domains—land, sea, air, space, cyber, and the electromagnetic spectrum projected from littoral battlespace.[40] The units are designed to operate as agile, forward-deployed hubs, capable of coordinating and executing complex operations that challenge adversaries across all domains of warfare. Neither the MDTF nor MLR is decisive in any one domain. Rather, the theory of victory is that they can generate effects in multiple domains to place the adversary on the horns of a dilemma, thus disrupting freedom of action.

The MDTF is a brigade-sized formation tailored to penetrate and disintegrate adversary A2/AD systems. It integrates long-range precision fires—including a mix of land and sea cruise missiles—with non-kinetic capabilities, including cyber and electronic warfare, to create multiple dilemmas for adversaries.[41] The formation also has organic air and counter–unmanned aircraft system (UAS) defense.[42] Central to the MDTF's effectiveness is the Multi-Domain Effects Battalion (MDEB), which synchronizes targeting across domains, leveraging space-based sensors for real-time intelligence and coordinating cyber and electromagnetic spectrum operations to disrupt enemy networks.[43] These are coordinated with novel low-cost sensors, including long-endurance UASs and high-altitude balloons.[44]

The MDTF's structure includes components such as the Intelligence, Information, Cyber, Electronic Warfare, and Space (I2CEWS) battalion, which ensures seamless integration of operations across domains. This integration enables the MDTF to conduct operations that combine kinetic strikes with cyber and electronic attacks, effectively targeting adversary command and control systems and creating opportunities for joint force exploitation.

The MLR is designed as a stand-in force capable of conducting sea denial operations, particularly in contested maritime environments. It leverages Expeditionary Advanced Base Operations (EABO) to establish temporary, low-signature positions that can launch antiship missiles, conduct air defense, and support maritime domain awareness.[45] The integration of systems like the Navy/Marine Corps Expeditionary Ship Interdiction System (NMESIS) enhances the MLR's ability to target enemy vessels effectively. The formation also includes more organic infantry than the MDTF and high-end mobile radar that allows it to coordinate surface and air search missions that support naval strike and sector air defense.[46]

Additionally, the MLR's coordination with the Marine Expeditionary Force Information Group (MIG) allows for synchronized operations across the electromagnetic spectrum, cyber, and space domains.[47] The group provides capabilities such as electronic warfare, signals intelligence, and information operations, ensuring that the MLR can operate effectively in the information environment and support joint force objectives.

Both the MDTF and MLR exemplify the U.S. military's shift toward integrated, multi-domain operations. By serving as agile hubs that coordinate effects across land, sea, air, space, cyber, and the electromagnetic spectrum, these units enhance the joint force's ability to respond to complex threats and maintain strategic advantages in contested environments.

Conclusions

Landpower is not vanishing in the age of long-range fires and precision-guided munitions. Rather, it is transforming. As this chapter has shown, land remains the essential hub that links, sustains, and amplifies effects across domains. From the defense of Kyiv to drone strikes on strategic airfields, ports, and satellite arrays, Ukraine has illustrated that territorial control

and infrastructure access remain central to projecting power in modern warfare. Likewise, China's militarized islands and BRI infrastructure demonstrate how states use physical footholds to enable distributed operations in cyberspace and space and across the electromagnetic spectrum. Modern landpower does not just seize ground. It shapes the strategic environment across domains. In short, land is no longer just where wars are fought. It is the platform from which they are connected, contested, and won.

Implication 1: Secure terrain is strategic infrastructure.

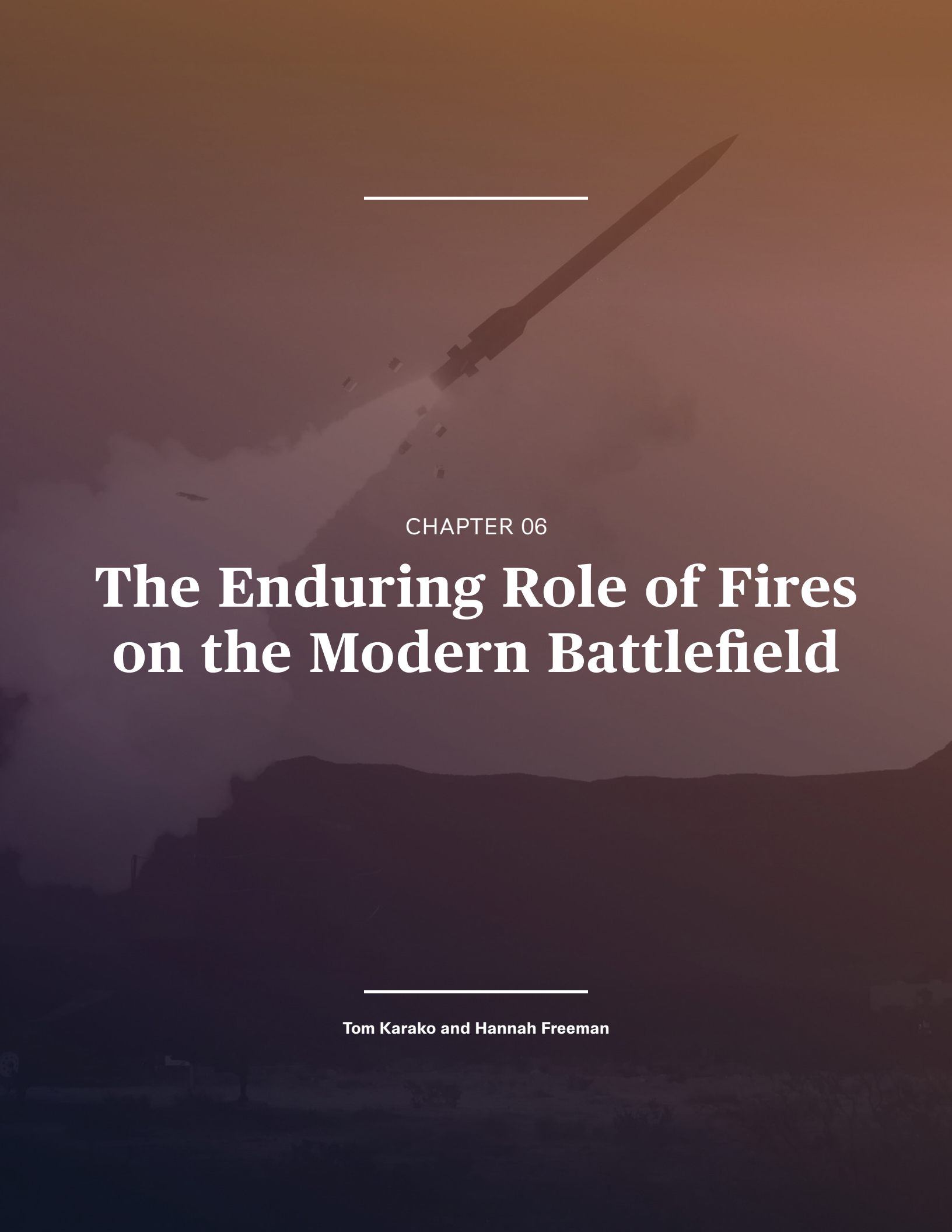
The first implication is that future campaigns will hinge on the ability to secure and deny access to key land-based infrastructure—airfields, ports, ground stations, fiber-optic hubs, and satellite uplinks. As seen in Ukraine's ATACMS strikes on the Berdiansk and Luhansk airfields and its attack on the Yevpatoriya space communications hub, controlling or disrupting critical ground nodes can dismantle an adversary's multidomain battle network. For operational planners, this means the geography of future conflict will expand beyond front lines to include "strategic terrain" tied to logistics, sensing, and information flows. The side that can hold or disrupt these land-based hubs will set the tempo across all domains. As Ukraine's campaign demonstrates, even a nation under invasion can impose strategic effects if it understands and targets the warfighting infrastructure that enables adversary operations.

Implication 2: Combined arms now means combined domains.

Second, the evolution of the U.S. Army's MDTF and the Marine Corps' MLR underscores that modern combined arms no longer simply means integrating tanks, artillery, and infantry—it means synchronizing effects across land, sea, air, space, cyber, and the electromagnetic spectrum. This concept is at the core of the new Joint Warfighting Concept and Joint All-Domain Operations, as well as part of Army doctrine.[48] Hence, the future is likely to resemble the present but with greater ability for land-based units to generate effects in multiple domains. These units act as forward-deployed hubs capable of generating converging dilemmas for adversaries. The MDTF's Multi-Domain Effects Battalion and the MLR's coordination with the MIG show that command nodes must now integrate not just fires and maneuver, but sensing, spoofing, jamming, and even narrative control. In effect, multidomain formations are emerging as the new combined arms teams—agile, integrated, and capable of commanding terrain in both the physical and information space.

Implication 3: Strategic competition is a battle of infrastructure.

Finally, the broader logic of China's BRI—including its extension into digital and space infrastructure—alongside its militarized island strategy highlights that the future of great power competition will hinge less on massed formations and more on positional advantage. China is building the physical scaffolding for a global battle network—ports, data centers, and ground stations—that can project power and support coercion at a distance. In this context, strategic competition becomes a race to build, access, and protect key infrastructure nodes across the globe. Like the United Kingdom building coaling stations and laying undersea cables in the past, Beijing is laying the foundations for global reach in the age of sensors, satellites, and digital terrain. For U.S. strategists, this means deterrence and campaigning must account not just for military postures, but for the infrastructure ecosystems that allow domain integration. In the age of multidomain operations, holding the high ground often begins with holding the right hub.



CHAPTER 06

The Enduring Role of Fires on the Modern Battlefield

Tom Karako and Hannah Freeman

> **The future of warfare will likely be characterized by an increased demand signal for offensive and defensive fires.**

From time to time, commentators opine that emerging technology will make some traditional features of war obsolete. These predictions are almost invariably premature. The use of antitank weapons in Ukraine was initially received as signaling the death of armor.[1] The arrival of mass unmanned platforms on land, sea, and air, likewise, has been accompanied by predictions of the death of platforms such as advanced tactical aircraft and ships.[2] The advent of numerous means of non-kinetic and electronic warfare has been occasioned by predictions that they will render traditional kinetic fires, if not a thing of the past, at least less important than they have been.

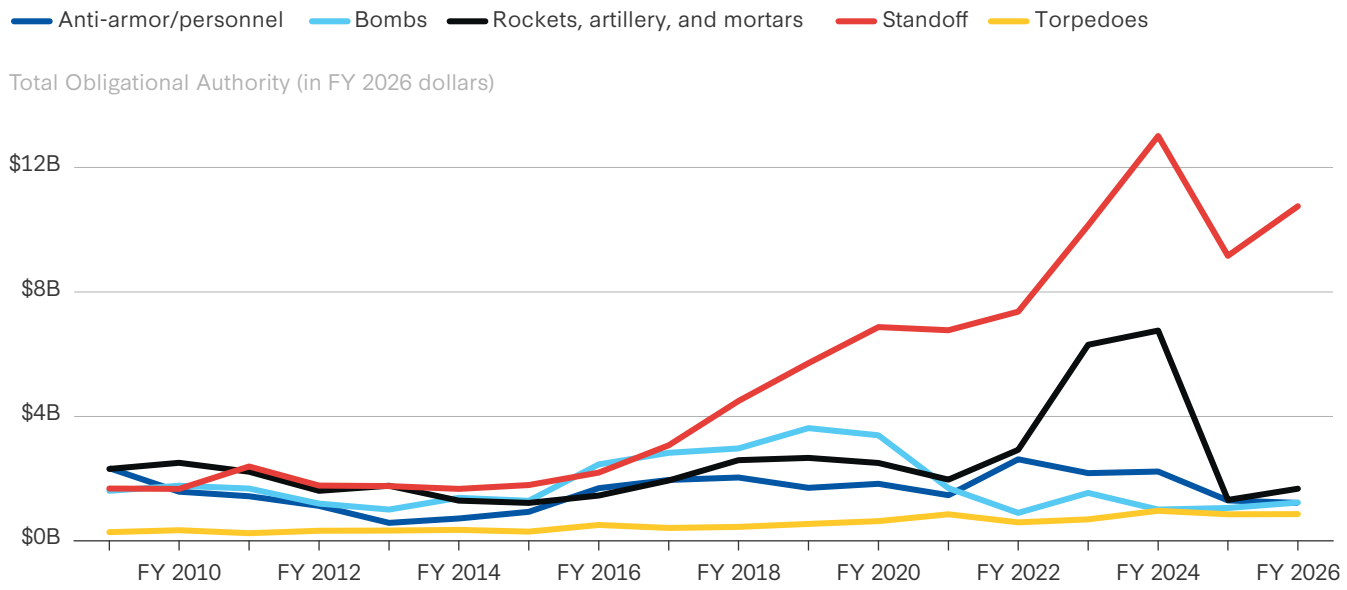
Artillery has long been known as the "king of battle," and for good reason. In virtually every major land conflict for centuries, artillery and missilery have accounted for the vast majority of casualties. Instead of becoming less relevant, the future of warfare will likely be characterized by an increased demand signal for offensive and defensive fires.

Trends affecting the demand for fires include the diffusion of precision guidance and its marriage with pervasive surveillance and targeting abilities. In a transparent battlefield, anything can be targeted, and in a world full of precision-guided munitions, everything will be. Weapon systems development likewise reflects these trends. Today, virtually all rockets are equipped with guidance of some kind, and almost all gravity bombs are smart bombs.

The reign of fires, both offensive and defensive, is at little risk of being toppled. Today's new missile age is defined by a surge in the global supply and demand for a spectrum of standoff strike capability and the means to counter it. Air defenses and long-range missiles have consistently been the Ukrainian government's top two requests for aid. The United States has significantly increased spending on long-range strike since Russia's 2014 invasion and occupation of Crimea, and this trend is unlikely to change anytime soon (Figure 6.1). Air and missile defense (AMD) and long-range precision fires are likewise the top-two

PHOTO: OFFICIAL U.S. ARMY PHOTO

Figure 6.1: Conventional Strike Modernization, 2009–2026



Source: DOD Comptroller data and CSIS analysis.

modernization priorities for allied countries such as Australia and Japan.[3]

Defensive fires have also assumed a newfound salience and reputation. Over the past four years, nearly every AMD system the United States or Israel operates has had successful engagements against missiles fired in anger, especially in Ukraine, the Red Sea, and in the defense of Israel. Only the Ground-based Midcourse Defense system, the system designed to intercept ICBMs, has not been operationally employed.

The rest of this chapter is divided into six sections. The first outlines the nature and character of missiles. The second, third, and fourth sections examine lessons from Ukraine, the Red Sea, and Israel, respectively. The fifth assesses implications for the future, especially the salience of fires, and the sixth provides brief conclusions.

What Is a Missile, Anyway?

To understand the character of this new missile age, it is helpful to consider the nature and character of missilery. Given that the defense world has a penchant for jargon, word definitions and origins are one way to seek clarity amid confusion. In this case, it is helpful to recall the etymology of the word "missile," which derives from the Latin verb *mittere*, meaning "to send, dispatch, cause to go, let go, release, discharge."[4] A *missilis* is something "that may be hurled or cast, that is thrown or hurled."[5] The words "mission" and "emissary" share this etymology—thus the old saw in diplomatic circles that an ambassador is "an honest man sent to lie abroad for the good of his country."[6]

In the early days of the first missile age, distinctions were made between the terms "rocket" and "missile," with the latter usually reserved for projectiles that are guided rather than unguided. Thus, a simple Katyusha rocket was distinguished from an Atlas missile, though the distinction was somewhat artificial. At bottom, a missile is simply a thing that is sent. When the 2019 Marine Corps commandant declared in his guidance document that the operational environment had become "an era of missile warfare," it was a way of saying that there is a high supply and demand for standoff capability.[7]

In today's jargon, Iranian Shaheds are often referred to as one-way attack drones, loitering munitions, remotely piloted aircraft, Group 3 unmanned aircraft systems (UASs), or some other turn of phrase.[8] Fundamentally, however, they are missiles: physical, kinetic delivery systems sent to accomplish some mission. In the past, air defenders had several basic categories to contend with, such as fixed wing (FW),

Table 6.1: Traditional Air and Missile Defense Taxonomy

System	Target: *Ballistic missile*	*Cruise missile*	*Rotary wing*	*Fixed wing*	*UAS groups 1–3*	*UAS groups 4–5*	*Rockets, artillery, and mortars*
Terminal High Altitude Area Defense (THAAD)	■						
Patriot	■	■	■	■			
Indirect Fire Protection Capability (IFPC)		■	■	■	■	■	■
Stinger			■	■	■		
Mobile-Low, Slow, Small Unmanned Aircraft Integrated Defeat System (M-LIDS)			■	■	■	■	
Counter-Rocket, Artillery, and Mortar (C-RAM)		■	■		■		■
Directed Energy (DE), High-Power Microwave (HPM), and High-Energy Laser (HEL)			■		■		■

Source: U.S. Department of the Army, U*.S. Army Air and Missile Defense Operations* (Washington, DC: U.S. Department of the Army, 2020), https://irp.fas.org/doddir/army/fm3_01.pdf.

rotary wing (RW), tactical ballistic missile (TBM), and air-breathing threats (ABTs) such as cruise missiles (Table 6.1). The diffusion and increased reliability of guidance, propulsion, and targeting have led to the massive blurring of these categories.

For this reason, it was entirely appropriate that the 2022 Missile Defense Review included UASs as part of its mandate.[9] Countering UASs is such a prevalent need that the mission is now part of U.S. Army basic training.[10] Rather than creating a new threat category, however, it might be better to think about countering UASs as simply a new chapter of air and missile defense.

For this reason, a new taxonomy will be needed to better explain the spectrum of objects sent in and through the air. With the ubiquitous availability of remotely piloted or autonomous systems, the characteristic of being unmanned will likely come to be taken for granted. A future taxonomy might deprioritize the distinction between unmanned and manned as well as focus on the physical characteristics of systems. A Shahed is, after all, a fixed-wing air-breathing threat not unlike the V-1 missiles of yesteryear.

Lessons from Ukraine

The last three years of the Ukraine conflict have yielded considerable case studies of the role of standoff capability in the future of warfare. Hundreds of thousands of drones, cruise missiles, ballistic missiles, and even some hypersonic systems have been employed to great effect. As in wars past, the vast majority of casualties on both sides of the Ukraine war have resulted from artillery and missile attacks. Russia has made advances through its use of long-range strikes, but the effects have been insufficient to produce a decisive victory.

At the outset of the war, Russian forces attempted to attack too many targets with too few missiles, a result of their underestimation of the scale of effort needed to accomplish their objectives.[11] Analysts

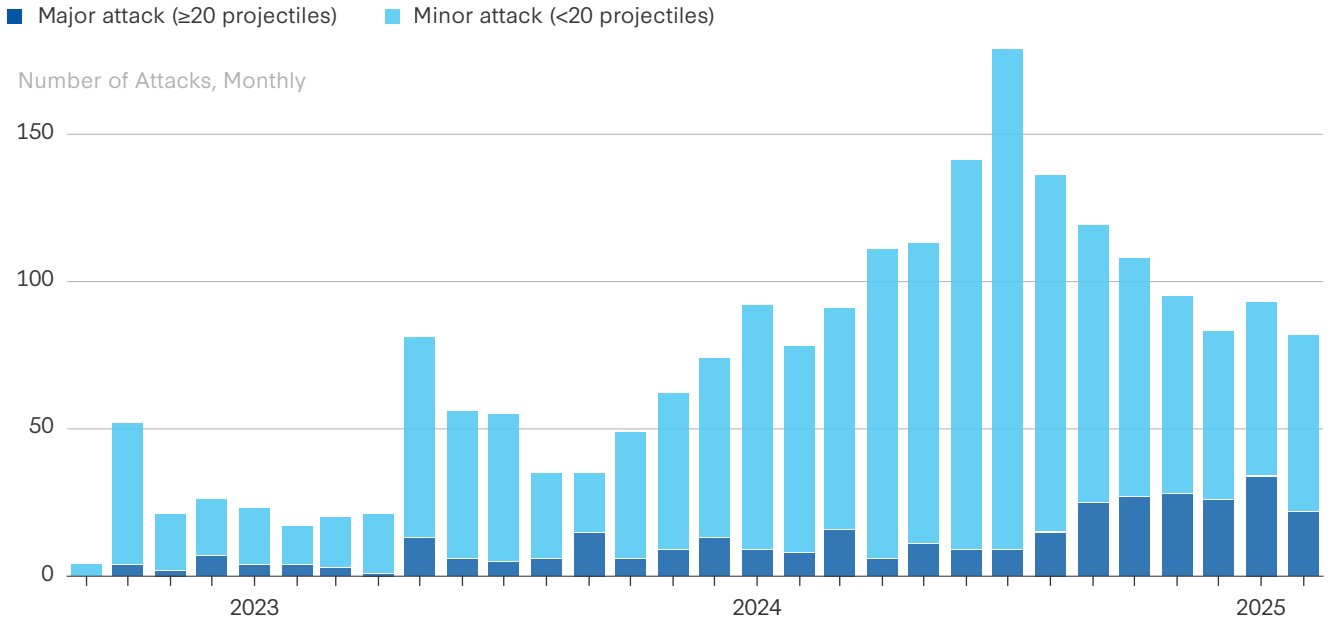
have noted a slow over-the-horizon targeting cycle, frequent shifts in targeting priorities, and irregular availability of precision-guided munitions (PGMs) on the Russian side. Russian failures after the initial period are attributable to Ukrainian defense tactics and poor Russian strategic planning. In this respect, the decisive edge may go to the side with the better surveillance and the ability to accelerate their targeting cycle. Conversely, new forms of countering missile threats may emerge from electromagnetic warfare: camouflage, concealment, and deception (CCD) and other means to thwart the intelligence, surveillance, and targeting that underlie an adversary's standoff strike. The missiles or drones may always get through, but they may not get to the right place at the right time.

Since the fall of 2022, Russia's long-range air and missile attacks against Ukraine have become larger but less frequent as Russia has attempted to overcome the growing efficiency of Ukrainian air defenses (Figure 6.2).[12]

Although Ukrainian air defenses have proved effective, especially since the influx of Western air defense systems in October and November 2022, no weapon system or operation is perfect (see Figure 6.3). The overall neutralization rate of Russian missiles since the beginning of the conflict remains high, estimated at around 84 percent.[13] Ukrainian air defenses have struggled the most with intercepting faster missiles, with Russian short-range ballistic missiles having the lowest successful intercept rate.[14] Even with a diminished frequency and a high intercept rate, sustained air attacks against Ukraine's electrical grid increase the risk of exhausting Ukraine's capacity to repair it, highlighting the importance of passive defense and the capacity to quickly reconstitute capabilities and infrastructure.[15] In addition to degrading Ukraine's electrical grid, the composition of Russian missile salvos since October 2022 suggests a secondary Russian goal of depleting Ukrainian air defense capacity.

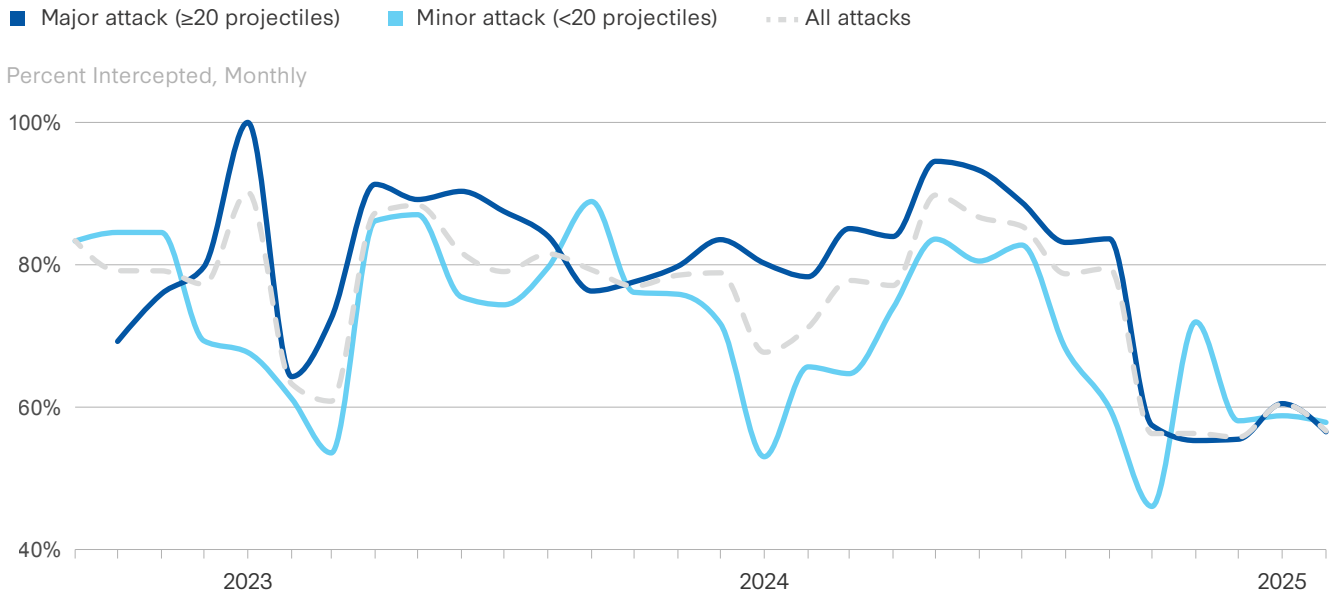
A combined arms approach remains critical to contending with Russian long-range fires. Operational art will require incorporating new aerial assets into traditional formations and capabilities, which, in many cases, has not been done well by either side. Across domains, Ukrainian forces must use different combat arms simultaneously and effectively, including mechanized infantry, tanks, artillery, air defense, and antitank systems.[16]

Figure 6.2: Russian Air and Missile Attacks on Ukrainian Civilian Infrastructure, 2022–2025



Source: CSIS analysis of data from Air Force Command of Ukraine and General Staff of the Armed Forces of Ukraine.

Figure 6.3: Intercept Rates of Russian Air and Missile Attacks on Ukrainian Civilian Infrastructure, 2022–2025



Source: CSIS analysis of data from Air Force Command of Ukraine and General Staff of the Armed Forces of Ukraine.

Lessons from Red Sea Operations

Another critical case study is the protracted conflict with the Houthis in the Red Sea, which has been marked by numerous tactical successes for U.S. AMD forces. A frequent refrain in popular commentary on the engagement has been the cost-exchange ratio, measuring the cost of a threat missile against the cost of a defensive interceptor. While lower-cost interceptors exist, they come with greater operational risk due to their limited range and capabilities.[17] When a $2 billion warship is at risk, the cost trade-off of shooting down a cheaply manufactured threat with a sophisticated interceptor is no longer so unfavorable. While the cost ratio of an offensive missile to a defensive interceptor is a valid one to consider, it also reflects a partial perspective. A more complete assessment would consider other factors, including the value of the defended asset, the operational cost of failing to defend, and the ratio of combined arms activity by both sides.

For ship-based air defenses, inventory limitations have proved a restrictive factor. With only so much capacity on board, equipping a ship with numerous low-cost options limits the space available for high-necessity systems or interceptors. An increase in short-range, low-cost intercept options means a corresponding decrease in the number of longer-range, high-value interceptor vessels needed to defend larger areas. The U.S. Navy is reportedly looking at a Maritime PAC-3 MSE, which the Army produces in greater quantities than the SM-6.[18] It seems likely that navies will look to supplement maritime counter-UAS capacity as well, even if resources must be taken from land-based systems.[19]

The USS *Carney* has thus far set the standard for successful air defense engagements at sea—a standard that has been replicated many times since October 2023. Recently, the Navy detailed the types and quantities of intercept methods used in engagements with more than 400 Houthi-launched aerial threats (Table 6.2). The wide variety of Standard and Evolved Sea Sparrow missiles used highlights the cost-exchange fallacy: A commander is sure to decide that a grave threat to the safety of the crew is worth the cost of an interception.

The challenges and successes of the U.S. Navy in the Red Sea have demonstrated the effectiveness of missile defense technology in an active weapons

Table 6.2: U.S. Navy Intercept Usage in the Red Sea Through Early 2025

Type	Number of engagements
SM-2	120
SM-6	80
5-inch rounds	160
ESSM/SM-3	20

Source: Vice Admiral Brendan McLane in Geoff Ziezulewicz, "Navy Just Revealed Tally of Surface-to-Air Missiles Fired in Ongoing Red Sea Fight," The War Zone, January 14, 2025, https://www.twz.com/news-features/navy-just-disclosed-how-many-of-each-of-its-surface-to-air-missiles-it-fired-during-red-sea-fight.

engagement. At a CSIS event, Rear Admiral Fred Pyle, former director of surface warfare, observed that U.S. Naval forces have not seen this level of action since World War II.[20] The near-immediate response time required, combined with an imperative to "get it right" 100 percent of the time, suggests that defensive interceptors warrant a high degree of trust.

Pyle additionally highlighted several possible routes for minimizing the perceived inefficiency of the cost-exchange ratio.[21] Whether improving the recertification process for older munitions or increasing scalability, options exist to reduce the spending burden for defense without sacrificing operational integrity. Developing technologies in directed energy (DE), such as lasers or high-powered microwaves, could also contribute to a more attractive cost per shot, though development and maintenance costs will be substantial.

Lessons from the Defense of Israel

A third case study of recent air and missile warfare comes from the defense of Israel against missile attacks. On April 13, 2024, Iran launched a large salvo of missiles and drones at Israel. A retaliation for a fatal Israeli air strike against an Iranian diplomatic base in Damascus, Syria, Operation True Promise included approximately 170 drones, 120 surface-to-surface ballistic missiles, and 30 cruise missiles.[22] The attack was the single largest instance to date of a complex and structured air and missile attack. It also represented the single largest number of same-day AMD engagements in history. Another attack in October 2024 included a wave of approximately 200 ballistic missiles launched from Iran.[23] In both cases, a relatively small number of missiles reached their targets.

The importance of effective AMD capabilities was once again made clear in the Israel-Iran conflict in June 2025.[24] Over the course of the 12-day conflict, Iran launched a series of missile attacks at Israel. According to reports of Israel Defense Forces estimates, these included approximately 550 ballistic missiles and 1,000 drones.[25] While Israel's layered missile defense systems were largely successful in responding to the incoming strikes, their efficacy was increasingly challenged as the conflict progressed, and Israel and the United States expended large numbers of interceptors, forcing difficult choices about which assets to defend, and potentially changing shot doctrine.[26]

In addition, U.S. air defenders reportedly fired more than 150 Terminal High-Altitude Area Defense (THAAD) missiles, almost a quarter of the total number the United States military has purchased in its history. The number expended will likely take years to replace.[27] Israeli officials reported concern about the ability of their interceptor stockpiles to outlast successive Iranian missile attacks, with one former official saying that interceptor stocks are not infinite, and another explaining that "we can make it, but it's a challenge."[28] These defensive successes highlights the importance of magazine depth, defended asset prioritization to conserve interceptor expenditure in protracted conflicts, and accurate sensors that can inform defenders about the end target of a threat. Following the Iranian attack on the Al Udeid air base in Qatar, U.S. soldiers fired a considerable number of PAC-3 interceptors, and only 1 of the 14 missiles fired reportedly got through.[29]

Israel's development philosophy has been informed by the urgency and proximity of its threat environment. "Cheap enough" and "good enough" are more attractive technology descriptions in times of conflict than they would be in times of stability. This approach is not necessarily applicable to the United States or other actors. Nevertheless, Israel's historical integration of disparate and multinational AMD ele-

ments has proven critical in weathering major attacks from Iran over the past two years.

One of the features of Israel's defense is multinational cooperation.[30] Moshe Patel, the director of the Israeli Missile Defense Organization, highlighted the importance of the interoperability and integration that the United States provides, expressing a newfound appreciation that "sharing the sky picture and the full engagement cooperation capability" is "very, very important."[31] Patel highlighted a series of landmark missile defense moments from the conflict, from the "first outer space, exoatmospheric kind of operational interception of a ballistic missile" in November 2023 to the April 2024 coordinated defense that "built a huge confidence about [the Israeli] capability and . . . system."[32] While these successes are worth celebrating, they also provide a blueprint for continued development. The attacks launched on Israel demonstrate the potential composition of future attacks and once again highlight the need to scale up current capabilities.

Implications for the Future

Each of these case studies confirm the salience of fires in this new missile age. Missiles coming and going, offensive and defensive, will be in high supply and demand for the foreseeable future. The United States and its allies have already begun to reckon with the implications of this new environment for operational doctrine and force planning. The forthcoming U.S. Army Warfighting Concept, for instance, is expected to emphasize that maneuver forces should support fires, rather than the other way around. To contend with this new environment, at least four areas of technological and operational innovation merit special attention: frying the sky, hunkering down, building up, and the advent of space fires.

Missiles coming and going, offensive and defensive, will be in high supply and demand for the foreseeable future.

Frying the Sky

The first such area is only partly a technological one, namely the continued development of DE systems. The ability to "fry the sky" will be an important offset to the capacity problem posed by air and missile swarms and salvos. Although the United States is making significant investments in DE technologies, hurdles remain to transition DE capabilities from research and development to programs of record.[33]

Operationalizing DE capability is by no means just a technological problem. Doctrine, organization, logistics, and sustainment are among the many aspects of DE that must be considered. Moreover, DE is not as inexpensive as marketing brochures might suggest.[34] The real cost is not measured in the "cup of coffee" worth of electricity for a single shot but rather across the life cycle—what it takes to build, maintain, and operate the system continuously. Increasing the role of DE weapons in responding to aerial and missile threats will increase the advantage of the defender. Future investment in high-powered microwave weapons, high-powered radio frequency weapons, lasers, various forms of jammers, and other forms of electronic attack will be pivotal to effective AMD operations.[35]

Building Up

A second category meriting attention is the need to build up offensive and defensive munitions. U.S. and allied defense industries have been structured to be lean, with limited stockpiles for peacetime, which has left a number of countries woefully underprepared for conflict scenarios.[36] The expenditure of THAAD, PAC-3, and Standard Missile variants in the Red Sea operations and in the defense of Israel now presents the United States with a considerable shortfall of AMD interceptors. It seems likely that supplemental appropriations will likely be applied to replenish and expand the inventory.

Limited munitions stockpiles have hindered U.S. assistance to Ukraine throughout the conflict. Both the Trump and Biden administrations delivered far fewer missiles to Ukraine than were necessary to deter Russia.[37] The conflict between Israel and Iran highlighted the same issue of high intercept expenditure rates

depleting limited stockpiles. China's growing ballistic missile stockpile further exacerbates the deficit problem. In the event of a conflict in the Indo-Pacific, the United States would likely run out of munitions in less than a week, including long-range precision-guided munitions that would be critical to military success in a Taiwan Strait conflict.[38] The problem almost certainly necessitates a high-low mix of munitions, specifically a combination of commercial off-the-shelf technologies and novel technologies designed specifically to counter emerging threats on the battlefield.

Hunkering Down

Active defense is necessary but insufficient. The entire joint force needs to "look up" and understand what it can and must do regarding the spectrum of air and missile threats. Nevertheless, the simple reality is that not all air and missile threats can or will be engaged, and damage limitation and consequence management must assume renewed importance. The shifting threat environment also requires military planners to develop capabilities for hunkering down, giving increased attention to passive defense (including mobility); counter-intelligence, surveillance, and reconnaissance; hardening; and deception. For both offensive and defensive fires alike, there will be growing demand for mobile launchers that can better "shoot and scoot" to evade counterbattery fire and suppression. Passive defenses and the operational concepts to operate within an adversary's weapon engagement zone represent a necessary means to compensate for the simple reality of active AMD shortcomings.[39]

Space Fires

A final, emergent category of fires will soon appear in the newest warfighting domain: the heavens. Although tracking and interceptor capabilities will increase the resilience of forward-deployed assets, they will never be 100 percent effective. This implies a need for hardening and deception to minimize losses.[40] As air and missile threats become more complex, it will be necessary to have military assets that can survive attacks that get through active defenses. Investing in hardening things like air bases, missile silos, and command centers is low-hanging fruit in AMD: The Department of Defense can increase the resilience of infrastructure over a much shorter time horizon than it can develop and scale production of components like DE weapons.[41] These strategies will be force multipliers in future conflicts, ensuring mission success in the face of increasingly complex air and missile threats.

As space becomes an increasingly pivotal warfighting domain, both offensive and defensive "space fires" will assume a new salience, including space-based interceptors. The Trump administration's January 2025 executive order calling for the creation of a homeland missile defense shield references a provision for space-based interceptors. Boost-phase intercept is becoming an increasingly attractive option as missile technology matures, as these interceptors strike missiles before they maneuver, reach high speeds, or release decoys or multiple warheads.[42]

While creating these capabilities is still costly and technologically challenging, it is a much more realistic objective than it was 20 years ago.[43] The cost of launching a satellite into orbit has also fallen by orders of magnitude, and the emergence of counter-space capability may well yield spinoff capability for countering missiles of various kinds.[44]

Conclusion

The reign of fires will long endure, and its kingdom spans from mud to space. Combined operations will necessarily incorporate a number of new technologies and concepts, including non-kinetic cyber, information, electronic warfare, and DE activities. The demand for kinetic kills, however, will not dissipate anytime soon, and any prediction of its forthcoming demise will almost certainly be premature.

Offensive and defensive fires will remain a central feature of the future battlefield. Operations in Ukraine, the Red Sea, and Israel have emphatically demonstrated their salience. Fires remain the king of battle, and long live the king.

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CHAPTER 07

Intelligence in a Transparent World

Emily Harding

Hiding in the sea of data was once hard but doable, but the proliferation of AI processing tools and emerging quantum decryption capability mean that intelligence services will need to either create more extreme workarounds or accept the difficulty of hiding and learn to fight in the light.

"I think I may have found the people who tried to kill you."

–Bellingcat researcher Christo Grozev to Russian dissident Alexey Navalny, November 2020[1]

Shortly after the Russian Federal Security Service (FSB) attempted to poison Alexey Navalny in August 2020, Bellingcat researchers identified not only the service responsible for the heinous attack, but the individuals.[2] This intelligence feat was not the result of exquisite signals intelligence (SIGINT) or a highly placed human intelligence (HUMINT) source. It resulted from the in-depth sleuthing of an independent team of open-source intelligence (OSINT) experts. Bellingcat researcher Christo Grozev used leaked telephone metadata, flight records, and Navalny's own recollections of his travel to cross-reference which Russian agents appeared to be shadowing Navalny's movements. One unfortunate agent turned on his phone on the night of the poisoning, pinging off a cell tower just north of Navalny's hotel.[3]

This mystery's resolution was but one of many Bellingcat exposures over the last decade. Their achievements, which include finding the agents who poisoned Sergei and Yulia Skripal, proof of Syrian chemical attacks, the Russian missile that downed MH-17, evidence of EU mistreatment of refugees, and the identities of several men who stormed the U.S. Capitol on January 6, have repeatedly proved the power of OSINT to uncover some of the same secrets as a multibillion-dollar intelligence enterprise.

Along with the data capabilities required to carry out this kind of private intelligence, industry has delivered a slew of advancements that are reshaping other parts of the spy world. Quantum computing is already changing encryption standards, and ubiquitous technical surveillance is making traditional HUMINT tradecraft dangerously obsolete.

These trend lines combine to form a clear hallway for the future of intelligence work—on one side is the stretching expanse of open-source data, which can provide insights or sow confusion, depending on how

PHOTO: DIGITALGLOBE/GETTY IMAGES

states use it. On the other side, hemming in the capabilities of intelligence services worldwide, is the difficulty of operating in secret. Hiding in the sea of data was once hard but doable, but the proliferation of AI processing tools and emerging quantum decryption capability mean that intelligence services will need to either create more extreme workarounds or accept the difficulty of hiding and learn to fight in the light.

In the immediate post–Cold War era, information was hard to obtain, particularly from behind the Iron Curtain. Access was rare and precious, and extraordinary measures were worthwhile to get information, including putting lives of assets and operators in grave danger. Today, the inverse is true. Information is cheap. Processing it is expensive, and sense-making is exquisite. True secrets still exist, but they are far rarer, and the cost-benefit calculation for obtaining them has shifted.

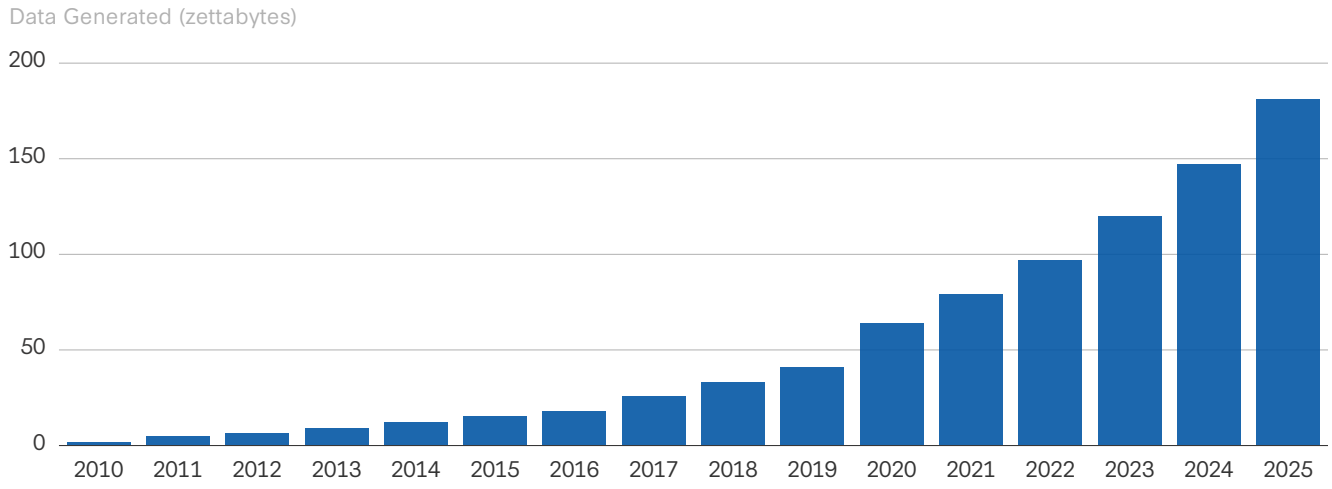
This chapter explores these trend lines, particularly the challenges and opportunities of OSINT, and the efforts intelligence agencies will need to undertake to keep up with rapid developments in new dual-use technologies. It provides background on how intelligence is changing and then discusses how wars in Ukraine and the Middle East have brought these lessons into acute relief. Finally, it lays out the implications of these trend lines for national security leaders.

Modern Intelligence: Oceans of Accessible Data and Nowhere to Hide

Intelligence is more than information; it is insight that helps policymakers avert strategic surprise. The vehicle for that advantage is largely irrelevant. Indeed, it has evolved over time in at least four previous iterations, from when George Washington was the nation's first spy master, reading other gentlemen's mail; to an era of tactical warning and denial and deception operations in two world wars; to the covert action–heavy, spy-versus-spy world of the Cold War; to the age of counterterrorism, focused on identifying and unraveling low-tech but highly deadly networks.

Today, computers and data define modern intelligence, thanks to the estimated more than 400 million terabytes of data the world produces every day.[4] That sea of information makes open-source analysis easier and more impactful than ever before, but it has made traditional intelligence collection far more challenging. Just as intelligence services can use this data to find secrets, rival services can use video data and a person's "digital dust" to reveal the true identity of an officer operating under cover. Intelligence services should capitalize on the insights available from enor-

Figure 7.1: Global Data Generated Annually



Source: Fabio Duarte, "Amount of Data Created Daily (2025)," Exploding Topics, last updated April 24, 2025, https://explodingtopics.com/blog/data-generated-per-day. Data from Petroc Taylor, "Volume of data/information created, captured, copied, and consumed worldwide from 2010 to 2023, with forecasts from 2024 to 2028," Statista, June 30, 2025, https://www.statista.com/statistics/871513/worldwide-data-created/.

mous amounts of publicly available data, but they also must find new ways to obtain the information that states try to keep secret.

Human operations, once the bread and butter of spy work, changed dramatically in the last two decades, thanks to a proliferation of "smart city" technologies and biometric identity data.[5] Back in 2010, the Emirati intelligence services were able to quickly identify the members of a Mossad operation that assassinated a senior member of Hamas in Dubai. Using surveillance camera footage, travel records, and phone records, they identified the Mossad operatives responsible for the attack within a month.[6] Today, with AI-enabled facial recognition and Chinese companies selling security systems across the globe, it is too easy to connect dots and unravel an entire intelligence operation. Starting with an image of a suspected case officer meeting with an asset, an enterprising intelligence service can track that case officer's movements across the world over the last 10 years, using AI to identify everywhere they have been seen and whom they have been seen with. In 2018, a senior technology officer at the CIA said that in many places, "the level of surveillance was so mature that local security services no longer needed to follow the agency's officers in order to know where they were."[7] Biometric passports make traveling under an assumed identity far more difficult, and false identities seem paper thin with no decades-long social media history to back them up. Plus, any border guard has the ability to fact-check backstories instantly. As *The Economist* points out: "A spy can be instantly quizzed on their assumed identity's childhood route to school by an enterprising immigration officer using Google Maps."[8]

OSINT has the potential to fill at least some of the gaps left by more challenging HUMINT. A multitude of industries have decided that data is the new oil and are mining every available source to create massive, useful datasets. According to the Office of the Director of National Intelligence's (ODNI) senior advisory group on commercially available information (CAI), "CAI includes information on nearly everyone that is of a type and level of sensitivity that historically could have been obtained, if at all, only through targeted (and predicated) collection, and that could be used to cause harm to an individual's reputation, emotional well-being, or physical safety."[9] Beyond information on people, governments can obtain data on the health of shipyards based on soundscapes, the movements of submarines based on sonar designed to locate fish, or the location of tanks and troops based on commercial space assets.

Critical to open-source work will be recognizing the potential pitfalls of this relatively new discipline. First, the ubiquity of data means it can be selected or manipulated to fit nearly any narrative. Second, in an era where data is power, democracies must walk a tight corridor between harvesting information and protecting the rights of citizens. Finally, for every Bellingcat exposure of nefarious action, there are likely a handful of crises averted because of exquisite, highly classified intelligence collection. OSINT should be additive to the intelligence picture, even serving as the intelligence of first resort, but it cannot fully replace clandestine collection.

Lessons from Modern Wars

Ukraine's and Israel's recent conflicts have much to teach about the power of intelligence and where the discipline is headed. The conflict in Ukraine has been revolutionary on two fronts: First, it has been a truly open-source war, with crowd-sourced intelligence work making both a tactical and a strategic difference. Publicly and commercially available data has been pivotal to widespread sharing at a high level among allies and on a tactical level between units in the field. Second, the Biden administration's decision to declassify intelligence strongly indicating that Russia was about to invade teaches twin lessons—calling out Moscow's plans did not deter Russia from invading, but it did help pre-bunk ridiculous narratives and galvanize allies to assist Kyiv in blunting the Russian offensive.

Conversely, students of the practice of intelligence will study the tragedy of October 7, 2023, for decades. As a counterpoint, they will study Israel's astonishing victory over Hezbollah in the ensuing year, in which Israel systematically dismantled the group's fighting apparatus, for the opposite reason. Israel had all the information it needed to identify and preempt the Hamas attack, but cognitive bias

prevented action. With Hezbollah, on the other hand, Israel took the threat from the group seriously and created in-depth, multiyear plans to strike, with devastating results when it eventually pulled the trigger.[10] The failure-success juxtaposition of Gaza and Lebanon shows that a rigid mindset trumps even the most sophisticated intelligence, but the combination of detailed intelligence work and persistent attention to a threat can devastate even a talented adversary.

Ukraine: The First Open-Source War

Ukraine is the first truly open-source war. According to General Jim Hockenhull, commander of the United Kingdom's strategic command, OSINT has been instrumental in providing Ukrainian commanders with anticipatory intelligence.[11] Commercial satellite imagery, tech data, and social media helped expose Russian deployments well ahead of the February 2022 invasion. A Russian submarine commander reportedly was killed after logging his daily run on the fitness tracking platform Strava.[12]

Every citizen with a cellphone became a sensor, taking videos and photos of Russian troop movements. At first, they uploaded the geotagged images to social media. Then Kyiv adapted the Diaa app, originally designed to help Ukrainians access social services, to create the e-Enemy platform.[13] By one estimate, 260,000 Ukrainians reported Russian locations to the app in the first month of the invasion.[14] Ukraine's Security Service also welcomes reports of sightings of "suspicious" activity via a Telegram chat function called @stop_Russian_War_bot.[15] Stories abound of Ukrainian commanders needing to know what was happening at a certain location, finding a business on Google Maps that was near that location, then calling to ask the proprietor to look outside and report what they saw:

> "We open a Google map, see a store, see its phone number, and dial it," said Shevchuk, who described a typical conversation: "Good evening, we are from Ukraine! Do you have any Katsaps [Ukrainian slur for Russians] in the village?" "Yes." "Where?" "Behind Grandma Hanna's house." "What house does Grandma Hanna have?" "Well, everyone knows her!" "So you talk to people a little bit and realize where everything is," Shevchuk added.[16]

Classic honey traps have evolved for the online space. Defense Mirror reported that a Ukrainian woman used several Tinder profiles to collect information on more than 70 Russian soldiers, which she promptly passed to Ukrainian troops to help with strikes.[17] Similarly, MI-6 reportedly used Grindr to find Russian troops.[18]

Commercially available intelligence services have been a game changer in Ukraine. Kyiv has leaned into a relationship with space technology company Maxar, which provides fairly comprehensive satellite imagery on demand. The cyber war in Ukraine was also a proving ground for cyber defense firms. As a Microsoft intelligence report said, "The first shots [in the Ukraine war] were in fact fired hours before, when the calendar still said February 23. They involved a cyberweapon called 'Foxblade' that was launched against computers in Ukraine. Reflecting the technology of our time, those among the first to observe the attack were half a world away, working in the United States in Redmond, Washington."[19]

The fact that commercial intelligence is available to everyone is an asset as well: Sharing across borders is simpler if there is no declassification process, no calculation about revealing sources and methods. The United States does not need to protect Maxar's secrets. The easy availability of unclassified evidence probably helped prompt the Biden administration to go public with additional intelligence that indicated Russia was planning an imminent full-scale invasion. That effort galvanized Europe to overcome its own cognitive bias—a false sense of hope that Russia would leave Ukraine alone.

Israel: High-Tech Collection and Cognitive Bias

In the run-up to October 7, Israel's high-tech intelligence collection against Hamas worked; it was only the interpretation of that information that failed. At least

a year before the attack, Israeli intelligence collected a copy of Hamas's attack plan, called "Jericho Wall." The plan showed how Hamas planned to take apart automated security measures, including cameras and sensors built into perimeter fences.[20] Months before the attack, a young female analyst wrote a report flagging that a Hamas day-long training exercise matched the stolen plan. Separately, Israel's red team unit, looking at largely the same information, issued four warnings that Hamas was planning for a confrontation.[21] Around the same time, Egypt's intelligence service told its Israeli counterpart that "something big" was in the works.[22] And the night before the attack, security services saw dozens of Israeli SIM cards activated.[23]

Despite all these signs, Hamas managed to send hundreds of fighters into Israel, causing at least 1,200 casualties. The "why" of this failure will haunt Israel for decades, but early analysis boils down to a mental block, in the form of anchor bias and confirmation bias.[24] Humans tend to anchor their beliefs to certain information. They then use new information to confirm those perhaps erroneous beliefs. Unless officers work to identify and break these biases, disaster can strike even the most sophisticated intelligence service.

Israel's war on its northern border, however, was a highly effective—and lethal—combination of intelligence and warfighting. Israel pulled off a clever, tailored covert-action operation that caused more than 3,000 Hezbollah pagers to explode simultaneously, disabling the bulk of Hezbollah's fighting force and severing its communications network. Over the course of nearly 20 years, Israel had developed targeting packages against the totality of Hezbollah leadership and frontline positions. When the fight turned kinetic, the Israel Defense Forces destroyed more than 1,600 Hezbollah facilities and weapons sites. Those strikes killed four Hezbollah senior leaders, including Secretary General Hassan Nasrallah. In six weeks, Hezbollah went from the most capable terrorist group in the world to a shell of its former strength, thanks to the strength of Israeli intelligence gathering.

Both of these conflicts are instructive for an era of great power competition. China and Russia have learned lessons from the Ukraine war, including the importance of information warfare and how to capitalize on, or undermine, an engaged population serving as a network of sensors. On a larger scale, China in particular has perfected the art of staying below the threshold of antagonizing the United States while aggressively collecting its own intelligence. It also has fully committed to technological competition, pushing ahead with the next generation of technologies that will provide an immense intelligence edge.

Implications for the Future of Intelligence

The wars in Ukraine and Israel and the accelerating competition between the United States and China underscore several implications for the future of intelligence work. Information is plentiful and can be used responsibly or selectively to serve a particular viewpoint. The wars of the future will be fought in conditions of near transparency, and intelligence collection efforts will be similarly exposed to scrutiny. But just because facts are available does not mean interpreting them will be straightforward. Intelligence professionals will need to be humble about what they do not know, and they will need an extensive rolodex to find someone to help, and help quickly. The sections below explore these factors in more depth.

Dueling Facts

The oft-repeated quote "there are lies, damn lies, and statistics," popularly attributed to Mark Twain or Benjamin Disraeli, will apply in force to the modern environment featuring oceans of data. With so much available information, a person can find data to support any point of view. To use a popular example, data shows that shark attacks rise in lockstep with ice cream sales; bad data science could lead a person to assess that sharks prefer people who taste like ice cream. Intelligence assessments drawing on a seemingly endless sea of data must be rigorous in both logic and collection to avoid mistakes like mixing up correlation and causation (ice cream sales and shark attacks both go up when people spend time at the beach) or something far more serious, like deciding whether a pattern of data indicates a country is preparing for war. Decisionmakers must be discern-

ing, work with intelligence analysts to interrogate the data, ask for confidence levels, and investigate whether contradictory evidence exists to ensure strong outcomes. Patience will also be required—solid tradecraft takes time, and the first answers are almost never the right ones. An internet sleuth could be first to the scoop—and very wrong.

AI-Enabled Insights

AI and cloud computing are empowering those in and outside government to learn more, know more, and find more. If a curious individual can ask good questions, AI can find the data and sort the results as requested. Inside intelligence services, the good questions are the easy part. The hard part is ensuring the security of the AI systems and the integrity of its answers. The even harder part is the cultural change necessary to make best use of the revolutionary technology. Fear of change is a serious friction point, and using AI as a copilot is a big change.[25] The U.S. intelligence community is already incorporating AI and machine learning in processing huge amounts of video and imagery. MI-6 has reportedly used AI to summarize information and sift through the ever-growing sea of data, while China's Ministry of State Security developed an AI system capable of tracking U.S. spies and other foreign agents.[26] The next frontier will be using AI to process and summarize quantities of text in a dependable way, with a system capable of showing its sources and protecting classified information in a high-side environment. An AI system that hallucinates preparations for a coup is exceedingly dangerous, but an AI system that can summarize 10 years of speeches in 10 minutes to analyze the decisionmaking style of a world leader is invaluable. As AI systems progress beyond data processing toward agentic decisionmaking, intelligence services will be able to send autonomous systems into hostile environments for long-dwell intelligence collection, with the system able to "decide" when it should emerge and report home.

From Toiling in the Shadows to Fighting in the Light

In the early days of the U.S. intelligence community, the National Security Agency (NSA) was referred to as "No Such Agency." The National Reconnaissance Office did not exist. Today, CIA has an account on X, formerly known as Twitter; its famous first post was rather tongue-in-cheek.

But far less humorous intelligence issues have spilled out into the public realm. A poorly informed debate about the intelligence community's authorities under Section 702 of the Foreign Intelligence Surveillance Act took place surrounding the last two renewal battles, with privacy advocates making unfounded assertions about the intelligence community's overreaching collection and intelligence agencies largely unable to publicly explain why that information was incorrect out of an obligation to protect sources and

CIA's first tweet.

Source: CIA (@CIA), "We can neither confirm nor deny that this is our first tweet.," Twitter post, June 6, 2014, 1:49 p.m., https://x.com/CIA/status/474971393852182528.

Intelligence has always been a team sport, but the team needs to become bigger, more fluid, and more agile.

methods. Similarly, in 2013, Edward Snowden stole an estimated 1 million pages of documents from NSA, which revealed some facts but also fed misconceptions about the checks on intelligence collection. Once again, the intelligence community was largely unable to defend itself.

There is an inherent tension between democracy and intelligence work. Democracy is synonymous with accountability, and direct accountability is impossible if most work is classified. The U.S. government and other democracies have resolved this tension with indirect accountability: robust legal checks on the power of intelligence agencies and intensive oversight by specialized committees in Congress. The Church Committee created the intelligence committees in the House and Senate for exactly this purpose—even though every American citizen cannot inquire about the activities of their intelligence agencies, their elected representatives can conduct that oversight on their behalf.

Still, the explosion of new technologies and the advent of robust open-source capabilities provide intelligence services more opportunities to step into the light. They can share more information than ever before with their own public and allied governments without fear of exposing hard-won secrets. Chances are good that the same information exists somewhere in the open-source realm, provided by a highly sensitive source or an exquisite satellite capability. Intelligence services should also do more to explain their processes to the American people, if not the outcomes of those processes. Leaders serious about preserving the power of intelligence services should work hard to explain the checks on that power.

Boldly Going into New Intelligence Domains

As technical and military advancements further intertwine, intelligence officers will hustle to keep up with both traditional topics and an increasing range of nontraditional topics. Operators will chase adversaries' developments in bioengineering; quantum computing, sensing, and communications; AI; 3D printing and additive manufacturing; autonomous systems; and critical minerals mining. Further, with global supply chains and intertwined economies, societal dynamics far abroad will have impacts on U.S. national interests. In a post-Covid-19 environment, intelligence services will be asked to anticipate developments in public health, human migration, economic shocks, and other societal issues that are less secrets to steal than mysteries to unravel. Intelligence officers will need to think differently about collection and analysis, and they will especially need to reconceptualize expertise. Having deep experts on each of these topics as full-time employees will be a waste of time and resources; rather, the intelligence community will need to find people who can temporarily consult on a niche topic, like what a particular subcomponent of a quantum system might do, or how economic shocks shape human migration. Intelligence has always been a team sport, but the team needs to become bigger, more fluid, and more agile.

Conclusion

At the intersection of intelligence work, massive data creation, and tech developments like AI and quantum computing, the world of spycraft changed. In some ways, the craft got easier, because data is easy to come by, but it also got harder because new information calls for new tradecraft. Further, traditional intelligence collection became nearly impossible without extraordinary precautions. This new world is one in which intelligence services will need to "fight in the light."

AI will affect intelligence as much as it will warfare. Within five years, agentic AI will be able to task collection systems, get an answer, analyze how the new information changes the operational picture, and send updated targeting information to a weapon

system, all without a human in the loop. Bias and bad data in these systems can poison the entire kill chain, so defense of data will be critical, and efforts to throw off the enemy's systems will become a priority. There is only so much classified data available for training, so manufactured data will fill the gap for many intelligence services. This is inherently dangerous—errors are magnified and natural variations in real life wash out of synthetic data. Manufactured data also provides opportunities for enterprising intelligence services to attempt to poison it. A supply chain attack on a large synthetic dataset could have widespread ramifications.

As much as a sea of available data has made warfighting far more transparent than ever before, quantum decryption could remove the last veils of secrecy. It could decrypt communications and weapons telemetry in real time, giving a technologically advanced state a critical edge in battlefield awareness.

Lines between intelligence agencies, academia, and industry may become increasingly blurry. Because so many of these technological advancements are exquisite and outside the realm of the knowledge of a generalist, intelligence services will need to develop close ties to a range of experts in order to understand new developments—in particular, to understand their significance. For authoritarian regimes, quick conscription and threats of retaliation for lack of cooperation come easy. Democracies, on the other hand, need to communicate the importance of collaboration and recruit a team. Similarly, alliances will prove even more valuable. The chances of one intelligence service having the right expert on hand is smaller than the chance of, say, someone in the Five Eyes having a PhD in the right aspect of synthetic biology. This closer cooperation with allies, along with a proliferation of private sector "intelligence" organizations, could open the aperture of targets in a conflict. Russia is already making extensive use of groups like Wagner for information gathering and operations. China views businesses as a useful extension of state power when asked to serve. Both are likely to view U.S. businesses as legitimate targets in a conflict, under certain circumstances.[27]

Finally, OSINT is the genie that cannot go back in the bottle. Nations can effectively opt out of OSINT, bypassing the challenges of grappling with an ocean of data. But they do so at their peril. In a conflict, it is impossible to know which piece of information—which intelligence insight—will open an opportunity or provide crucial warning, and nations that are behind in OSINT risk willful blindness.

Imagine that the investigation described at the beginning of the chapter is happening five years hence. The Bellingcat researcher has at their fingertips a powerful computer and an AI assistant. The assassin is far less able to hide his digital dust—his biometric passport pings off two airports, and a near-continuous train of security cameras in transit stations, on streets, in shops, and in taxis can easily piece together his movements. The would-be victim has a bioengineered compound in his pocket: a bio agent designed to change color when exposed to poison. As he drips his tea on the compound, it turned a shocking shade of blue. He takes a photo, posts it on social media, and calls on all the internet sleuths to "find the assassin—he must be nearby!" Our researcher would have reams of data to draw on, the computing power to sort through it, and the ability to call the local authorities before the assassin could leave the city.

Intelligence professionals should embrace the technology, the sleuths, and the speed. They should continue to lead the world in intelligence tradecraft, and a big part of that tradecraft training should be ethics, civics, and a mandate to lean into cooperation.

CHAPTER 08

Extending the Battlespace to Space

Kari A. Bingen

The democratization of space technology has shifted traditional notions of who can wield space capabilities in war and created new motivations for warring sides to deny the advantages that satellites provide.

"@elonmusk, while you try to colonize Mars—Russia try to occupy Ukraine! . . . We ask you to provide Ukraine with Starlink stations and to address sane Russians to stand."

-Mykhailo Fedorov, Ukrainian Vice Prime Minister and Minister of Digital Transformation, February 26, 2022[1]

Hours before Russian tanks rolled across the Ukrainian border on February 24, 2022, the assault had already started. Soon after 0300 UTC, tens of thousands of satellite modems across Ukraine and Central Europe were knocked offline. The first target in Russia's invasion of Ukraine was a satellite system.[2] The cyberattack, later attributed to Russian state-sponsored cyber actors, targeted a commercial satellite network to disable Ukrainian military communications, but it also led to widespread disruption of internet services across Europe. In modern warfare, the first shot may not involve a rifle or a missile, but a line of malicious code aimed at satellites in orbit or critical infrastructure on Earth.

Two days later, Ukraine's Vice Prime Minister and Minister of Digital Transformation Mykhailo Fedorov took to Twitter pleading with Elon Musk to send Starlink satellite communications (SATCOM) terminals.[3] Over the next three years, Ukraine received over 50,000 Starlink terminals to connect the battlefield and to "provide uninterrupted communication in the places where it is needed most—hospitals, schools, critical infrastructure facilities."[4] An unprecedented amount of satellite imagery flowed to Ukraine and into the public domain, documenting the movements of Russian forces.[5] Even Russian troops sought the benefits of such satellite imagery and communications, including through the illicit acquisition of Starlink terminals, to improve their own battlefield coordination.[6]

The war in Ukraine marked a turning point in the role of space in warfare. Once considered a remote and predominantly strategic domain, space is now central to the day-to-day conduct of armed conflict. While the United States has long relied on space sys-

PHOTO: PLANET OBSERVER/UNIVERSAL IMAGES GROUP/GETTY IMAGES

tems to enable its military operations, dating back to Operation Desert Storm in 1991, Ukraine has demonstrated how even a militarily outmatched nation—with little indigenous space infrastructure—can leverage space capabilities to gain battlefield advantage. From the onset of the war, Ukraine has marshaled a range of space-based tools for communications, surveillance, targeting, and information sharing, many provided by commercial actors, leading some observers to call the Ukraine war the "first commercial space war" and space a "great equalizer."[7]

Simultaneously, as space systems continue to demonstrate their utility from peacetime to conflict, it is unsurprising that they are being targeted. The Ukraine conflict has revealed how adversaries can and will attempt to block access to space capabilities. In Ukraine, this has occurred largely through jamming and cyberattacks, but other conflicts could see more expansive use of both kinetic and non-kinetic means as adversaries seek to erode each other's satellite systems. These actions underscore the increasing vulnerability of space assets, particularly those operated by commercial entities that may not have been designed with wartime resilience in mind.

The democratization of space technology has shifted traditional notions of who can wield space capabilities in war and created new motivations for warring sides to deny the advantages that satellites provide. These modern conflicts are normalizing the idea that space—like land, sea, air, and cyber—is a domain to be exploited, attacked, and defended in wartime.

This chapter explores four interlinked dimensions of space in modern warfare: (1) the equalizing effect of space capabilities in warfare, as seen on the Ukrainian battlefield, especially access to commercial satellites; (2) the imperative to deny the advantages that space capabilities provide to one's opponent; (3) the broader implications of an increasingly transparent battlefield where strategic surprise will be harder to achieve; and (4) the integration of counterspace weapons into battlefield operations. It concludes by examining the policy challenges posed by these trends and what they mean for the strategies and policies of the United States and its allies and partners in the space domain.

Space as a Battlefield Equalizer and Force Multiplier

One of the most striking aspects of the war in Ukraine has been the extensive and effective use of space capabilities, especially from the commercial sector, to bolster a nation's defenses and resilience under attack. This trend is likely to be more prevalent in future conflicts as space technologies increasingly proliferate and satellite data and services become more accessible.[8] While Ukraine has minimal sovereign space assets, it quickly mobilized support from foreign governments and international commercial providers to gain access to satellite imagery, communications networks, and data analytics platforms.[9] In many respects, space-based capabilities became a great equalizer and force multiplier, allowing Ukraine to punch above its weight on the battlefield.

Leading up to and during the Russian invasion in February 2022, satellite imagery companies in the United States and Europe captured the buildup of Russian forces along the Ukrainian border and documented their movements into Ukrainian territory.[10] Satellite images published by the U.S. company Maxar showed a 40-mile convoy of Russian military vehicles en route to Kyiv.[11] According to the Defense Intelligence Agency of the Ukrainian Ministry of Defense, Finnish company ICEYE, operating synthetic aperture radar (SAR) satellites that image the Earth at night and through clouds, collected data on the disposition of "enemy forces, its training grounds, military camps, mobilization deployment centers."[12] Satellite imagery, paired with GPS-guided drones and other munitions, enabled Ukrainian forces to track Russian military movements, direct counterattacks (including deep within Russian territory), and plan defensive strategies with greater precision.

On the battlefield, commercial satellites providing broadband internet services have also played a critical role. The widespread deployment of SpaceX's Starlink terminals, prompted by the Twitter appeal from Fedorov, helped ensure Ukrainian forces maintained resilient communications despite Russian cyber and jamming disruptions. Called a "gamechanger" by one senior Ukrainian official, Starlink became a lifeline that

A convoy of hundreds of Russian military vehicles, as captured in high-resolution satellite imagery by U.S. company Maxar, seen roughly 40 miles northwest of Kyiv, Ukraine on February 27, 2022.

Photo: Maxar/Getty Images

allowed commanders to stay in contact with dispersed units, share intelligence, and conduct decentralized operations—a key advantage in resisting a more centralized and conventionally superior adversary.[13]

The Ukrainian battlefield has become a crucible for experimentation, tactics development, and risk-taking, with private companies dropping into a war zone and the Ukrainian government embracing their technologies. Ukrainian and partner analysts have used satellite data—paired with drone data, sensitive intelligence collection, and other information sources—along with data fusion platforms, AI tools, and communications networks to rapidly identify targets and feed actionable information back to units on the ground.[14] Space capabilities have played a crucial role in this convergence of technologies that has enabled a level of battlespace awareness and battlefield innovation unthinkable for a country like Ukraine just a few years ago.

Space-based assets have also been employed for humanitarian and diplomatic purposes. Satellite imagery has been used to map evacuation routes, assess damage to infrastructure, and document evidence of war crimes. In one stark example, a satellite captured the word дети ("children" in Russian) painted on the ground outside Mariupol's theater prior to Russia bombing the location.[15] These unclassified images have not only been useful for Ukrainian operational planning but also as tools of public diplomacy, enabling the Ukrainian government and its allies to counter Russian disinformation and rally international support. As the Ukrainian ambassador to the United States noted in February 2024, while space capabilities are enabling military forces to communicate, they are also connecting hospitals and civil society and collecting evidence of war crimes to support judicial prosecutions.[16]

It is not just the defender that seeks the benefits of space to provide military and information advantage, but the aggressor as well. While Russia remains a global space power, its space program has atrophied in recent years, suffering from sanctions, an aging population, and corruption.[17] As a result, Moscow has resorted to using "others' civil and commercial remote-sensing satellites to supplement" its

Satellite imagery captured the before and after a Russian airstrike on the Mariupol Drama Theater (left image dated March 14, 2022, right image dated March 29, 2022). The word "children" written in Russian in white letters can be seen outside the theater in both images.

Photo: Maxar/Getty Images

own capabilities.[18] For example, the Wagner Group acquired satellite imagery from Chinese companies such as Spacety and HEAD Aerospace, prompting the U.S. Treasury Department to issue sanctions against those providers in January 2023.[19] Russian forces have reportedly also obtained Starlink terminals illicitly to improve their own connectivity and coordinate attacks on Ukrainian positions.[20]

Today, any nation seeking military or information advantage, or any outgunned nation wanting to level the playing field, can take advantage of the high ground of space. Whether defender or aggressor, they will have an array of space-derived data and services available, and commercial companies willing to provide them.

Denial and Disruption: The Battlefield Utility of Counterspace Weapons

With space capabilities playing such a significant operational and tactical role on the battlefield, it should come as no surprise that adversaries will seek to deny them. For both Russia and Ukraine, their means of denial and disruption have largely been through cyberattacks and electronic jamming systems, but other conflicts could see more expansive use of both kinetic and non-kinetic means as adversaries attempt to erode each other's satellite systems. These counterspace weapons—employed by both attacker and defender and integrated into military units at the tactical and operational levels—aim to degrade the battlefield effectiveness of space-enabled capabilities, including communications and precision weapons.

Space Capabilities: An Early Target

As noted at the beginning of this chapter, on February 24, 2022, before artillery was fired or Russian tanks were driven into Ukraine, a cyberattack was launched against a commercial SATCOM provider, Viasat, aiming to disrupt Ukrainian government communications and military command and control. A targeted denial of service attack took tens of thou-

sands of satellite modems offline across Central and Eastern Europe, not just affecting Ukrainian users but also knocking out wind turbines and internet access for civilians across Europe.[21]

The attack, later attributed to Russian state-backed cyber operators, underscored a new reality of modern warfare: Space-based systems are prime targets in the opening salvos of an attack, especially those that provide command, control, communications, computers, intelligence, surveillance, reconnaissance, and targeting (C4ISRT) capabilities.[22]

Recent conflicts underscore this trend. On October 7, 2023, Hamas attacked Israeli border surveillance cameras and communications towers to disable military communications and command and control (C2) and slow any responses.[23] Likewise, during Operation Rising Lion, on June 13, 2025, Israel conducted widespread strikes against Iranian military C2 nodes alongside attacks on nuclear sites and key personnel. While not targeting satellites (of which Iran has few), it was a bold act to degrade Iranian military commanders' situational awareness, operational coordination, and ability to respond to further strikes, including by the United States against Tehran's nuclear infrastructure.[24] Though neither case involved direct attacks on satellites, both demonstrate how warring sides will target C4ISRT infrastructure and both challenge any assumptions that parties would not seek bold, extensive, and perhaps escalatory ways to cripple the other side's C4ISRT systems—whether terrestrial or space-based—to degrade operational capacity and any information advantage.

The U.S. military has long assessed that its C4ISRT systems—particularly those based in space—would be among the earliest targets in a conflict with China. In the Indo-Pacific, U.S. forces depend heavily on the "high ground" of space for deterrence, defense, and warfighting. Satellites are vital for providing indications and warning of Chinese military activity, connecting distributed forces across vast maritime distances, and enabling the employment of precision weapons. This assessment is reinforced in successive U.S. Department of Defense reports on China's military and security developments, including one which noted that "PLA texts emphasize using cyber operations and other capabilities to degrade adversary C4ISR, weapon systems, and support nodes early in a conflict to seize information dominance."[25]

For the last three decades, the United States, in particular, has been able to project, stage, and maneuver forces with relative impunity, dominating all domains of warfare and conducting C2, sensemaking, and target prosecution largely unimpeded. Yet trends in the global accessibility and acceleration of advanced technologies are creating challenges to that military dominance. Further, the People's Liberation Army (PLA) intends to leverage its own C4ISRT networks to gain an edge.[26] In modern warfare, parties now have to concern themselves with their own C4ISRT vulnerabilities, as well as contend with adversaries utilizing advanced C4ISRT capabilities for their own operational and informational benefit.

In future conflicts, the ability to disrupt or deny an adversary's C4ISRT will be both a strategic objective and a vulnerability—placing a premium on one's own resilient, adaptable C4ISRT architectures, capabilities, and processes in contested operating environments as well as investments in counter-C4ISRT capabilities.

The Pervasiveness of Electronic Warfare

One of the most dominant features of the modern battlefield has been the pervasiveness of electronic warfare (EW), especially for force protection. Aiming to erode the effectiveness of drones and other precision munitions, EW systems provide a temporary and reversible way to target satellite navigation, communications signals, and intelligence, surveillance, and reconnaissance (ISR) collection. Beyond the Ukrainian battlefield, widespread electronic jamming and spoofing of GPS signals has been detected in Israel, along Russia's western borders, and elsewhere around the globe.[27]

EW systems have long been part of Russia's military tool kit. Well before Russia's full-scale invasion of Ukraine in 2022, Moscow demonstrated a capability and willingness to employ EW systems in regional conflicts. In 2018, the commander of U.S. Special Operations Command reflected that Syria had become "the most aggressive EW environment on the planet," after reports surfaced that Russia had been

"disabling" U.S. AC-130 gunships and blocking small U.S. surveillance drones from receiving GPS satellite signals.[28] That same year, the U.S. Army commander in Europe offered similar observations on Russia's EW capabilities in Ukraine, noting that "you cannot speak on a radio or any device that's not secure because it's going to be jammed or intercepted or worse, it's going to be found and then it's going to be hit," contrasting it to "something we never had to worry [about] in Afghanistan and Iraq."[29]

In the months prior to February 2022, an increase in GPS interference was detected along the Belarus-Ukraine border and in the Donbas.[30] This was preceded by reports in 2021 that unmanned aircraft systems (UASs) used by the Organization for Security and Co-operation in Europe (OSCE) for border monitoring continued to experience a high level of GPS signal jamming, affecting their ability to take off, land, and navigate.[31]

As the war in Ukraine has progressed, both Russian and Ukrainian forces have ramped up their use and production of EW systems that interfere with global navigation satellite system (GNSS) and SATCOM transmissions.[32] Russian efforts have been aimed at undermining the performance of Western-supplied precision weapons, complicating the use of drones, and interfering with military C2 and communications.[33] For example, the High Mobility Artillery Rocket System (HIMARS), Excalibur 155 mm guided artillery shells, Ground-Launched Small Diameter Bomb (GLSDB), and Joint Direct Attack Munitions (JDAMs) have all reportedly experienced degraded accuracy due to intense GPS jamming, which causes the weapons to veer off course and miss their targets.[34]

Ukraine has made its own progress in employing electronic jammers and spoofers to erode Russian drones and guided munitions reliant on satellite navigation signals. However, a former commander in chief of the Armed Forces of Ukraine wrote in 2023 that Russia "continues to maintain a significant electronic warfare superiority" with layered EW systems that "constantly change their location."[35]

These EW weapons—also considered counterspace weapons because their targets are space-based capabilities and services—have become integrated with conventional ground forces and moved around the battlefield. Rather than holding these capabilities in strategic reserve, the Russian military has embedded EW systems within command and logistics units.[36] This allows Russian forces to use them as force protection, shielding units from drones and smart weapons, while also disrupting Ukrainian targeting and coordination.[37] These counterspace tools, once regarded as strategic instruments, have become part of the daily tool kit of ground forces at the tactical and operational levels of warfare.

Israel also conducts widespread, persistent GPS jamming and spoofing, no doubt aiming to protect itself from missile and drone threats launched by Iran, Hamas, Hezbollah, and the Houthis.[38] PLA military exercises "regularly incorporate jammers against space-based communications, radars, and navigation systems like GPS," and the PLA "may be developing jammers to target SATCOM over a range of frequencies."[39] The United States has also begun to increase its inventories of EW systems fielded by the Army and Space Force to "disrupt their [adversaries'] comms and their kill chains and their targeting links."[40]

With electronic jamming and spoofing of space-derived services producing the desired military effect—eroding the ability of munitions and drones that rely on GPS to find their targets—this counterspace weapons trend is likely to continue. However, as the next section highlights, it is not a magic bullet for drone defense or protection against munitions strikes, as technologies and tactics continue to evolve to mitigate the effects of EW systems. Furthermore, those jammers—when on and radiating—can be detected, located, and struck if one's targeting process can beat the time it takes to move the jammers.

Not only will future battlefields see the ubiquity of EW, but regions outside of conflict zones will also experience greater electromagnetic interference, risking harm to civil and commercial transportation and public safety. As the CSIS Aerospace Security Program reported in the 2024 and 2025 editions of its *Space Threat Assessment*, in recent years, observers have tracked daily occurrences of GPS jamming and spoofing in regions like the Baltic Sea, Middle East,

and parts of South Asia.[41] In 2023, the International Federation of Air Line Pilots' Associations issued warnings to pilots about Chinese warships engaged in radio signal and GPS jamming over the South China Sea, Philippine Sea, eastern Indian Ocean, and northwest of Australia. Several UN agencies have emphasized the harms of jamming and spoofing, noting that interference with satellite navigation signals is a threat to air and maritime safety and security.[42]

Agility and Adaptability

Russian counterspace weapons have also targeted satellite communications in Ukraine, including through repeated attempts to jam Starlink terminals supporting Ukrainian forces. However, SpaceX has demonstrated remarkable agility in countering this jamming, specifically by deploying rapid software updates. One U.S. defense official called Starlink's updates "eye-watering," contrasting them to the often-sluggish response cycles of traditional military systems.[43] The episode underscored both the importance of commercial space assets in modern warfare and the battlefield agility and adaptability needed to counter EW threats.

The Ukraine conflict has served as a proving ground for the agility and adaptability that will be needed in future conflicts, particularly as both sides contend with the disruptive effects of GPS and SATCOM jamming. Drone developers have played a central role in this adaptation, pushing innovation cycles to weeks rather than months or years. For example, in response to electronic interference, companies have fielded drones with electromagnetic interference detection kits, autonomous terminal guidance, and even fiber-optic tethers that eliminate reliance on wireless signals for communications and targeting altogether.[44] These measures have allowed Ukrainian forces to maintain effectiveness despite widespread jamming while also providing valuable insights into how Western militaries might mitigate vulnerabilities in precision-guided weapons through a mix of technology and adaptive tactics.

At a broader scale, both Ukraine and its partners have actively evolved their approaches to operate through and counter EW. Ukrainian forces have expanded sensor networks to geolocate Russian jamming systems and quickly suppress them.[45] These EW systems have increasingly become high-value targets on the battlefield. The United States, for its part, is upgrading its GPS satellites with military transmission signals more resistant to jamming, investing in alternatives to GPS, and developing more resilient and proliferated satellite communications architectures—like Starlink—to ensure operational continuity.[46]

Going forward, EW will be the norm. Jamming and spoofing satellite navigation, communications, and ISR will be integral to maneuvering forces and protecting battlefield assets. Militaries will place a premium on operating effectively in degraded environments, geolocating and neutralizing electronic threats, and striking EW systems as part of operational campaign plans.

Battlefield Transparency

The proliferation of space capabilities, including commercial space assets, has introduced a new level of transparency to modern warfare. From intelligence professionals and military forces to private open-source intelligence (OSINT) companies and amateur analysts, more groups will be able to assess military forces and posture and even counter disinformation thanks to access to commercial imagery and other publicly accessible data sources.

This transparency has strategic implications. It enables rapid attribution of military activity, counters disinformation, and enhances situational awareness. During the early days of the Ukraine war, the availability of satellite imagery helped debunk Russian narratives and provided real-time evidence of atrocities and battlefield developments. Satellite imagery generated greater public awareness of Russia's military aggression and aided nations rallying to condemn Moscow's actions in diplomatic forums, counter with security assistance to Ukraine, and assess damage to Ukraine's infrastructure and places of cultural significance.

Yet transparency is a double-edged sword. Adversaries also benefit from greater access to space capabilities and services. As noted earlier, Chinese companies have supplied satellite imagery to Russian forces, and similar dynamics may emerge in

other conflicts. By 2025, two Chinese entities had begun launching satellites for their Starlink-like, low Earth orbit broadband constellations, with other Chinese entities planning additional SATCOM constellations. The U.S. intelligence community assessed that "China has achieved global coverage in some of its intelligence, surveillance, and reconnaissance (ISR) constellations."[47] When global ISR coverage is paired with advanced processing, AI tools, and global distribution networks, China will possess real-time target detection and tracking across the planet, including of naval vessels, force movements, and aircraft. As one senior U.S. Space Force official noted, "the full deployment of a space-enabled targeting network means that China can hold U.S. and allied forces at risk with long-range precision weapons."[48]

U.S. and allied forces are not accustomed to operating in an environment of persistent surveillance. The Cold War–era emphasis on denial and deception waned after the 1990s. From 2001 onwards, two decades of counterterrorism operations in Iraq and Afghanistan were conducted with the United States and its allies and partners operating under the cover of dominant air, space, cyber, and electromagnetic spectrum capabilities. Now, with commercial and foreign sensors proliferating, all militaries must adapt to a world where movements, emissions, and signatures are constantly monitored.

This demands a fundamental shift in training, doctrine, operational planning, and posture. Military forces—especially those at fixed sites and massed in central locations—must assume that they will be seen and their movements and emissions detected. Operating in this environment requires renewed emphasis on operational security, deception tactics, and electromagnetic spectrum discipline. Exercises should simulate conditions where adversaries possess near-real-time ISR capabilities. The threat of persistent surveillance further reinforces the necessity of eroding an adversary's ISR capabilities and the networks that enable them early in a conflict.

It is also important to note that transparency does not always lead to deterrence. Despite overwhelming satellite evidence and the disclosure of sensitive U.S. intelligence, including warnings about false flag operations, Moscow proceeded with its invasion of Ukraine. Even Ukrainian President Volodymyr Zelensky expressed skepticism in the days leading up to the attack. Thus, while transparency can shape the information environment, it does not guarantee strategic restraint.

This transparency nevertheless made it harder for Moscow to deny its actions and for third-party countries to ignore the facts. However, as technology continues to advance in areas like adversarial AI, where new kinds of deception, obfuscation, and misinformation can be generated at machine speeds, trust in such information will be tested in the years to come.

Beyond the Tactical: The Expanding Counterspace Tool Kit

While the conflict in Ukraine has illuminated the battlefield utility of certain counterspace weapons, there is an array of counterspace capabilities being pursued by global actors to deny or disrupt the advantages that space assets provide in peacetime and conflict.[49] The war in Ukraine has provided an unprecedented look into how counterspace capabilities are actually employed in conflict—not just in theory or doctrine. While Russia has demonstrated a willingness to integrate EW weapons into conventional operations for tactical and operational effect, it notably has refrained from using other elements of its counterspace arsenal. This selective employment raises important questions about doctrine, thresholds, and the evolving nature of escalation in the space domain.

Russia has leaned heavily on reversible, non-kinetic counterspace weapons—specifically EW systems that jam or spoof signals such as GPS and SATCOM. These tools have proved effective in degrading the performance of Ukrainian and Western-supplied precision munitions and drones. However, Russia has avoided more overt or escalatory counterspace actions, such as kinetic attacks or the use of laser weapons designed to blind or damage optical sensors in orbit.

For instance, despite the heavy and transparent use of imagery satellites to track Russian forces, there is little publicly available evidence to suggest that

Russia has used laser systems (such as the Peresvet and Sokol-Eshelon) or SAR jamming systems to blind ISR satellites.[50] A European Space Agency SAR satellite did experience interference while imaging Sevastopol in November 2023, echoing similar disruptions observed in 2021, but it was unclear whether this resulted from intentional satellite jamming or radar interference in the region.[51]

At the same time, in the lead-up to its invasion, Russia engaged in a pattern of ambiguous demonstrations that could be interpreted as strategic signaling. In November 2021—just three months before its invasion—Russia conducted a direct-ascent anti-satellite (ASAT) missile test, generating significant debris in low Earth orbit. While the test was not directly tied to operations in Ukraine, its timing raised questions: Was this a message of intent, a readiness demonstration, or a rehearsal for more aggressive action?

Other activities further complicate the picture. The Russian "inspector" satellite Luch, believed to be for gathering signals intelligence, has maneuvered and loitered in geostationary orbit throughout the Ukraine conflict near Western satellites providing high-throughput communications over Europe. And perhaps most notably, in the same month that Russia invaded Ukraine, it launched an experimental satellite believed to be an ASAT weapon capable of carrying a nuclear device—though this development was not revealed publicly until February 2024. The timing and nature of these developments suggested a willingness to use space demonstrations as strategic signaling tools, possibly as a form of deterrence or coercive leverage, even if the weapons themselves were not directly employed in combat.

These patterns—employing reversible, non-kinetic means in a tactical fight and exercising restraint in some areas while signaling ambiguity in others—offer insights into how Russia may view the utility of counterspace weapons, the conditions under which certain weapons might be employed, and how it manages escalation risks. Moscow's strategy blends tactical denial with strategic ambiguity—a doctrine that may favor deterrence through uncertainty rather than action.

For the United States and its allies, this raises important questions. What thresholds are adversaries observing in space? What conditions on Earth precipitate actions against space assets? And how should the United States and its allies respond to demonstrations that fall below traditional red lines but still aim to alter the strategic calculus? These are not theoretical concerns. Future conflicts are likely to be shaped by similar patterns of gray zone counterspace activity.

Beijing, which possesses a full range of space capabilities that it is increasingly integrating into its own joint force, is undoubtedly watching these developments closely. The U.S. intelligence community considers the People's Republic of China (PRC) to be the most expansive space threat and a global space power, competing with the United States. In its 2025 annual threat assessment, the U.S. intelligence community assessed: "Counterspace operations will be integral to PLA [People's Liberation Army] military campaigns, and China has counterspace-weapons capabilities intended to target U.S. and allied satellites."[52]

PRC doctrine has long emphasized the value of striking C4ISR capabilities early in a conflict to deny the U.S. military its operational edge. The lessons emerging from Ukraine—especially around EW, ISR denial, and the use of counterspace capabilities for both warfighting and signaling—are likely reinforcing China's investments in a broad suite of space denial tools. Further, with the pursuit of large, proliferated satellite constellations (involving hundreds or thousands of satellites) as an approach to enhance performance and resiliency in key capability areas—whether SpaceX's Starlink for communications or the U.S. Department of Defense's Proliferated Warfighter Space Architecture for tracking missiles—adversaries will inevitably look for ways to hold these systems at risk.[53] Such options are likely to shift toward methods that generate widespread effects, such as cyberattacks, debris-generating attacks to collapse an entire orbital plane, high-altitude nuclear detonations (HANDs), or attacks on physical infrastructure like ground stations. Indicators for such a shift could include research to understand the effects of HANDs on satellites, for example, as Chinese scientists are reportedly doing at a PLA research institute.[54] Each

of these variants of counterspace weapons has policy, operational, and technical trade-offs.[55] Some would be highly escalatory and others, like HANDs, would be both escalatory and indiscriminate, presenting as much danger to the attacker's own satellites as to its intended targets.

Beyond Russia and China, the United States and its allies have become more explicit about their counterspace policies and investments to protect their assets and target adversary satellites.[56] Although the United States has long held space control as a core mission, it has been reticent to publicly discuss its capabilities. But that stance is shifting. In April 2025, the U.S. Space Force released a space warfighting framework emphasizing both "offensive and defensive actions" to achieve space superiority.[57] France has been particularly outspoken among Western nations, outlining plans to develop and field orbital counterspace capabilities and bodyguard satellites, potentially with shoot-back or jamming systems on board.[58] Even commercial companies, like U.S.-based True Anomaly, are developing new "spacecraft purpose-built for space superiority."[59] This raises the specter that in the future satellite operators could contract with private firms to protect their assets.

As space systems prove critical from peacetime to conflict, they are increasingly vulnerable to a growing array of counterspace weapons as adversaries seek to erode each other's space-based advantages. In Ukraine, Russia has employed reversible, non-kinetic tools for tactical denial of space services while exercising restraint and signaling ambiguity with others—revealing a nuanced approach in the employment of counterspace weapons and highlighting the complexity of deterrence and escalation involving counterspace weapons in modern warfare.

Policy Challenges and the Road Ahead

The use of space in the Ukraine conflict raises profound policy questions for the future of warfare. First, the centrality of commercial space capabilities to military operations demands a rethinking of public-private relationships. U.S. and allied governments have traditionally relied on commercial capabilities as a supplement to national systems. Increasingly, these capabilities are at the core of operational planning, with countries like Poland adopting commercial space solutions as the foundation for their sovereign satellite constellations.[60]

This creates new challenges in acquisition, integration, and protection.[61] How can U.S. and allied forces rapidly incorporate commercial space services into joint and coalition operations? How can contracts and partnerships be structured to ensure responsiveness and resilience in conflict? And what obligations does a government have to protect commercial assets that become military targets?

One area of active debate is whether commercial satellites used for military purposes become legitimate targets under the laws of armed conflict. Russian officials have made statements suggesting that they consider such systems valid military targets.[62] This raises concerns about the protection of dual-use infrastructure and the potential escalation of conflict into space.

Another key issue is deterrence. How can the United States and its allies and partners deter attacks on their space assets, including those operated by commercial providers? What signaling, posture, and capability mix is required to communicate resolve without provoking escalation? These questions are central to ongoing doctrinal development, especially within the U.S. Space Force, and the source of debate within the U.S., European, and Asian space policy communities.

Classification is also a barrier. Much of the U.S. space architecture remains highly classified, as do certain allied capabilities and cooperative space defense initiatives, complicating efforts to share information among allies and integrate commercial partners. As space becomes more contested and more crowded, information sharing and interoperability will be vital.

Finally, space business leaders will increasingly find themselves in the middle of geopolitics and global security questions. Companies like SpaceX, Maxar, and others have found themselves making geopolitical decisions—such as whether to provide services in contested regions, how to handle adversary access,

The evolving role of the space dimension in modern warfare is reshaping how conflicts are fought and who can influence them.

and how to balance global business interests with national security.[63]

There are also emerging signs of adversarial cooperation in space. Russia and China have expressed interest in greater space collaboration, and Chinese support for Russian military efforts in Ukraine suggests a growing willingness to share capabilities. U.S. and allied strategies must account for the potential of a "coalition of convenience" in space.

Conclusion

The evolving role of the space dimension in modern warfare is reshaping how conflicts are fought and who can influence them. The greater accessibility of satellite data and services can both level the playing field for underdogs and serve as a force multiplier for those best able to exploit them and mitigate attacks against them. The persistent coverage of terrestrial activities by space assets is making the battlefield more transparent, diminishing strategic surprise, and inviting the public to peer into the fight in unprecedented ways. Business leaders, too, increasingly find themselves in the middle of geopolitics, crises, and war.

The war in Ukraine has crystallized these trends, demonstrating the power of commercial systems, the impact of persistent surveillance on force posture and movements, and the growing risks of counterspace threats. These lessons are urgent and enduring. The space domain will be central to future conflicts—not just as a support function, but as a contested arena of operations. Policymakers must act decisively to update doctrine, enhance resilience, deepen public-private integration, and prepare forces for a world in which space systems are not only accessible to all, but visible to all.

CHAPTER 09

Technological Evolution on the Battlefield

Aosheng Pusztaszeri and Emily Harding

Ultimately, the next generation of warfare will not be defined solely by who possesses the most advanced technology, but by who can integrate, adapt, and counter it the fastest.

"Soldiers hike for miles, ducking into cover, through drone-infested territory too dangerous for jeeps, armored personnel carriers or tanks. Soldiers say it has become strangely personal, as buzzing robots hunt specific cars or even individual soldiers. It is, they say, a feeling of a thousand snipers in the sky."

–Marc Santora, "Rise of the Dragons: Fire-Breathing Drones Duel in Ukraine," *New York Times*[1]

In war, soldiers get creative. They find new ways to use old equipment and ask for new technologies to solve problems as they emerge. In turn, those new technologies drive tactics and operations for warfighting in unprecedented and sometimes unpredictable ways. The party that innovates, procures, and adapts first secures an often insurmountable edge. For instance, during World War I, the British developed the first rudimentary tank to break the stalemate of trench warfare, spawning successive models that ultimately helped turn the tide on the Western Front.[2]

The recent conflicts in Ukraine and the Middle East have represented a leap forward in the employment of technology on the battlefield by sophisticated actors. Ukraine and Russia have each evolved to shape a battlefield defined by drone warfare and drawn to a stalemate, and Israel has used its technological edge, including AI-generated target recommendations, to devastate Hamas.

However, overdependence on technology courts dangerous consequences. For example, Israel's tech-intensive Gaza border defenses clearly failed on October 7, 2023, and the Israeli government has also been heavily criticized for its use of AI systems for targeting and identifying alleged members of Hamas in large crowds. Further, in the race to out-innovate the adversary, there is a real risk of overlooking ethical considerations and the need for rigorous testing in favor of speed and lethality.

This chapter examines how emerging technologies are reshaping modern warfare by considering the ongoing conflicts in Ukraine and around Israel. In this

PHOTO: PAVLO BAHMUT/UKRINFORM/FUTURE PUBLISHING/GETTY IMAGES

future landscape, conflicts will increasingly resemble Ukraine's high-tech cat-and-mouse game rather than the Battle of Medina Ridge and Desert Storm.[3] It will be less of a grind, making the best use of the forces as they exist, and more of a game of leapfrog, where parties try to leap ahead of each other for a technological edge.

Lessons from Ukraine

Emerging technologies have reshaped battlefield tactics and weaponry in Ukraine. The most marked change is cheap, flexible, and highly maneuverable intelligence, surveillance, and reconnaissance (ISR) drones.[4] Cover and concealment are of the utmost importance, and large combined arms maneuvers involving columns of highly visible tanks and personnel carriers are more vulnerable to drone strikes and less capable of achieving the same rapid breakthroughs seen in previous conflicts.[5] This has led to a highly iterative game of cat and mouse, with advancements in electronic warfare meeting drone advancements step for step. Beyond drones, the war has changed in other ways, including aggressive information warfare, cycles of cyber war, and initial uses of true autonomy with the advent of AI. The last three years of warfare have dramatically accelerated technology innovation, and the years ahead point to a growing global acceptance of drone-based and autonomous warfare.

Unmanned Vehicles

As reflected by the quotation at the beginning of the chapter, drone warfare has defined the battlefield in Ukraine. For reconnaissance, Russia and Ukraine have incorporated first-person view (FPV) drones into their military tactics, which locate enemy tanks and infantry vehicles, then signal their positions to artillery and attack drones to conduct precise strikes. Drones of all sizes serve as highly flexible kinetic-strike vehicles, whether by dropping "dumb" bombs or themselves serving as the delivery vehicle in a one-way strike mission. Ukrainian unmanned aircraft system (UAS) units use advanced quadrotor drones to drop grenades into Russian tank hatches with pinpoint accuracy.[6] So-called dragon drones spew burning thermite into enemy trenches, burning away the vegetation they use for concealment.[7] Because drones cause fear, they can also drive adversary behavior; for example, Russian forces have used drones to funnel columns of Ukrainian troops into minefields.[8]

Further, tanks and armored personnel carriers are easy targets, so troops on both sides have adapted to operate in smaller units, which advance more cautiously and often on foot.[9] The drone war has extended to sea, too, with Ukraine using uncrewed surface vessels (USVs), such as the Magura-V5, to decimate Russia's Black Sea Fleet.[10] Small enough to avoid radar detection, these USVs can carry 500 to 700 pounds of explosives and infiltrate harbors to damage or sink Russian ships.[11] In May 2025, Ukrainian Magura-7 drone boats armed with infrared-guided air-to-air missiles successfully downed two Russian Sukhoi Su-30 fighter jets over Novorossiysk and Crimea—marking the world's first recorded shootdown of fighter aircraft by a sea drone.[12]

On land, both Ukraine and Russia have expanded their use of unmanned ground vehicles (UGVs). In northeastern Kharkiv, for instance, Ukrainian forces used UGVs to clear mines and conduct reconnaissance missions. This operation was supported by unmanned mine-laying vehicles and aerial drones, marking the "first documented machine-only ground assault" of the war, according to Ukraine's Khartiia Brigade.[13]

Aerial drone units are also becoming central to battlefield strategy, prompting both sides to intensify recruitment and training programs for new UAS units, which require a vastly different skill set than traditional infantry.[14] Ukrainian UAS operators must master aviation meteorology, learn to operate collision avoidance systems, and perform takeoffs and landings in a wide range of conditions.[15] Ukraine created the world's first drone-focused branch of the military in 2024, calling it the Unmanned Systems Forces.[16]

Innovation

The war in Ukraine has established a blistering cycle of measures and countermeasures, with both sides rapidly innovating to stay ahead of enemy advancements. According to Nick Reynolds of the Royal United Services Institute, current technology has a

The logo of Ukraine's new Unmanned Systems Forces is an AI-generated image of a robotic swallow. The swallow is a Ukrainian symbol of victory.

Source: Olivia Savage, "Ukraine conflict: Ukraine establishes world's first unmanned force," Janes, June 14, 2024, https://www.janes.com/osint-insights/defence-news/air/ukraine-conflict-ukraine-establishes-worlds-first-unmanned-force.

"six week learning cycle on the battlefield."[17] This dynamic is most acute in electronic warfare. As each side has found new ways to jam drone signals, the other side has found ways to get around that jamming. Ukraine has significantly improved its radio jamming capabilities and can now disrupt the communications link between Russia's satellite-guided KAB and UMPK glide bombs and its GLONASS satellite constellation (Russia's equivalent of GPS), causing Russian glide bombs to veer off course by up to a kilometer and detonate harmlessly in open fields.[18] Further, Ukraine has developed AI-enabled drones that can lock onto pre-identified targets in the final phase of flight—an innovation designed to counter Russian jamming.[19] Both sides have reverted to operating drones using fiber-optic cables, which keep drones tethered but can reach up to a 10 km range and are impervious to jamming. Additionally, Russia has made advancements in directed energy weapons, providing Moscow with a more cost-effective way to counter Kyiv's inexpensive FPV drones.[20] Ukraine has also adopted a more decentralized communications model, using multiple dispersed radio nodes and smaller radios to reduce the detectability of its signals and make it harder for Russian forces to track and jam their communications.[21]

Innovation does not necessarily mean high-tech solutions. As AI-enabled drones have gotten good at locating tanks and armored vehicles, the Russian military has switched to donkeys and horses for moving troops and delivering supplies. "It's better if a donkey gets killed than two men in a car carrying the things necessary for battle and sustenance," said Russian Lieutenant General Viktor Sobolev.[22] Meanwhile, the Ukrainian military has employed hand carts for the same purpose.[23]

Information Warfare

Information warfare has leapt ahead in the Ukraine conflict, with Moscow focusing on spreading mis- and disinformation at home and abroad and Kyiv using facial recognition to identify Russian soldiers and lost children. Both sides have capitalized on AI. In March 2022, for example, Russia released a deepfake video of Ukrainian President Volodymyr Zelensky surrendering.[24] AI has also played a crucial role in documenting and verifying facts on an unprecedented scale. Ukraine has used AI-powered facial recognition software to identify over a quarter of a million Russian soldiers in the country.[25] The software was also instrumental in locating 198 missing Ukrainian children who were kidnapped and taken to Russia early in the war and in enabling Ukraine's Prosecutor's Office to identify the people in Russia who "adopted" them.[26] AI has further been used to counter Russian propaganda: While Moscow often downplays or conceals its battlefield losses, Ukrainian authorities have used the same AI to create an online database of identified Russian soldiers killed on the battlefield to notify their families in Russia.[27] Additionally, AI software has been used to collect evidence of war crimes, clear land mines, assist in refugee resettlement, and even combat corruption.[28]

Cyber War

Both Russia and Ukraine have used cyberattacks as additive to their war efforts. Even before the full-scale invasion, Russian-affiliated cyber actors targeted

Ukrainian oil and gas companies, Ukraine's largest commercial bank, and the Ministry of Defence's websites.[29] These attacks were likely aimed at undermining the Ukrainian public's trust in the military, disrupting their access to money and fuel needed for evacuation, and trapping them in the line of fire, further dampening hope. As the conflict escalated into open war, Russia shifted its cyber focus to government institutions, communication networks, power grids, and media.[30] As of April 2024, technology companies on the ground in Ukraine reported an ongoing onslaught of Russian attacks, in particular directed at the power grid and banks. Ukraine, too, has expanded its own cyber operations, primarily through its "IT Army"—a volunteer force of thousands of hackers conducting offensive cyber campaigns against Russian financial systems, state services, and media (to counter Russian disinformation and propaganda campaigns and conduct propaganda campaigns of their own).[31] Ukraine in particular has proven highly resilient to these attacks—the result of more than a decade of preparation and enduring Russian cyber operations.

AI-Enabled Information Processing

The speed of information processing and decision-making is also rapidly changing, with both sides using ISR drones to collect vast amounts of data and AI to exploit the data for usable insight. AI plays an increasing role in Ukraine's targeting operations. Ukrainian UAS units now use AI to automate drone takeoffs and landings and assist in target identification (albeit with human oversight), sometimes reducing the time from detection to destruction to just over 30 seconds.[32] The Ukrainian Ministry of Defence is using AI software to "analyze satellite imagery, open-source data, drone footage, and reports from the ground" and provide Ukrainian commanders with lists of potential military targets.[33]

Incorporating Commercial Tech

Recognizing the advantages of commercial technology, Ukraine has begun restructuring its military acquisition system away from traditional state-owned research and development (R&D) models in favor of the commercial sector, a shift driven in part by the battlefield successes of commercial technology and cost advantages.[34] Ukraine has also streamlined its procurement processes by offering economic incentives to private companies and eased its restrictions on AI defense development. Kyiv has also significantly reduced administrative barriers for acquiring unmanned systems (cutting procurement timelines from months or years to just weeks) and increased the adoption of off-the-shelf commercial technology, allowing military units to bypass long wait times for custom-developed systems and quickly acquire new technology.[35]

Lessons from Israel

As in Ukraine, emerging technologies have played a critical role on the battlefield in Gaza and are reshaping the conduct of the war. However, the Gaza war has yielded fewer insights on the impact of emerging technologies, as Israel was already a global leader in incorporating technological solutions. Further, the conflict was less evenly matched—Israel's quick bursts of activity and Hamas's lack of technological prowess have not resulted in the leapfrogging technological achievements that have featured in Ukraine.

Among the technologies that have been publicly acknowledged, the most notable is the AI-enabled decision-support systems (AI-DSS) that the Israel Defense Force (IDF) uses for targeting, which has dramatically accelerated the processing and analysis of battlefield information. AI tools have also supported Israeli forces in tracking the movements of suspected Hamas operatives at checkpoints across Gaza and the West Bank. To support these systems, Israel has significantly increased its demand for data storage and cloud computing, drawing heavily on commercial providers as well as its startup ecosystem to rapidly field new technology for the battlefield.

High-Speed Information Processing

The ongoing conflict in Gaza is rapidly transforming how information is processed and used in warfare. For instance, Israel has increasingly relied on AI-DSS such as Gospel for its targeting.[36] Gospel is a decision support tool used by the IDF that aggregates vast amounts of intelligence data, including "cell phone messages, satellite imagery, drone footage and . . .

seismic sensors" to identify potential Hamas compounds, bases, and homes for targeting.[37] Gospel is capable of generating significantly more targets than traditional intelligence teams. Previously, IDF officers could manually identify 50 targets per year; Gospel can generate more than 100 per day.[38] These AI-generated recommendations are then reviewed by human analysts, who relay approved targets to the Israeli Air force, Navy, and Ground Forces through an app called Pillar of Fire.[39]

Israel has also increasingly relied on AI-driven facial recognition at security checkpoints. The IDF uses these systems to scan the faces of passing individuals and to detain those flagged as having ties to Hamas.[40] While facial recognition technology has been used in the region for over a decade, Israel has significantly expanded its use during the current war, using tools developed by Corsight, a private Israeli company, to scan and cross-reference the faces of Palestinian residents against a "wanted persons" database. If the algorithm identifies a match, they are detained for questioning.[41]

Commercial Technology

As in Ukraine, the conflict in Gaza has witnessed a sharp rise in the use of commercial technology on the battlefield. Like the Ukrainian Armed Forces, the IDF is capitalizing on the strengths of smaller, more agile companies capable of rapidly fielding new and innovative designs. For example, as of late 2024, the Israeli Defense Ministry enacted a "green path" program for certain startups to fast-track their licensing processes.[42] Between October 2023 and December 2024, the ministry also awarded 101 contracts collectively worth ILS 782 million ($219 million) to startups and small firms, many of which sprang up out of skills gained in service with the IDF.[43] According to military expert Isaac Ben-Israel, startups in particular excel in this environment, as they are often "a group of few people that can do something in weeks" rather than months or years.[44] This shift has been particularly evident in the development of anti-drone technology—a critical need as the IDF faces a constant barrage of varied drones and hardware launched from Gaza, Lebanon, Iran, and Yemen. In response, startups have provided approximately 50 percent of the anti-drone systems deployed by the IDF during the conflict so far.[45]

Ravenous Need for Data Storage

The ongoing war in Gaza has highlighted the growing wartime demand for large-capacity data storage and cloud computing—capabilities now largely provided by commercial vendors. As the IDF's use of AI has expanded during the conflict, so too did its need for supporting cloud infrastructure.[46] However, by the early months of the war, Israel's domestic server capacity had come under strain, possibly due to the large mobilization of reservists from the technology sector and preexisting declines in foreign direct investment. In response, the IDF significantly increased its reliance on overseas cloud providers.[47] According to the Associated Press, the amount of IDF data stored on Microsoft servers more than doubled between March and July 2024, surpassing 13.6 petabytes—the equivalent of roughly 14 billion printed books.[48] Beyond direct military applications, Israel has also relied on foreign cloud providers to support systems such as Rolling Stone—a tool developed by Israeli security forces to manage certain population registries in the West Bank and Gaza.[49] (It remains unclear whether this is part of the same system used at border checkpoints mentioned earlier.) As the war continues, the demand for cloud computing and expansive data storage is only expected to grow.

Danger of Overreliance on Technology

The ongoing war in Gaza has revealed the ethical and practical risks of overreliance on technology. The pace of Israel's offensive against Gaza led the IDF to lean into AI to ease the burden on operators. According to *The Guardian*, the IDF's policy of targeting all individuals with ties to Hamas, including those of junior rank, significantly expanded the scope and volume of potential targets and quickly overwhelmed human operators.[50] Some analysts admitted there was insufficient time to carefully "incriminate every target" while another admitted to spending just 20 seconds per target, processing dozens each day, and contributing "zero added-value as a human, apart from being a stamp of approval."[51] Further, during the early months of the Gaza conflict, IDF command-

ers pushed their analysts to "bring [them] more targets," which caused human analysts to increasingly defer to and trust AI's recommendations.[52] Border guards fear making errors and tend to assume that the AI is more accurate than they could be, leading to false positives.[53] While the Israeli firm behind the facial recognition system claims its technology can accurately recognize a face even if 50 percent is obscured, anonymous IDF officers told the *New York Times* that the software still struggles with partially covered faces and grainy drone footage and noted that the system occasionally misidentifies individuals as being connected to Hamas.[54] Israel also leaned heavily on technology to secure the border between Gaza and Israel before October 7, with disastrous effects. Hamas knew how to dismantle static, automated systems, rendering defenses largely useless. (For more on this dynamic, see Chapter 7: Intelligence in a Transparent World.)

Implications for the Future of Warfare

The last three years of warfare have prompted a leap forward in technology on the battlefield, and the near future points to several continuing trend lines. First, the stealthy maneuver of large land and sea forces will become increasingly rare, thanks to small aerial drones using flexible, cheap commercial overhead imagery, crowd-sourced intelligence, and camera-guided one-way USVs at sea. Logistics chains will be in constant peril for many of the same reasons and will increasingly depend on disposable UGVs to perform tasks too dangerous for humans.

Defenders who can dig in with effective counter-drone measures will have a significant advantage, and those who must cross open land will be at a significant disadvantage. Future commanders will have access to a massive amount of information from a multitude of sources, demanding that they operate on a rapid-spin OODA (observe, orient, decide, act) loop. There is great promise for AI to make this process easier. It has already appeared on the battlefield in limited ways, but it is poised to rapidly expand as warriors get comfortable with the technology and iterate on its use.

When both sides have AI-enabled targeting and processing, the incentive will lean heavily toward deferring as much as possible to the AI's capability. For now, that surely will lead to mistakes.

With that ease comes the peril of using AI as a crutch: When both sides have AI-enabled targeting and processing, the incentive will lean heavily toward deferring as much as possible to the AI's capability. For now, that surely will lead to mistakes. AI is not trained or tested enough to take on such life-and-death responsibility. Finally, this entire ecosystem of rapid innovation and speedy decisionmaking will require the heavy involvement of industry, not only back at factories and in labs, but at or near the front lines, to receive rapid feedback and anticipate the next adaptation.

Ready to Fight in Full View

UAS units will prove a quick, lethal tool in future conflict. Drone teams will be able to detect enemy armaments and movement on supply lines within minutes and take rapid action to destroy targets. Units must prepare to fight in full view of the enemy, rendering large-scale combined arms maneuvers less common. Troop transport will be dangerous, necessitating movement in small numbers and likely under cover of some other purpose. Meanwhile, valuable military targets will need to be outfitted with increasingly advanced electronic warfare systems and constantly patrolled by interceptor drones to counter enemy UASs and glide bombs. The air domain will be increasingly contested, with UASs engaging in aerial combat for temporary control of the skies. The sea domain will also change dramatically: If a $500 drone can destroy a multimillion-dollar tank, so, too, can a USV swarm destroy a fleet of ships. Counter-drone solutions will be decisive on the future battlefield.

Highly Empowered Individual Units

The future of warfare is shifting toward smaller, highly mobile, adaptable units, where field commanders are empowered to make decisions about cover, concealment, and tactics while minimizing their communications signature. These units will rely on technology designed for hit-and-run attacks and ambushes, such as quiet ISR drones followed by autonomous swarm attacks, which might provide a distraction from a precise sabotage operation that must be conducted by a human. Rather than large-scale mechanized maneuver—such as the tank battles of Desert Storm—guerrilla-style tactics, hit-and-run operations, and sabotage will define the front lines of battle.[55]

Troubled Logistics Tails

Supplying the front lines will be more challenging—and likely deadlier—than ever. Modern armies need to anticipate that only a fraction of supplies will get through, given adversaries' ability to identify and eliminate targets quickly. As a result, armies will seek to minimize deliveries to the front lines. Where possible, drone deliveries of goods will be preferable to protect the lives of pilots, sailors, and cargo drivers. Additionally, militaries will increasingly turn to inexpensive, expendable UGVs for mine clearing, mine laying, and frontline reconnaissance.

In response, militaries will adopt technologies that increase self-sufficiency. For instance, advancements in 3D printing could enable the on-site production of specialized replacement parts, reducing the need to use long and vulnerable supply routes.[56] Similarly, bacteria-based biofuels could allow units to generate their own energy, increasing mobility and reducing reliance on traditional fuel supply lines.[57] Autonomous fuel-delivery vehicles are also expected to play a greater role in resupplying frontline units, minimizing the need for manned convoys that remain vulnerable to enemy drone attacks.[58]

Highly Networked Forces

Future militaries will be equipped with cutting-edge, integrated technologies that form highly advanced battle networks. These include quantum positioning systems, autonomous drones, and autonomous or semi-autonomous support robots. These systems will require two enablers: (1) dependable communications to network the effort and (2) fuel to keep it running. First, secure, redundant communication systems are essential to making this highly networked form of war possible. Units will need resilient mesh networks to ensure continuous communication even if multiple nodes go dark.[59] Second, highly mobile units will need mobile fuel. Ideally, they will not struggle under the weight of heavy rucksacks loaded with old, bulky batteries and instead can use compact, efficient, newer forms, alongside readily dependable alternative fuel, like high-efficiency solar and biofuels.

Rapid Adaptability Cycles

Future wars will likely feature extremely fast cycles of innovation and adaptation, as seen in Ukraine. With a more widespread battlefield, the front lines may evolve at different paces or in divergent ways, necessitating central nodes to facilitate sharing lessons learned. To keep up with the pace of innovation, militaries must adopt a more streamlined procurement process, allowing commercial vendors to rapidly iterate. Additionally, the speed of adaptation means creating bespoke equipment will likely be too slow; units must make do with off-the-shelf commercial technologies. Central commands can help push these commercial products in the right direction by telegraphing anticipated needs, giving industry a strong demand signal and a head start on the next iteration. This approach bypasses the time-intensive process of developing custom technologies and could reduce procurement timelines from years to weeks.

No Front Lines

The future of warfare will further blur the line between combatants and noncombatants. As the commercial sector takes on a greater role in military operations, civilian service providers—such as those supplying power, cloud storage, and internet connectivity to warring nations—could increasingly be seen as legitimate military targets.[60] Future militaries will need to develop clear policies about defense of private sector assets. For instance, companies deploying personnel and equipment to the front lines may warrant greater military protection than those pro-

viding services from thousands of miles away. As militaries become increasingly reliant on commercial technology, they will have to navigate the influence of corporate leadership, many of whom have their own (sometimes conflicting) sets of priorities—such as revenue growth, shareholder interests, or company reputational risk. This misalignment is likely to become a recurring challenge in military operations.

Humans and AI

Future militaries will likely depend heavily on AI for targeting, with AI systems able to autonomously identify and eliminate targets with minimal or no human intervention, making combat faster.[61] Militaries already have autonomous systems for defense, in particular missile defense; a shift to offense is likely to take place first as matched targeting—for example, AI drone swarms attacking AI drone swarms. Later usages will include autonomous "find, fix, finish" of clear military targets, like ships and tanks. The last frontier will be strikes on particular human targets. However, increasing reliance on AI in life-and-death decisions raises serious ethical concerns. Human error in war is already too common today, but if a human operator allows an AI system to mistakenly target a school bus instead of an enemy tank, who bears responsibility? What are the accountability mechanisms? If an AI system is the cause of a friendly-fire incident, who is to blame?

The Next Decade of Warfare

The future holds other uncertainties for warfare in the next 10 years. Adversaries are already employing AI for deepfakes designed to sow doubt and confusion. The next iteration could entail deepfake military orders or highly realistic denial and deception operations designed to sow tactical chaos. In the next few years, sophisticated adversaries will probably find ways to combine AI and cyberattacks, with offense likely outstripping defense at first. AI agents will be able to find vulnerabilities and exploit them, perhaps in series, without phoning home and raising alarms, which will allow for persistence on networks in a way never seen before. A quantum computer able to defeat military-grade encryption is likely 5 to 10 years out, and the first state to use it will hold an unparalleled advantage. A combination of AI and powerful computing power, quantum or traditional, will allow for leaps ahead in bioengineering, including new chemical combinations and edited viruses for biowarfare; alternatively, these advancements could create biofuels or medicine tailored to a soldier's specific needs. Each of these adaptations could change the way of warfare all over again.

Conclusion

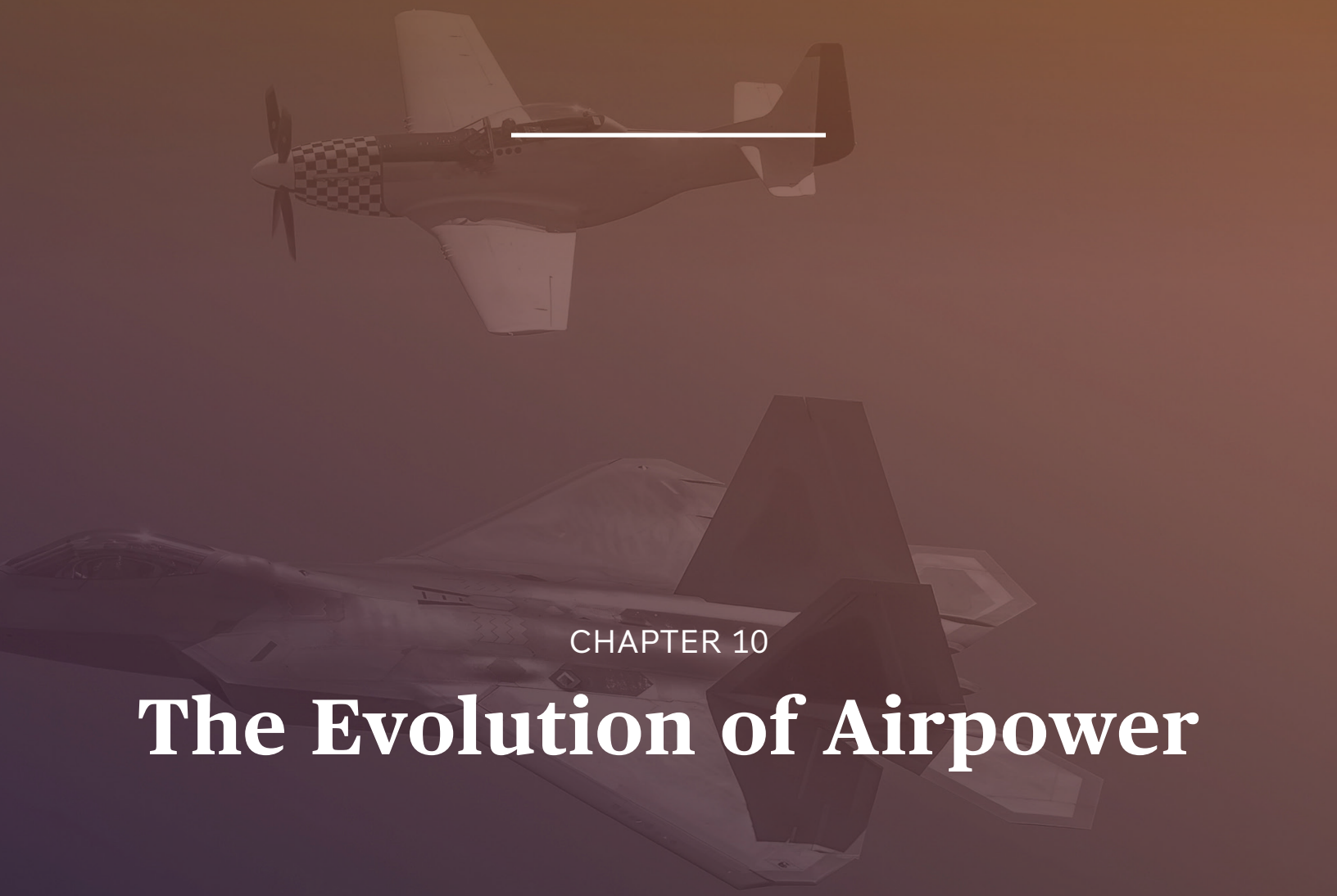
The conflicts in Ukraine and the Middle East have shown how emerging technologies—particularly unmanned vehicles, AI, and information warfare—are reshaping combat, forcing militaries to adapt or risk obsolescence. Modern conflicts are increasingly defined by speed, adaptability, and innovation. Ultimately, the next generation of warfare will not be defined solely by who possesses the most advanced technology, but by who can integrate, adapt, and counter it the fastest.

This trend line will challenge most political systems based on capitalism and democracy. The market will take time to catch up to need and respond to demand, whereas a centrally planned system will shortcut those steps. The United States in particular, despite excelling at invention and problem solving, is tragically slow at purchasing and integrating that new technology. To compete in this iterative form of warfighting, Washington needs to shift away from the fear of corruption and the reams of regulations designed to squash it. Policymakers must recognize a more pressing fear: that the United States is forced into a hot war with last-generation technology while its adversaries sprint ahead—a position it has not experienced since World War I.

Still, future militaries will need to incorporate technology without depending on it. A force multiplier is a high-priority target for an opponent, and militaries must be ready to lose those tools and keep fighting. Using technology as a crutch happens today—overdependence on signals intelligence at the expense of human intelligence contributed to a critical intelligence failure before the attacks on October 7.[62] Against a highly capable adversary, however, the extent of the failure could be far worse. For example,

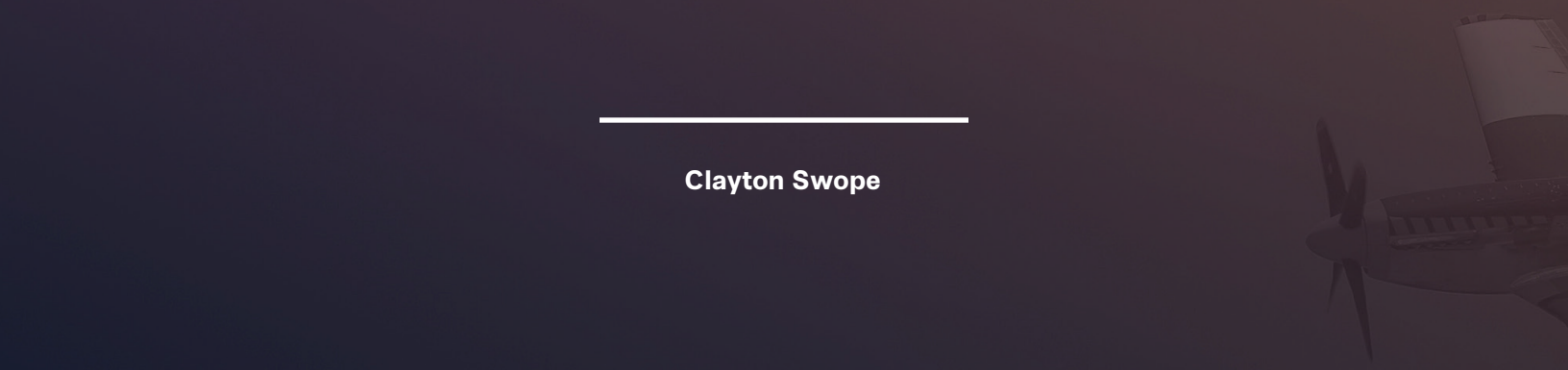
militaries depending entirely on GPS for precision navigation and timing of weapons systems could find themselves toothless, should the GPS satellite cluster go dark. Quantum sensing might be a future alternative; in the meantime, the U.S. Naval Academy is teaching coping mechanisms like navigating by the stars.[63] A drone swarm accompanying a mobile attack squad can be a force multiplier, but if that swarm is taken down by an electromagnetic pulse or another form of electronic warfare, the squad must be able to fight on. If undersea cables are cut and war in space imperils satellite communications, militaries need a backup plan to continue to coordinate multidomain warfare.

While technology offers significant advantages, it also introduces new vulnerabilities, as adversaries are continuously innovating and developing countermeasures. The rise of AI-enabled decisionmaking, for instance, raises ethical concerns about the trend of human deference to AI recommendations. Moreover, the increasing role of the commercial sector in warfare is blurring the lines between combatants and noncombatants. Militaries must strike a delicate balance: using technology without becoming overly reliant on it and maintaining ethical safeguards and rigorous testing to keep technology safe. The side that strikes this balance will be best positioned to harness the full potential of technology in the ever-changing landscape of warfare.



CHAPTER 10

The Evolution of Airpower



Clayton Swope

Trends observed from recent conflicts should only serve as jumping off points for the future, rather than the playbook for air operations in the next war.

"Victory smiles upon those who anticipate the change in the character of war, not upon those who wait to adapt themselves after the changes occur."

– Giulio Douhet, *Command of the Air*, 1921

Giulio Douhet, an Italian general who directed the first wartime use of airplanes in 1911, called the airplane the "offensive weapon par excellence," alone capable of deciding the outcome of wars.[1] The core military functions of airpower today—long-range bombardment, support to military surface forces, surveillance and reconnaissance, and transportation, as well as counterair operations—would look remarkably familiar to Douhet.

However, the tools and tactics used to perform these functions are constantly changing, having experienced a particularly rapid evolution on the battlefield in Ukraine. Air operations there and in the Middle East have been shaped by the mass production and deployment of both armed and unarmed uncrewed systems at scale, operational challenges arising from the lack of air superiority, and the effectiveness of electronic warfare and signal jamming. The convergence of these developments has produced new ways to carry out long-range bombardment and support to military surface forces, as well as tested and honed counterair operations using modern, layered integrated air defenses.

The future of military airpower will undoubtedly reflect warfighting experiences from Ukraine and the Middle East. But trends observed from recent conflicts should only serve as jumping off points for the future, rather than the playbook for air operations in the next war. As Douhet observed, wars are won by those who can anticipate changes in warfighting and not through merely adapting to the last war.

Anticipating the future, it is quite likely that thinking machines will play a major role in air and counterair operations. AI-enabled lethal autonomous weapons, which to date have barely been deployed, will play a prominent role, which in turn presages a diminishing role for human-piloted aircraft. Air oper-

PHOTO: GEORGE BEKRIS/GETTY IMAGES

ations in the future will also be challenged by the proliferation of increasingly sophisticated and diverse sensors, which will make it harder to maintain air superiority over any given area.

The Character and Functions of Military Airpower

The basic functions of military airpower have been apparent since at least the end of World War I and are likely to remain fairly unchanged, though the weapons and how those weapons are used will evolve.[2] Aircraft, missiles, one-way drones, and other airborne projectiles are used for long-range bombardment, attacking an enemy's ability to make war by striking targets located well behind the front lines, such as economic and national infrastructure. Airpower is also used to attack elements of an enemy's armed forces engaged in warfighting and to support joint operations across all domains. Additionally, airpower can provide surveillance and reconnaissance (e.g., scouting, one of the earliest proposed military uses for the airplane) and transportation capabilities.[3]

To provide for the command of the air—allowing one's own forces to use airpower for the aforementioned aims and preventing an adversary from doing so—the final basic function of military airpower is counterair operations.[4] All sides of the conflicts in Ukraine and the Middle East have used air power for long-range bombardment, support to military surface forces, surveillance and reconnaissance, and transportation, and have all engaged in counterair operations. Of these functions, airpower used for transportation has played only a minor role in both conflicts due to the compact geography of their zones of operation.

Adapting to Change: Lessons from Ukraine and the Middle East

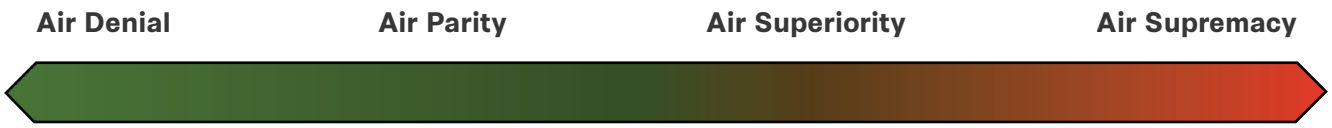
The conflicts in Ukraine and the Middle East provide a window into the evolution of military airpower and presage the rough outlines of the challenges and opportunities that will confront military planners in future air operations. Key observations relate to the role of modern counterair measures in obstructing the establishment and maintenance of air superiority, the increased use of uncrewed airborne systems, and the widespread disruptions to the use of radio frequency spectrum caused by effective electronic warfare measures. Though undoubtedly airpower will continue to evolve—during both peacetime and subsequent conflicts—these developments provide insights into how military airpower will be used in future wars.

Challenges to Achieving Air Superiority

Typically, air superiority, also sometimes called command of the air, has been viewed as a spectrum of balance between two opposing air forces. The U.S. Department of Defense (DOD) defines it as the "degree of dominance in the air battle by one force that permits the conduct of its operations at a given time and place without prohibitive interference from air and missile threats."[5] There is a range of relative airpower in any given conflict or arena. On one end is air denial—being denied the ability to operate in the air domain by an opposing force. Air parity is a situation in which neither side has control of the air and is "typified by fleeting, intensely contested battles at critical points," as defined by U.S. Air Force doctrine.[6] Next is air superiority, an advantage in the air domain that may still be contested by an opponent. Finally, air supremacy is the ultimate level of superiority, when one side is not capable of any resistance or interference to the opposing side's air operations.

Throughout the war in Ukraine, neither Ukrainian nor Russian forces have been able to establish a recognizable level of air superiority, though—as detailed more thoroughly in the following section—each side has been able to interfere with each other's air operations.[7] Neither side has demonstrated the means to disable or destroy the opposing side's integrated air defenses, resulting in a prolonged state of air parity. According to analysis by the CSIS Futures Lab, Russia launched over 11,000 missiles, one-way suicide drones, and other munitionized airborne systems into Ukraine from September 2022 to October 2024.[8] Though Ukrainian counterair operations have proven mostly effective, they have not been able to deny Russian forces the ability to launch air attacks.[9] Similarly,

Figure 10.1: Spectrum of Air Power



Note: The color shift from green to red reflects increasing control of the air domain.

Source: CSIS Defense and Security Department.

Russian air defenses have been able to down and disable many, but not all, Ukrainian drones aiming at targets inside Russia.[10] Ukraine's Operation Spider's Web, a radical departure from conventional thinking, however, introduced low-altitude munitionized airborne systems into an environment in which Russia had not deployed countermeasures and, in so doing, managed to circumvent Russian air defenses.[11]

In stark contrast to the situation in Ukraine, Israel has managed to establish an effective degree of air superiority throughout the surrounding region, defending the skies over Israel and showing that it can strike targets in Iran, Lebanon, and Syria without interference.[12] In October 2023, Hamas fired thousands of rockets and missiles at Israel—but nearly 90 percent of them were intercepted by Israel's air defenses.[13] In October 2024, Iran launched 170 drones, 30 cruise missiles, and 120 ballistic missiles at Israel. Of the entire barrage, all but a handful of the ballistic missiles were shot down.[14] But the overall intercept rate may obscure important nuances. Subsonic cruise missiles and one-way drones are almost all getting shot down, while supersonic cruise and ballistic missiles are much harder to intercept, even if they are still getting shot down in large numbers.[15] In addition to maintaining air superiority over Israel, Israeli forces have achieved that same feat over Iran; Israel arguably achieved total air supremacy over Iran by mid-June 2025. Israel used its command of the air to carry out sustained air attacks on Iranian military targets and laid the foundation for the U.S.-led Operation Midnight Hammer, which targeted Iranian nuclear facilities.[16] For both homeland defense and the projection of airpower, Israel achieved its air superiority by maximining the use of cutting-edge technologies, training, and tactics and, in the case of operations over Iran, spycraft and the element of surprise.[17]

Future conflicts may very well look like the one that has played out in the Middle East since late 2023. In that notional case, a technologically advanced, well-resourced, and well-trained force operating a layered air defense system would have a leg up on the opposing force. But pitting two peers who are roughly equivalent in terms of technology, resources, and training against each other might easily result in a conflict that looks more like the persistent state of air parity over Ukraine's skies. To gain superiority, each side in a future conflict will aim to disable or destroy its opponent's air defenses on both a sector-by-sector and a layer-by-layer basis, possibly through sheer numbers and mass—an approach Russia has tried in Ukraine without using enough mass to actually gain air superiority—or through attacks coming from unexpected directions that rely extensively on the element of surprise, as was the case in Operation Spider's Web. The effectiveness of attacks from unexpected directions was also demonstrated in Israel, for instance, when a lone Houthi drone came in from an unusual trajectory and was able to penetrate Israel's air defenses.[18] This also foreshadows the importance of keeping counterair defenses in the dark as long as possible, blinding kill chains to allow temporary access, and using decoys and deception—another lesson from Israel's operations in Iran and Ukraine's Operation Spider's Web, during which drones were transported undetected closer to their targets.

Proliferation of Uncrewed Systems

Unmanned aircraft systems (UASs) can be grouped into two main categories: systems intended for one-way, single-use munitionized applications (e.g., mis-

siles, rockets, guided bombs, loitering munitions, and kamikaze or suicide drones) and systems designed for return and reuse. Either type of system can be used for attack, surveillance, or transportation. Both types can be operated under the direct control of a human operator or use various degrees of autonomy to perform their operations. UASs designed for return and reuse can serve as carriers for one-way, single-use systems, such as one-way drones, missiles, or mines.[19] The conflicts in Ukraine and the Middle East have seen widespread use of both single-use systems and systems designed for return and reuse, as well as extensive use of counterair operations using integrated air defense systems. In these conflicts, one-way systems have primarily been used to deliver munitions, while reusable systems have been primarily used for intelligence and surveillance purposes.

Both Ukraine and Russia have relied heavily on the use of one-way systems during the conflict in Ukraine.[20] Since February 2022, Ukraine has been subjected to almost daily attacks by Russian airpower, primarily by one-way UASs.[21] These one-way weapons have conducted long-range bombardment of national infrastructure—including infrastructure that was primarily civilian in nature, such as power and energy facilities.[22] Small one-way drones have also been used to great effect against surface forces, like tanks and individual soldiers.[23] Many of the one-way drones used by both sides are based on mass-produced, inexpensive, commercially available models that have been retrofitted to carry a small munition. This approach has allowed the economical deployment of one-way munitionized drones on a vast scale and facilitated a trial-and-error approach to developing new drone systems and tactics.

Meanwhile, one-way drones—particularly drones manufactured by Iran—have been used extensively by Iran and the Houthis in the Middle East.[24] Hamas used a variety of one-way and reusable drones during its October 7, 2023, terrorist attacks on Israel, especially for targeting monitoring and communications systems and dropping munitions on tanks, soldiers, and emergency responders.[25] Israel has deployed a specific variant of one-way attack drone, usually called a loitering munition, which is designed to circle a designated area over a period of time, waiting for direction from a human operator or sensor-triggered action to strike its target.[26] Israel's Harpy drone is a loitering munition designed to detect and destroy air defense radars by homing in on radar signals. Iran's Shahed drone is another example of a loitering munition.[27] During the conflict in the Middle East, UASs have also been used for surveillance, not only by Israel and Iran but also by nonstate actors like Hezbollah.[28]

Based on their use and evolution in Ukraine and the Middle East, there can be little doubt that UASs will play significant roles in future conflicts. Drones will be manufactured and deployed on massive scales—Ukraine alone claims it can manufacture 2.5 million drones per year.[29] Whereas operations in Ukraine or the Middle East may have involved dozens or hundreds of UASs, future operations may include thousands of drones operating according to pre-programed instructions or under the control of a human operator or AI-enabled algorithm. Drones will be used for long-range bombardment, support to military surface forces, surveillance and reconnaissance, and transportation. Due to their cost-effectiveness, drones will also be used for counterair operations, with Ukrainian forces having already demonstrated the use of one-way drones for intercepting and destroying their hostile Russian counterparts.[30] Additionally, reusable loitering drones are likely to become more important, possibly as carriers for one-way attack drones or missiles.[31] Finally, as both Israel's operations in Iran and Operation Spider's Web demonstrate, the impact of munitionized drones increases when they can be conveyed—for example, by suitcase or truck—without detection into areas without specialized counter-drone defenses.[32]

Effectiveness of Electronic Warfare

The effectiveness of pervasive signal jamming in Ukraine as a tool of counterair operations has underlined that battlefield communications are fragile and easily disrupted. This has the potential of interfering with the ability of human operators to control uncrewed systems, including those operating in the air domain. Russian signal jamming in Ukraine has also impacted the reception of position, navigation,

and timing (PNT) signals received from GPS satellites, eroding the accuracy and effectiveness of missiles and drones that rely on GPS to find their targets. The architecture of proliferated satellite constellations has offered some protection against jamming, but Russia is increasingly successful at degrading Starlink service and has consistently been able to disrupt many other signals—like GPS and drone command and control links.[33]

Experts have been trying to enhance the jam resistance of weapons systems as part of the cat-and-mouse game between the jammers and the jammed, with each side racing to develop technologies that defeat the other's latest and greatest capabilities.[34] As a result, the ability to remotely command and control uncrewed systems and communicate with crewed ones can never be assured from mission to mission. It also means that it may not be possible to rely entirely on GPS or any signal-based PNT technology. In support of counterair operations, based on its effectiveness in Ukraine, electronic warfare—and electronic countermeasures—will feature prominently in future conflicts. The threats to signal-based positioning, navigation, and links used for timing and command and control communications emphasize the need for incorporating greater autonomous decisionmaking into UASs.

Anticipating the Future: Looking Over the Horizon

Though there are lessons for the future of airpower that can be directly gleaned from Ukraine and the Middle East, there are also trends that can be seen through a glass, darkly, with only the rough contours visible on the horizon. In the future, AI-enabled lethal autonomous weapons, which to date have not been extensively—if at all—used in combat, will play a main role. Such a development will lead over time—it is too early to say whether that time is measured in years or decades—to a decreasing need for human-piloted aircraft. The proliferation of sensors, and AI-enabled solutions making sense of that data at machine speeds, will make it more difficult for airborne systems to evade detection, leaving air platforms exposed to kill chains enabled by these technologies and making it harder to maintain air superiority.

The proliferation of sensors, and AI-enabled solutions making sense of that data at machine speeds, will make it more difficult for airborne systems to evade detection, leaving air platforms exposed to kill chains enabled by these technologies and making it harder to maintain air superiority.

AI-Enabled Autonomy

Automated decisionmaking for weapons that operate in the air and other domains is not a new concept. Heat-seeking missiles, mines, and torpedoes, as well as systems like the Phalanx radar-guided gun and Israel's Harpy drone, make lethal decisions autonomously, albeit following a very tight script that probably falls short of being considered artificial intelligence.[35] Though a magnetic underwater mine detonating is an automatic reaction to it coming near a metallic warship hull, the action—the "decision" made—looks more like the instincts of a closing Venus flytrap than human decisionmaking. AI-enabled solutions using machine learning, trained to make decisions like people, are the evolution of these "Venus flytrap" platforms.

The designers of these legacy weapons turned to autonomy for one of two reasons: a requirement to make sense of a situation and act faster than would be possible with a human in the loop, or a need to make a decision in the absence of human input. Looking to the future, airpower will rely on autonomous decisionmaking for these same two reasons—but unlike today, decisions with lethal consequences will be made by AI-enabled algorithms trained using machine learning. One new driver for this shift is the increasing effectiveness and impact of electronic warfare and its ability to sever the links between uncrewed machines and human operators. Another evolving driver is the availability and need to quickly make

sense of the deluge of data collected from a myriad of sensors monitoring the battlespace. The amount of data is already so enormous that it cannot be completely assessed at operationally relevant timescales using human input.[36]

There are interim solutions on the horizon that attempt to keep the human in the loop for UASs in highly jammed signal environments. In Ukraine, some operators have resorted to fiber-optic lines to maintain the ability to communicate with their drones.[37] This solution is unwieldy and will not scale to a future battlefield environment in which thousands if not millions of drones are operating together. The long-term response will involve implementing more AI-enabled autonomous decisionmaking in uncrewed aircraft, including decisionmaking that involves the use of deadly force. Defenses operating at machine speeds can deploy countermeasures much faster against hypersonic weapons and drone swarms than a system relying on human reaction times. The United States is already buying an AI-enabled counter-drone system—the Bullfrog robotic gun system—capable of fully autonomous operations.[38]

Though researchers have observed that AI-enabled decisionmaking cannot today replicate human judgment, AI-enabled problem solving will probably improve over time.[39] But exactly when that could happen is hard to predict. Until that point—when machines make as good as or better warfighting decisions than people—AI-enabled airborne systems will have to operate side-by-side with human pilots and crews. This creates challenges for both the human and machine, as each will struggle to operate most efficiently and effectively unless both sides learn how to predict and understand how the other side reacts in situations encountered on the battlefield.

Next-Generation Camouflage and the Element of Surprise

The conflicts in Ukraine and the Middle East have demonstrated the importance of early-warning and fire-control radars for detecting, tracking, and defeating airborne threats.[40] Today, air threat detection and tracking systems supporting long-, medium-, and short-range integrated air defense systems rely on radar.[41] In some applications, infrared seekers are used as guidance systems for missiles, which hone in on the heat or thermal signatures of their targets rather than their radar signatures. In addition to radar and infrared, other types of sensors play increasingly prominent detection and tracking roles, including acoustic, visual, and LiDAR-based sensor networks.[42] To date, these non-radar sensors have been primarily used in counterair point defense systems intended for defeating airborne threats in close proximity to their targets.

Due to the reliance on radar for all but close-proximity point defense systems, stealth technology has enabled strikes against a wide range of important and presumably well-defended military targets by Israel in Iran and Syria, such as during Operation Midnight Hammer. While terrestrial radar will likely continue playing a central role to enable kill chains for airborne targets, space-based systems, including electro-optical sensors, will begin to serve similar purposes. Future space-based sensor webs will be able to detect, identify, and track objects in real-time using a combination of phenomenologies beyond just radar.[43] This will pose a challenge to stealth aircraft trying to avoid detection by an adversary's air defenses: Though designed to avoid detection by radar, stealth aircraft can certainly be seen by the naked eye and, thus, are susceptible to optical space-based sensors.

It is not difficult to imagine a time in the near future when every point on the globe is observable by a space-based sensor at all times, with no break in coverage. This can be achieved by a constellation of satellites in lower Earth orbits or by a series of high-resolution satellites in geostationary orbits. Notably, China has already deployed a number of electro-optical satellites in geostationary orbit.[44] The United States is investigating the use of satellites for tracking targets in the air.[45] Pairing data from space-based sensors with AI-enabled processing will produce systems capable of identifying and tracking aircraft, including those using stealth technologies.

Challenging the efficacy of traditional stealth will challenge the ability of air forces that rely on it to secure and maintain air superiority. However, new uses of electro-optical space-based sensors in kill

chains do not foreshadow the obsolescence of stealth technology. Because radar can see through weather phenomena (such as clouds) that render electro-optical sensors less effective, radar will likely retain its critical place in integrated air defense detection and tracking architectures. But stealth platforms will have to operate in environments in which optical sensors play a greater role in kill chains. This development will require improved tactics—perhaps flying most sorties when there is cloud cover or inventing new types of high-tech camouflage that can hide aircraft from space-based optical sensors.[46]

Future conflicts may see greater use of the undersea domain to deploy airpower, as undersea systems offer unique opportunities for stealth and surprise. Because submarines can be designed to minimize their detectability, crewed and uncrewed submarines may see greater use as platforms from which drones are deployed, aiming to reduce the time air defense systems have to identify, acquire, track, and neutralize hostile airborne targets. Just like suitcases and trucks were used by Israel and Ukraine in June 2025 to smuggle drones closer to their intended targets, undersea systems may be used for a similar effect in future wars.

Conclusion

The contribution of airpower to future wars will be shaped by the evolution and use of technologies and tactics that have appeared on the battlefield in Ukraine and the Middle East. That future will see greater use of uncrewed systems, AI-enabled lethal autonomous weapon systems, and improved camouflage technologies masking radar, thermal, sound, and—possibly—visual signatures. These technologies and the evolving tactics for deploying them, such as AI-enabled systems working side-by-side with humans, will be required to operate under the shadow of ever more sophisticated counterair capabilities.

The goal will be to provide sufficient command of the air to execute core military airpower functions. This is unlikely to mean total air supremacy—but Israel has shown that it is still possible to obtain and maintain near-total control of the skies in certain circumstances. However, command of the air will probably be a balancing act, perhaps a temporary one, on the edge of a razor—air superiority may be ephemeral or something that is never fully achievable. Ultimately, there is probably a lot that cannot be foreseen about the future of military airpower based on lessons from today. It is worth keeping in mind the advice of the father of the U.S. Air Force, Billy Mitchell, who opined: "in the development of airpower one has to look ahead and not backward and figure out what is going to happen, not too much what has happened."[47]

CHAPTER 11

The Future of Seapower

Mark F. Cancian

> **Having a variety of naval capabilities available facilitates a response even if the tools are not initially available in the desired quantity. Expanding an existing capability is much easier than developing a new one in the crucible of conflict.**

The conflicts in Ukraine and the Middle East present the best opportunity to assess wartime naval operations since the 1982 Falklands War. Nothing is simulated, operations include all of the messiness of the real world, and difficulties cannot be assumed away as they can in peacetime exercises. Although maritime operations in these conflicts have had secondary—or even tertiary—importance after the ground and air campaigns, the experience they provide merits close analysis, as it can offer valuable insights about the future of seapower.

In parallel with these conflicts, analysis of a hypothetical U.S.-China conflict over Taiwan has suggested how a modern air and naval campaign might unfold (discussed further below). While these assessments lack the authority of actual operations, they complement insights derived from the current wars.

This chapter discusses five questions that arise from these conflicts and analyses:

1. Are surface ships viable in high-intensity conflict?
2. Do aircraft carriers still have a role?
3. What is the future role of uncrewed naval systems?
4. Why have Russia's Black Sea submarines not had more impact?
5. Can inventories of naval munitions ever be adequate?

The discussion of each question contains a summary of wartime experience and ends with insights into how navies can adapt to the new maritime environment. Because current data is imperfect and not necessarily indicative of a war between great powers, each discussion also includes indicators that can show where naval combat may be headed.

The Viability of Surface Ships in High-Intensity Conflict

Ukraine has achieved extraordinary naval success in its war with Russia.[1] Without the conventional attributes of a navy—ships and land-based aircraft—it has sunk or destroyed eight major Russian surface ships and one

PHOTO: PAVLO BAHMUT/UKRINFORM/FUTURE PUBLISHING/GETTY IMAGES

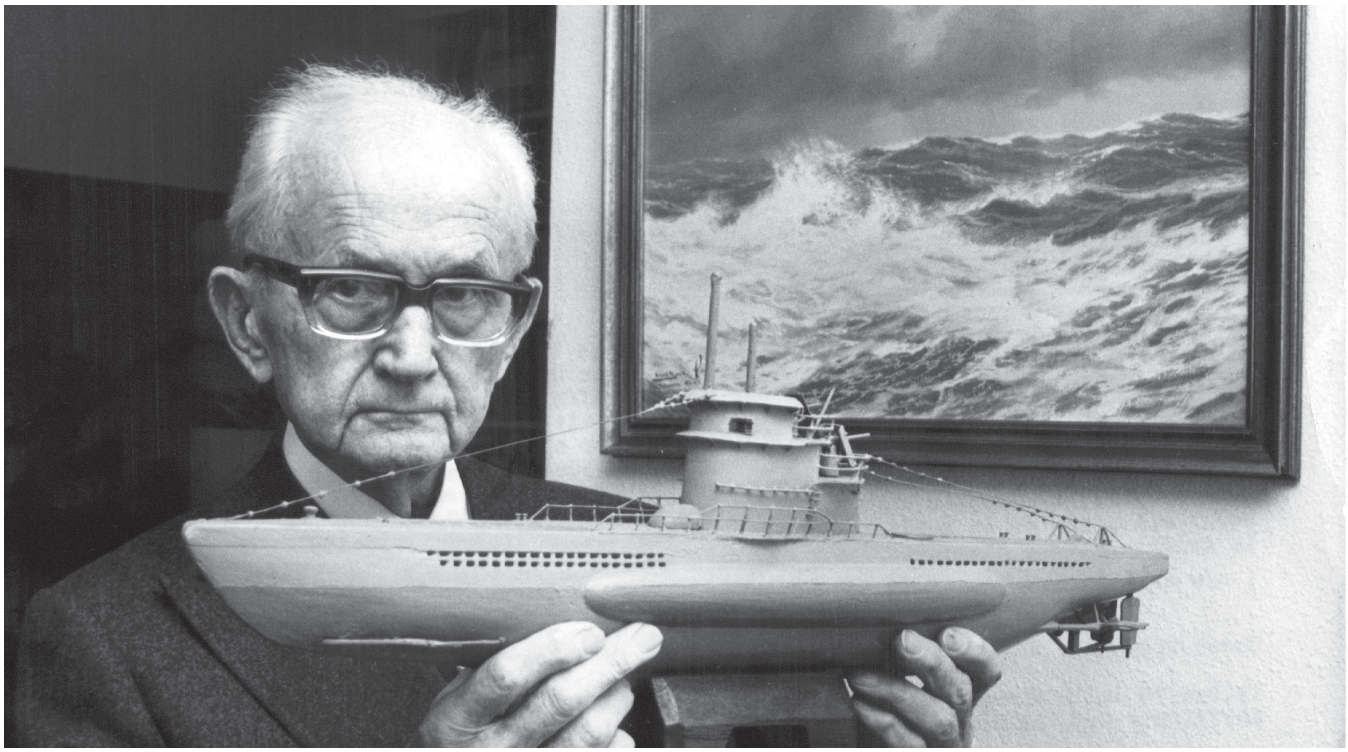
submarine, pushed Russian naval forces out of Russia's forward naval base at Sevastopol, and contested the entire Black Sea. This success particularly raises the question of the future viability of surface ships.

Wartime Experience

Ukraine's sinking of the Russian battlecruiser *Moskva* by long-range antiship missiles launched from the shore shocked Russia and the world. Nor was this an isolated event: Other Russian surface ships have fallen victim to one-way ("suicide") drones (two ships destroyed) and long-range surface-to-surface missiles (six ships destroyed).[2]

Wargames by CSIS, the Center for Strategic and Budgetary Assessments, the Hudson Institute, and the International Institute for Strategic Studies have questioned the survivability of surface ships in a great power conflict against China, especially large surface combatants (LSCs), the multibillion-dollar destroyers and cruisers that have been the backbone of fleets since World War II.[3] Volleys of Chinese missiles can overwhelm ship defenses and push surface ships back hundreds of miles to seek safety until Chinese missile inventories are depleted. Perhaps naval warfare has reached the state envisioned by Admiral Karl Dönitz, the head of Nazi Germany's fleet during World War II. Dönitz had a painting in his office entitled "The Fleet in 1955" (see below). It showed an empty ocean, reflecting his belief that submarines would become so dominant that surface ships would be rendered obsolete. That did not happen in 1955, but has it happened in 2025 because of antiship missiles?[4]

While Russian naval losses might suggest that for high-end conflicts, U.S. LSCs have nonetheless been valuable in the Red Sea and Gaza operations. Positioned in the Red Sea and Eastern Mediterranean, these ships have had 400 engagements with Houthi missiles. No missiles hit the warships, few hit Israel, and maritime traffic continued through the Red Sea, though at a reduced level. The ships' missile defenses were highly effective against the small missile volleys that the Houthis could launch. While this success is encouraging, it is not determinative; the ships remain untested against the volume of fire that a great power such as China could employ.



Admiral Karl Dönitz shown with the painting "The Fleet in 1955" in his home in December 1974.

Photo: Werner Baum/picture alliance/Getty Images

Adapting to the New Environment

Given this uncertainty, the U.S. Navy appears to be hedging its bets. The current fleet has 85 LSCs in a total fleet of 293.[5] This is far below the 104 LSC goal in the 355-ship Navy called for by the first Trump administration.[6] However, it roughly equals the 87 LSC goal in the Navy's 2023 381-ship fleet plan. Thus, between 2016 and 2023, the overall fleet plan increased by 7 percent, but the goal for LSCs decreased by 8 percent, reflecting this concern about LSC survivability. The U.S. Navy's alternative shipbuilding plan for FY 2025 further sacrificed surface fleet numbers to reduce shipbuilding costs, projecting a gradual decline in LSCs to 70 total.[7] Extrapolating these long-term plans produces an even lower projection for LSCs: The plan envisions a 1-2-1-2-1 building profile (i.e., three ships every two years) for the late 2030s.[8] With an expected LSC service life of 35 years, that equates to a long-term inventory of 53 vessels.[9]

The recent reconciliation bill ("One Big Beautiful Bill") developed by Congress and signed by the president added two destroyers, indicating some support for LSCs if funding were available.[10]

China's Navy—the People's Liberation Army Navy (PLAN)—has taken the opposite approach, building a large fleet of LSCs now numbering more than 100.[11] Where the United States builds two to three LSCs per year, China builds five.[12] Although China has made advances in uncrewed systems, the PLAN has prioritized building LSCs for its near-seas defense.[13]

Looking Ahead

An event showing high surface ship vulnerability, which is already widely discussed, would push many navies to reconsider their LSC programs. Alternatively, a revival could occur, driven by uncrewed surface vessels (USVs) equipped with sensors. These USVs would act as scouts, thereby reducing the vulnerability of surface ships. Regardless, ships need a lot of sea room to survive. The days of fleets standing close off a hostile shore are gone.

The Future Role of Aircraft Carriers

If LSCs struggle to survive in modern naval combat, aircraft carriers—the apex surface combatants—would be even more threatened. This is a perennial debate, having gone on for 50 years. It affects the U.S. Navy the most, as it operates 11 aircraft carriers, but eight other countries have invested in carriers: China (3), the United Kingdom (2), India (2), Italy (2), Japan (2), France (1), Spain (1), and Turkey (1).

Wartime Experience

Unfortunately, current events provide little insight into the role of aircraft carriers in combat between highly capable opponents. Russia's sole carrier has not participated in the Ukraine war. The sinking of the *Moskva*, an old battlecruiser without escorts, does not provide a sufficient example of what might happen to a modern aircraft carrier with its air wing and escorts. Events in the Eastern Mediterranean reinforce historical experience. U.S. carriers have conducted many missions to intercept Iranian and Houthi missiles. Missile threats did not force them to retreat. However, the carriers did not face the massive missile salvos that Russia or China could launch.

The debate on aircraft carriers might fade into the background, except that recent wargaming has also raised questions about aircraft carrier survivability. China's massive missile inventories could overwhelm carrier air defenses, and its fleet of 65 submarines might penetrate a carrier's defensive screen. Wargames alone are unlikely to change naval attitudes toward carriers, but they have kept the question on the table. And the matter of carrier cost is always present.[14] Nuclear carriers cost about $13 billion each, plus $8 billion for the air wing and another $8 billion for escorts. Helicopter and short-takeoff carriers cost about half that.

On the other hand, carriers show their usefulness every day for crisis response, regional conflicts, and deterrence. (For a more detailed description of this debate, see the carrier discussion in the 2022 CSIS report on military forces.[15]) U.S. carriers have been in constant demand and routinely conduct real-world missions. The same is true for other countries. Since 2014, UK and French aircraft carriers have launched airstrikes against ISIS targets in Iraq and Syria as part of an international coalition.[16] Carriers also played a key role in enforcing the NATO no-fly zone during the Libyan Civil War.[17]

As a result, the number of nations operating aircraft carriers has not changed. There are nine today, and there were nine 50 years ago in 1975 (Argentina, Australia, Brazil, France, India, Spain, the United Kingdom, the United States, and the Soviet Union). What has changed is that some medium powers have dropped out (Argentina, Australia, and Brazil), while some rising powers have joined the group (China and Turkey), as has Italy, a reviving naval power.[18]

Table 11.1: Navies with Aircraft Carriers, 1975 and 2025

1975	2025
Argentina	China
Australia	Italy
Brazil	Turkey
France	France
India	India
Spain	Spain
United Kingdom	United Kingdom
United States	United States
Soviet Union	Russia

Source: John Moore, *Jane's Fighting Ships 1975-76* (New York: Jane's Publishing, 1975); and Janes, *Janes Fighting Ships 2025-2026* (New York: Jane's Publishing, 1975), https://shop.janes.com/fighting-ships-25-26-yearbook-6541-3000250021.

Adapting to the New Environment

Aircraft carrier usefulness for regional conflicts and crisis response, coupled with the maritime prestige they bring, will keep them in the world's navies going forward. For most countries, cost and naval budgets will drive carrier construction decisions more than theory.

The U.S. Navy is doing what it did before World War II: pursuing all options until an answer is clear. In the 1930s, that meant maintaining both battleships and aircraft carriers. Today, it means sustaining aircraft carriers as well as potential replacements such as ground-based missiles, long-range aircraft equipped with antiship missiles, uncrewed systems, and submarines. Interestingly, the reconciliation bill does not provide any money for aircraft carriers despite having $29 billion for shipbuilding overall.

All countries face an additional influence in designing naval forces: the need to maintain a viable shipbuilding industrial base. For the U.S. Navy, that requirement has sometimes driven it to consider unwise policies, such as building more nuclear aircraft carriers, to satisfy the shipbuilding industry, but retiring older carriers early to satisfy critics. This increases the amortized cost of an aircraft carrier from $220 million per year to $370 million.[19] Other navies with carriers face similar pressures, as carriers represent the largest naval ship they build. All countries should remember that shipbuilding industrial bases exist to put strategically useful ships to sea, not to maintain themselves.

Looking Ahead

Eventually, the debate will be resolved; a high-intensity conflict will occur, and carriers will either show their survivability and value or be so severely damaged that their limited utility becomes evident. Resolution could happen tomorrow, or it might not happen for decades. Until then, expect continuing debate.

Eventually, the debate will be resolved; a high-intensity conflict will occur, and carriers will either show their survivability and value or be so severely damaged that their limited utility becomes evident.

The Future Role of Uncrewed Naval Systems

The rise of uncrewed systems in the Ukraine war is a major change from earlier wars and a recurring theme throughout this volume. The experience at sea has been particularly dramatic.

Wartime Experience

The use of small USVs has been a tremendous and unexpected Ukrainian success in operations against Russian forces. As noted earlier, Ukrainian USVs sank two major warships and half a dozen small vessels, while damaging several others. Controlled remotely and laden with explosives, Ukrainian USVs traveled far offshore (200–400 miles) to detonate against Russian targets. These attacks helped drive the Russian fleet from Sevastopol to the Russian naval base at Novorossiysk, 300 miles east.

These successes occurred in favorable circumstances. Ukraine had excellent intelligence on Russian dispositions; the Russian ships must spend most of their time at anchor in known ports because of the Black Sea's confines, and the distances are relatively short. Further, despite excitement about how USVs have revolutionized naval warfare, most Russian naval losses have been to long-range precision missiles against stationary ships in port, not surface drones. USV use in warfare is just beginning.

Adapting to the New Environment

Many navies face the problem of operating inside an adversary's defensive zone. Surface ships have difficulty doing that, but uncrewed systems—which are smaller, cheaper, and more expendable—could. The favorable circumstances that Ukraine enjoys for employing USVs describe the environment that most navies face. NATO navies, for example, are only a short distance from Russian ports, enjoy excellent reconnaissance, and have lots of time to prepare. This presents NATO navies with an opportunity.

One could imagine countries adapting existing systems, as Ukraine has done, to strike their adversary's vessels in port. As an illustration, a CSIS report, *Inflicting Surprise: Gaining Competitive Advantage in Great Power Conflicts*, imagined a surprise strike by U.S. autonomous underwater vessels against Russian ships of the Northern Fleet.[20]

The circumstances also apply to navies in the Pacific, with the important exception of the United States. The Philippines is next to the South China Sea, a region of great tension and possible future conflict. South Korean naval bases are only 100 miles from North Korean bases. Japan's Kure naval base is about 650 miles from the Chinese naval base at Shanghai. All could conduct USV attacks on their adversaries or similar attacks with uncrewed underwater vessels (UUVs).

A U.S. naval drone strike against Chinese ships would be more difficult because of the much longer distances. Guam, the closest base to China in U.S. territory, is 2,000 miles away. The United States would need to arrange close-in basing with an ally or partner.

However, one-way naval drones are an entirely different approach to uncrewed vessels than most countries have taken. The U.S. Navy has no programs for one-way naval drones, at least in the unclassified space. USVs in development have focused on long-range shooting and sensing, not one-way attacks. The primary U.S. Navy program for UUVs with strike capability is the Orca, designed for reconnaissance and mine-laying operations. The U.S. Navy has ordered six vessels (one test article and five prototypes), but only one prototype is in testing, delayed by years of technical difficulties.[21] At $110 million each, they are too expensive for a one-way mission.[22] U.S. Navy shipbuilding plans envision hundreds of USVs and UUVs in the fleet, but budgets do not yet reflect that. No USV or UUV is a program of record (a formal acquisition program with funds allocated and building plans specified in future budgets).[23]

The reconciliation bill makes a big bet on uncrewed and autonomous systems, adding $16.6 billion overall (11 percent of the defense increases). Of this amount, about one third ($5.3 billion) goes to Navy programs. This represents a substantial investment and a strong congressional statement about where increased efforts are needed.

Other navies are taking similar initiatives, though with access to fewer resources. The UK and French navies both have UUV programs underway that focus on minesweeping and intelligence, surveillance, and reconnaissance. The Royal Navy will begin trials for a crewless submarine in June 2025 as part of Project Cetus.[24] In 2024, France announced a program to develop the first UUV specifically designated for combat operations.[25] All are moving more slowly than Ukraine.

Navies also face the prospect of being attacked by such systems, which are available to weak states and nonstate actors as well as major powers. As Russia has discovered, a navy's greatest vulnerability is in port when ships are stationary for an extended period and an adversary can execute a strike that requires time to plan and execute. The U.S. Navy experienced this with the terrorist attack on the USS *Cole* in 2000; that short-range attack by suicide bombers badly damaged the ship and killed 17 sailors.[26] The proximity of NATO and Pacific navies to their adversaries, therefore, creates vulnerability as well as opportunity.

Naval anchorages have not faced long-range naval threats since World War II. Then, Japanese mini-submarines attacked anchorages at Pearl Harbor, Sydney, Australia, and Ulithi Atoll, the last two attacks being successful in sinking a ship.[27] Italian mini-submarines attacked the British anchorage at Alexandria, Egypt, sinking two battleships. The German U-47, under its celebrated captain, Gunther Prien, snuck into the Royal Navy's anchorage at Scapa Flow and sank a battleship. Navies face a "back to the future" moment.

Thus, navies will need to defend against USV and UUV attacks by hardening anchorages, a precaution that has been unnecessary since World War II. After both the *Cole* and 9/11 attacks, the U.S. Navy implemented new force protection procedures. These will need some expansion to deal with this new kind of threat—and better to do the next round of enhancements before an incident occurs. However, countermeasures cannot be too expensive, given all the other demands on naval budgets, or too intrusive, given the need for continuous naval operations.

Looking Ahead

Watch for future attacks against ships at anchor. Theoretical threats may drive some action, but a successful attack outside the Black Sea would galvanize the target navy and provide another alert to global navies.

The Small Impact of Russia's Black Sea Submarines

This is the dog that did not bark.[28] Submarines are regarded as the ultimate weapon in naval combat because of their stealth and lethality. Since the end of the Cold War, Russia has prioritized its submarine fleet at the expense of other naval capabilities like surface ships. Submarines have had a major impact on U.S. Pacific wargames, prompting the United States to invest billions of dollars in shipyards to accelerate production. Before the *Moskva*, the last major surface combatant sunk in conflict was the Argentine cruiser *Belgrano*, torpedoed by the UK submarine *Conqueror* during the 1982 Falklands War.

Wartime Experience

At the beginning of the war, the six relatively modern Kilo-class submarines in Russia's Black Sea fleet were expected to have a major impact. Yet, these submarines have been largely invisible, and not simply because they were submerged. There are no references to any operations they have conducted. Indeed, the most prominent mention of Russian submarines has been the loss of one, which was struck in dry dock by long-range Ukrainian missiles.

The answer may simply be a lack of targets. Ukraine has no major naval vessels, and Russia has been unwilling to use submarines to attack grain-laden cargo ships. Perhaps their mission was to keep NATO forces out of the Black Sea, and in that, they succeeded. Still, the lack of activity is curious.

Adapting to the New Environment

This lack of submarine impact will not alter anything in the U.S. shipbuilding plan for submarines, which is currently driven by expectations about a U.S.-China conflict in the Western Pacific. Submarines' stealth enables them to penetrate China's defensive bubble, where surface ships and even aircraft cannot go.

NATO navies are also unlikely to change their plans for submarines because they are largely driven by the Russian submarine fleet. That fleet has become more active in the last decade, having recovered from its post–Cold War doldrums. The current wars have not shed any light on submarine-versus-submarine conflict.

Other maritime powers and many minor powers will maintain their submarine fleets because it is the only way they can enter the major leagues of naval power. Submarines allow even a minor power to

threaten an adversary's largest warships and merchant fleet. This is unlikely to change.

Looking Ahead

Watch for the composition of Russia's postwar Black Sea fleet. If Russia withdraws its submarines from the Black Sea, that represents its assessment that the submarines' contribution was insufficient and that this asset would be better used in one of the other fleets—Northern, Baltic, or Pacific. If the submarines remain, the assessment is that submarines were Russia's ace in the hole. In either case, Russia's assessment will help the West better understand wartime submarine operations in the twenty-first century.

The Adequacy of Naval Munitions Inventories

Ships fire a lot of munitions in combat. Although this indicates a requirement for large inventories, the high cost of munitions prevents navies from stockpiling everything they might need in a protracted conflict.

Wartime experience.

U.S. operations in the Red Sea against Houthi missiles expended 200 missiles over 15 months, in addition to cannon rounds.[29] This has dented U.S. inventories and raised concerns about their adequacy for a major conflict. For example, 180 of these missiles were SM-2s or their replacement, SM-6s. In past years, the U.S. Navy has procured 125 missiles per year.[30] That means that one limited series of engagements expended a year and a half of missile production.

Ukraine's air war has shown the same dynamic. Attacks by cruise missiles and one-way drones have required large numbers of air defense missiles in response, overwhelming the limited inventories of the United States and NATO.

A series of CSIS wargames found that in a conflict with China, the United States ran out of Long-Range Anti-Ship Missiles (LRASMs) within the first week—often within the first several days.[31] A later CSIS analysis, *Empty Bins in a Wartime Environment*, described munitions shortfalls in many areas.[32] Indeed, many analyses have identified inadequate munitions inventories as a major weakness.[33]

Looking further back in history, the Royal Navy expended over 200 antisubmarine weapons to counter the single Argentine submarine at sea during the 1982 Falklands War. Despite this immense expenditure, the submarine was not damaged.[34] Whether the Royal Navy was trigger-happy, unlucky, or saddled with ineffective munitions, the high rate of expenditure was—and still is—worrisome.

The need for larger inventories of naval and other munitions is, therefore, old news. The U.S. Department of Defense got the message and has increased its production of nearly every type of missile. For example, production of SM-6s will increase from 125 to 300 per year by 2027, while production of LRASMs will increase from about 100 to 230 per year in 2027 (total Navy and Air Force procurement).[35] NATO navies are also expanding their inventories of naval munitions.[36]

That is an important step forward and will strengthen the joint force's capabilities to fight in high-intensity conflicts. However, U.S. forces in the CSIS wargame fired about 100 LRASMs per day, so the expanded inventories would last longer in a conflict but not beyond several weeks. It is difficult to build large inventories of expensive weapons ($4.4 million for an SM-6, $3.5 million for a LRASM) with limited shelf lives (about 20 years).[37] Ultimately, this is an unsolved problem.

Adapting to the New Environment

It is reasonable for all navies to build larger munitions inventories despite the high cost. Nearly all wars last longer than planners expect. Nevertheless, militaries must find affordable solutions to the missile inventory challenge because they cannot build inventories large enough for a protracted conflict. Solutions might include less expensive missiles or different technologies, such as directed energy.

Looking Ahead

Watch munition procurement levels when the war in Ukraine ends. Although the war in Ukraine does not drive U.S. or NATO demands for naval missiles, the end of that war may undermine the urgency of building stockpiles in general. This has been an industry concern, partly offset by multiyear contracts, which lock in future production.

The fundamental problem is that munitions struggle to compete in peacetime budget debates. Although vital in protracted conflict, they are a "sterile" investment: Investments in ships, aircraft, and combat vehicles are visible over the decades of their operational lives. Munitions go into secure bunkers, never to be seen again until they are expended or demilitarized.

Conclusion

Naval analysts should not extrapolate too much from recent events in the wars in Ukraine and the Middle East, since naval activity was limited and ancillary to the primary campaign on land. Nevertheless, some insights are clear enough to implement now: expanding munitions inventories, accelerating the development and production of uncrewed systems, and hedging on major surface combatants.

There are also many things to watch for as indicators for additional action. These recognize the uncertainty of projecting limited current experiences into the future, but acknowledging possible futures is the first step in adapting to them. Having thought through a problem ahead of time facilitates a response. Thus, it is worthwhile to spend time thinking about responses to different futures.

Finally, having a variety of naval capabilities available facilitates a response even if the tools are not initially available in the desired quantity. Expanding an existing capability is much easier than developing a new one in the crucible of conflict. Because expansion is easier than introduction, having a variety of capabilities already at hand provides a better hedge against an uncertain future.

CHAPTER 12

The Evolution of Irregular Warfare

Daniel Byman, Seth G. Jones, and Sofia Triana

U.S. and allied planning, posture, and doctrine must prepare for irregular warfare, incorporating the impact of civilians and recognizing the vital roles of special operations forces and intelligence services in conflict.

The wars in Ukraine and the Middle East offer many lessons for better understanding, conducting, and countering irregular warfare.[1] On October 7, 2023, the Hamas attack on Israel combined attacks on Israeli military bases near Gaza, border security infrastructure, and military communications equipment with atrocities against Israeli civilians and the taking of civilian hostages. Russia, for its part, accompanied its February 2022 invasion of Ukraine with cyberattacks, attempts to kill President Volodymyr Zelensky, and a deepfake in March 2022 to try to encourage Ukraine's surrender. Ukraine has used guerrilla attacks, sabotage, and leadership assassinations to fight Moscow. Some combination of these and other forms of irregular warfare is likely in future conflicts.

Drawing on the lessons from the Ukraine and Middle East wars, this chapter makes the following arguments about irregular warfare:

1. Irregular warfare often occurs as a prelude to, or side-by-side with, regular warfare and can inflict many casualties, undermine resilience, and raise the price of occupation.
2. Civilians are often at the heart of irregular warfare—as shields, as victims, and as targets of coercion—and governments must consider this when confronting opponents who use irregular warfare and in their own irregular warfare operations.
3. Intelligence is critical to counter irregular warfare, as Israel's successes show, and in general an effective response can limit the coercive power of irregular warfare.

U.S. and allied planning, posture, and doctrine must prepare for irregular warfare, incorporating the impact of civilians and recognizing the vital roles of special operations forces (SOF) and intelligence services in conflict. This, in turn, will require adaptation, including recognizing differences between irregular warfare involving great powers (as compared with past U.S. efforts against weaker insurgencies and terrorist groups) and ensuring that private

PHOTO: MOHAMMED HUWAIS/AFP/GETTY IMAGES

sector technology and expertise are incorporated into U.S. efforts.

This chapter has three sections. The first section notes several lessons from the Ukraine and Middle East wars; the second examines Israeli and Ukrainian successes regarding irregular warfare; and the third discusses the implications of these lessons for the future of warfare.

Lessons from Ukraine and the Middle East

The experiences of Ukraine and the Middle East offer many lessons on how to think about irregular warfare now and in the future. First, irregular warfare often occurs side by side with conventional warfare, and it is necessary to prepare for the two happening simultaneously as well as in isolation. Second, the death toll and other costs of irregular warfare can be high, especially for enduring conflicts. Third, hostage taking, terrorism, assassination, and other means of conducting and fighting irregular warfare are often part of broader efforts to coerce and deter opponents.

Irregular and Conventional Warfare in Tandem

In both the Ukraine and Middle East wars, irregular warfare has occurred simultaneously with regular warfare. In parts of Ukraine occupied by Russia, Ukrainian partisans, directed by Ukrainian special operations forces, used guerrilla attacks to kill Russian forces, disrupt lines of supply and communication, and sabotage Russian weapons systems. These efforts disrupted the flow of military supplies and forced the Kremlin to divert resources from the front lines to the repair and defense of its rail infrastructure instead, placing additional strain on an already struggling railroad network. Ukrainians have also used nonviolent resistance, such as wearing yellow ribbons in solidarity and distributing information to counter Russian propaganda.[2] Overall, Ukraine's efforts have hindered the movement of Russian troops and created supply bottlenecks.[3] More importantly, they have also prevented Russia from successfully incorporating captured Ukrainian territory into Russia. The cost for Ukrainian civilians is high: The United Nations reports over 12,000 civilians have died so far, including many in territory occupied by Russia.[4]

Ukraine has also targeted Russian warships in the Baltic Sea as well as railway networks, blowing up the Sveromuysky tunnel in eastern Russia and damaging a critical railway bridge near the city of Kinel. In the case of the Sveromuysky tunnel attack, Ukraine's Security Service reportedly sabotaged a train's fuel tank, causing it to catch fire as it moved through the tunnel. Other trains scheduled to go through the tunnel were then rerouted to a bridge where they were damaged as explosive devices planted along the alternate route promptly detonated.[5]

In the Middle East, some groups, like the Lebanese Hezbollah, have integrated irregular approaches to warfare into their order of battle and military doctrine. Hezbollah has long fought Israel with rocket and missile strikes, guerrilla warfare, and terrorist attacks, and it has also trained groups—like Hamas—that have a similar set of capabilities, if less powerful. Israel, which has mostly fought a conventional war against its opponents, nonetheless has mixed a conventional invasion of Gaza with leadership strikes on Hamas throughout the Middle East and Hezbollah in Lebanon.

The High Cost of Irregular Warfare

Irregular warfare is often considered a weapon of the weak, yet it can still inflict considerable costs on a strong opponent. Hamas was undeterred by Israel's military superiority and killed around 1,200 Israelis—mostly civilians—on October 7, inflicting an extremely high number of casualties on a small and casualty-sensitive country. Over 400 more Israeli soldiers have died in subsequent combat in Gaza, where Hamas has used hit-and-run attacks, improvised explosive devices (IEDs), and other indirect means to inflict casualties while avoiding a direct confrontation with the better-armed and better-trained Israel Defense Forces (IDF).[6] The ensuing conflagration has similarly led to the deaths of some 60,000 Palestinians, further illustrating the high costs of irregular warfare. In addition to the death toll in the Gaza war, the Hamas attacks pushed Israel into war not only in Gaza but also in Lebanon and Yemen.

Such irregular warfare measures have raised the price of occupation. Fighting insurgents, especially in densely populated areas like Gaza, requires a grinding counterinsurgency with high force levels. For the Gaza war and other Middle East conflicts, Israel mobilized some 360,000 reservists.[7] As of August 2025, Israel has conducted a 22-month war to suppress Hamas, yet the group remains the strongest organization in Gaza. Similarly, Russia has not fully pacified the territory it occupies.[8]

Irregular Warfare as a Tool of Coercion and Deterrence

The threat of irregular warfare can also be used in attempts to coerce and deter. Iran, for example, relies heavily on Hezbollah and other proxy groups to impose costs on Israel, the United States, and its Arab enemies. The threat of Hezbollah rocket and terrorist attacks was in part meant to deter Israeli operations against Iran itself. In addition, Iran-backed groups like the Houthis attacked Red Sea shipping to coerce Israel into ending its war in Gaza. Russia has also engaged in a comprehensive campaign of sabotage in Europe to punish countries that supported Ukraine and limit future support. Moscow's increasingly brazen attacks have included jamming GPS systems to disrupt civil aviation, causing deliberate damage to undersea gas pipelines and telecommunications cables, sabotaging water utilities in Poland and France, and conducting arson attacks in the United Kingdom, Czech Republic, Germany, Lithuania, and Latvia.[9] Russia has also targeted facilities with more direct links to the war in Ukraine, including a BAE Systems munitions factory in Wales and a U.S. military base in Bavaria.[10]

Hostage taking has proved an important part of both the Gaza and Ukraine wars. In Gaza, Hamas and other Palestinian groups initially took 251 hostages—including children, the elderly, and other noncombatants as well as many non-Israelis—and, as of August 2025, around 50 are still in captivity, although more than half of these are presumed dead. The presence of hostages has complicated Israeli targeting and offered a form of protection for Hamas leaders. In occupied Ukraine, Russia has engaged in forced deportations of almost 20,000 children to Russia, placing them with Russian families and refusing to return them to their Ukrainian relatives.[11]

In part because irregular forces hide among civilians, countering irregular warfare can involve considerable death and suffering in the civilian population. Hamas fighters have blended in with Gazan civilians and hidden arms and fighters in civilian infrastructure, such as hospitals and schools. Israel's response has been devastating for ordinary Gazans, with over 60,000 Gazans killed in total as of August 2025, most of them civilians, as well as most of Gaza's infrastructure destroyed. Operations that involve numerous civilian casualties place an additional burden on democracies, which are more likely to receive criticism when their military operations involve civilian deaths.

Israel has devastated Hamas and Hezbollah through assassinations, and both Russia and Ukraine have used assassinations as well. Although Ukrainian authorities rarely claim responsibility for their covert actions, they have carried out high-profile assassinations in occupied Ukrainian territories as well as on Russian soil. Among the individuals successfully targeted by Kyiv are Vladlen Tatarsky, a Russian military blogger; Igor Kirillov, the chief of Russia's radioactive, chemical, and biological defense forces; and Illya Kyva, a pro-Russia former Ukrainian member of parliament who fled to Russia during the war. Ukraine has also targeted leaders in occupied Ukraine who collaborated with Russia.[12] Moscow, for its part, has also undertaken a broad campaign of targeted assassinations in Ukraine and across Europe, poisoning the wife of Ukraine's military intelligence chief, killing a senior Ukrainian covert action leader, plotting to assassinate the chief executive of German arms maker Rheinmetall, and gunning down a Russian military defector in Spain.[13]

Countering Irregular Warfare

Although irregular warfare is difficult to combat, both Israel and Ukraine have scored many victories. The Lebanese Hezbollah, one of the world's premier guerrilla organizations and one that fought Israel to a standstill in their last all-out clash in 2006, largely failed in its use of irregular warfare against Israel and ended up

taking tremendous losses. Israeli intelligence deeply penetrated Hezbollah, sabotaging its pagers and walkie-talkies and gaining precise information on the locations of Hezbollah leaders. With this intelligence, Israel was able to decimate Hezbollah's senior leadership, including killing the group's longtime secretary general, Hassan Nasrallah, and inflicting significant losses on its rank and file. Israel also successfully targeted much of the group's rocket and missile arsenal. This stockpile, estimated to contain between 120,000 and 200,000 projectiles, was reduced by half due to Israeli airstrikes.[14] Hezbollah was forced to sue for peace, ending its attacks on Israel and agreeing to withdraw its forces from the Lebanon-Israel border, with Israel making few concessions.

Iran's ties to Hezbollah, militant groups in Iraq, and the Houthis did not deter the United States or Israel from acting against it militarily. Israel in particular targeted Iranian military leaders in Syria and Lebanon and the leader of Hamas when he was in Iran. Tehran did try to restore its credibility with drone and missile attacks on Israel, but this too was a failure, with Israel—helped by the United States, Jordan, and other countries—tracking and downing most of the attacking force. When Israel and Iran fought a bigger battle in June 2025, Hezbollah avoided joining the fray.

Hamas's seizure of Israeli hostages has likewise not proven an effective deterrent. Despite the presence of over 200 hostages, Israel launched an all-out assault on Gaza, and in its operations has conducted highly destructive attacks that have threatened the hostages as well as their Hamas kidnappers. Israeli ground forces have also accidentally killed hostages.[15]

Finally, Israel and the United States have prevented Iran from escalating irregular warfare into conventional success; indeed, Tehran's efforts to do so have led to embarrassing failures. After the killing of Iranian, Hezbollah, and Hamas leaders, Iran twice launched large salvos of rocket, missile, and drone attacks on Israel, and Israel responded with limited but precise attacks—the first time Iran and Israel have directly attacked each other's territory. Effective intelligence and air defense, however, prevented Iran's salvos from causing significant casualties in Israel, displaying Tehran's conventional military weakness in a highly public way. In part due to threats from Israel and the United States, Iran also hesitated to escalate further and counseled some of its proxies, such as those in Iraq, to limit attacks on U.S. bases.[16] When Iran and Israel (joined by the United States) entered into the larger conflict in June 2025, Israel was quick to gain air supremacy and, in a short but effective air campaign, set back Iran's nuclear program and killed many Iranian leaders, with only a small number of casualties on the Israeli side.

Implications for the Future of Irregular Warfare

During the Cold War, the most frequent type of competition between the Soviet Union and the United States was irregular warfare, as the two sides fought proxy wars in Africa, Asia, Europe, and Latin America. The same may be true in the coming years as China expands its global presence. Although a Chinese invasion of Taiwan is possible, more likely are cyberattacks, disinformation, sabotage, and military threats to coerce Taipei and undermine morale.

In addition, the staggering cost of the Ukraine war in both money and lives suggests that an exhausted but predatory Russia may in the future prefer to use irregular war instead of conventional attacks to expand its influence. Russia's Main Directorate (GRU), Foreign Intelligence Service, semiprivate military companies, and other state and nonstate organizations are likely to continue assassinations, sabotage operations, offensive cyber campaigns, disinformation operations, intelligence collection, and other clandestine activities. The GRU's Service for Special Activities is likely to be particularly active, including Unit 29155 (also known as the 161 Center or, more formally, the 161 Intelligence Specialists Training Center), Unit 54654, and the GRU's headquarters and planning department.[17] Russia will also likely continue to wage a disinformation campaign against the United States, conduct offensive cyber campaigns against U.S. and Western government agencies and companies, and engage in a range of other activities such as assassinations and sabotage.

Iran, for its part, emphasizes irregular warfare given the weakness of its conventional forces. It will

continue to pose an irregular warfare threat to the United States and its allies and partners across the Middle East using a range of partner forces such as the Houthis in Yemen, Hezbollah in Lebanon, Hamas and other groups in the Palestinian territories, and the Popular Mobilization Forces in Iraq. In addition, Iranian government entities such as the Islamic Revolutionary Guard Corps, as well as their nonstate partners, will likely improve their offensive cyber capabilities and their ability to conduct attacks against the United States and its allies and partners at home and abroad. Although Iran and its proxies' setbacks in 2024 and 2025 will make Iran more hesitant to take on Israel, Tehran has little choice but to fall back on irregular warfare, as its conventional forces are poorly armed.

In addition to excelling at high-end conflict, the United States and its allies must be prepared for irregular operations with attacks on civilians and the use of civilians as shields, ensure there are civil affairs officers who can repair civilian infrastructure, create partnerships with private sector companies with cyber and other expertise, and develop other capabilities to better counter irregular warfare.

Even as the United States emphasizes great power competition, it must not lose the knowledge gained after its interventions in Afghanistan, Iraq, and other parts of the world in the post-9/11 era—as happened when the U.S. military deliberately tried to put the Vietnam War behind it and, at high cost, had to relearn how to fight insurgencies. In addition, unlike in the Vietnam era, insurgents and other irregular forces may have great power support, including better weapons, funding, and intelligence. There is also a risk of escalation that must be managed when irregular forces have a great power sponsor.

Fighting irregular opponents often risks large numbers of civilian deaths. In some theaters there will be media and international scrutiny of the impact of military operations on the civilian population. Countries fighting in these regions will require a media and public relations strategy to go along with their operations, all while targeting procedures that seek to minimize harm to civilians. In addition, countries must be prepared for disinformation about their operations, specifically regarding their harmful impact on civilians.

Assassination and sabotage are likely to remain part of irregular warfare, both on offense and defense. If the Russia-Ukraine conflict is a guide, some of these assassinations are likely to occur far from the front lines, requiring new security protocols in more remote bases and even in faraway homelands. Sabotage of U.S. bases and supply lines, as well as those of allies, is also highly likely.

SOF will play a particularly critical role in combatting irregular warfare in the future. SOF need to adapt given the many differences between fighting against forces of or supported by a great power versus fighting terrorists. Russian forces, for example, have persistent surveillance and airpower that will make clandestine operations against them far harder for U.S. forces compared with U.S. efforts fighting terrorist groups. It will also be important to develop programs to raise forces to gather intelligence and fight behind enemy lines. Hostage rescue may also be required, even as military operations occur in close proximity.

Success in irregular warfare requires superb intelligence. Targeting adversary leadership (and protecting one's own) necessitates detailed information on leadership movements and communications. Striking irregular forces while limiting harm to civilians also requires excellent knowledge about the locations of fighters and the presence of nearby civilians. Sabotage, such as what Russia is currently conducting in Europe, needs to be disrupted, attributed, and called out to rally unified allied support. In addition, some intelligence may need to be released to counter claims that, for instance, the United States has targeted civilian infrastructure without military purpose.

Authoritarian states are also vulnerable to irregular warfare, of course, including information warfare. By leveraging commercial technologies, the United States and its partners should target the domestic populations of China, Russia, Iran, and other countries through covert, clandestine, and overt means, where appropriate. The commercial sector can be helpful in developing and utilizing AI, large language models,

and software that directs information to specific audiences that Beijing, Moscow, Tehran, and other regimes are attempting to control. Offensive information operations could focus on a range of issues, including domestic grievances and societal divisions, human rights abuses, economic problems, and corruption.

Military operations and intelligence units will likely need to develop greater capabilities to compete in the information space, including for such activities as covert influence and counter-value operations (targeting an adversary's civilian population). In cooperation with the commercial sector, AI and large language models have significant potential for irregular warfare applications. AI translation and message crafting can provide government officials with the ability to rapidly communicate in any language with anyone in the world. Advances in natural language processing will accelerate intelligence work, helping analysts sort through reams of text and drawing connections a human brain might not.

The military and intelligence communities need to fundamentally change the way they work with the commercial sector to compete more effectively in irregular warfare—both on offense and defense. Commercial innovation and commercial production capacity provide a major advantage for the United States and its allies and partners in irregular warfare, including for intelligence and military-related activities. But the United States has not adequately leveraged this advantage because of risk aversion, slow and burdensome contracting and acquisitions regulations, and a failure to adequately understand viable options in the commercial sector. There is a significant need to rethink the framework of government collaboration with this sector and to treat commercial entities as partners serving a common goal.

There is also a growing need to improve next-generation intelligence platforms, systems, and software that can quickly collect and analyze vast amounts of information on adversary activities for irregular warfare. Adversaries will likely attempt to hide their actions in a variety of terrains, including jungles, mountains, dense forests, subsurface locations, and tightly packed megacities. They will also attempt to use denial and deception tactics and techniques.[18]

Finally, an important goal is to limit the escalation of irregular warfare into conventional conflict. This can occur when major powers feel the need to respond to attacks on their proxies or when proxy attacks compel their targets to respond against the ultimate source. Israel and the United States achieved this with Iran in 2024, where Tehran's fear of U.S. and Israeli escalation led Iran to try to calibrate its initial attacks to avoid escalation and to avoid additional attacks after its failed drone and missile salvos.[19]

Conclusion

The wars in Ukraine and the Middle East demonstrate that irregular warfare is not a relic of the past, but a defining feature of contemporary conflict—one that democratic states must be institutionally and operationally prepared to confront. Civilians are often the primary victims, caught between actors that deliberately use population centers for tactical advantage and militaries that must operate under intense legal and normative scrutiny. Indeed, in dense urban environments like Gaza City, civilians are often used as shields, and in Ukraine, noncombatants are the principal victims of coercive tactics intended to undermine resilience and morale. The persistent threat of assassination, sabotage, and hostage taking—often executed through or with support from intelligence and SOF—will remain a central feature of irregular campaigns. As adversaries grow more adept in their use of irregular means, democracies must invest not only in better intelligence, cyber defense, and targeting capabilities, but also in public communication strategies to counter disinformation and preserve legitimacy.

Still, the wars in Ukraine and the Middle East have also demonstrated that well-coordinated efforts can reduce the impact of irregular warfare. Ukraine has disrupted numerous plots to assassinate President Volodymyr Zelensky. For Israel, timely and effective intelligence allowed it to decimate Hezbollah's ranks and quickly neutralize massive Iranian drone and rocket attacks.

Strategic adaptation is essential. The United States and its allies must preserve hard-won knowledge from post-9/11 counterinsurgency operations while recognizing that great power–backed irregular warfare

The wars in Ukraine and the Middle East demonstrate that irregular warfare is not a relic of the past, but a defining feature of contemporary conflict—one that democratic states must be institutionally and operationally prepared to confront.

poses far more sophisticated challenges than ever before. This includes preparing SOF for operations against technologically capable adversaries, building rapid and resilient intelligence-sharing platforms, and rethinking how the government works with commercial innovators to harness advances in AI and data analytics for irregular conflict. Future military operations will require increased readiness for irregular methods such as assassinations and sabotage, excellent intelligence, better cooperation with the private sector, and preparation for irregular warfare in an environment of great power competition. Future success will also depend on mitigating escalation risks—particularly when attacks by proxies or in the gray zone threaten to pull major powers into direct confrontation. The lessons from Ukraine and Israel point to a critical imperative: Irregular warfare is not only a tactical reality but a strategic domain in its own right, and ignoring it would be a grave miscalculation in an era of persistent geopolitical competition.

PART III

Implications for Defense Planning and Industry

CHAPTER 13

Defense Budgets in an Uncertain Security Environment

Seamus P. Daniels

Decisions on defense spending levels remain as much a product of political and economic realities as they are a response to strategic demands and the security environment.

Global defense spending has increased dramatically since the outbreak of the war in Ukraine in February 2022. As Russia has poured resources into funding its invasion and ongoing operations, NATO allies have sought to boost their own defense capabilities in light of the threat on their borders. Meanwhile, China has continued to report sustained annual growth in its defense budget as it modernizes and grows its military in pursuit of its strategic objectives. And in the summer of 2025, Congress provided an additional $156 billion for defense as a one-time supplemental fund to enhance the United States' military capabilities.[1]

Uncertainty in the current global security environment and heightened threats have prompted much of this growth in defense spending as states perceive themselves and their interests to be at greater risk. However, despite these increases, and an agreement among NATO allies for further growth, decisions on defense spending levels remain as much a product of political and economic realities as they are a response to strategic demands and the security environment. States will ultimately balance the urgency of their security concerns against fiscal concerns and other spending priorities.

This chapter explores trends in global defense spending, particularly since Russia's 2022 invasion of Ukraine. It first tracks changes in spending levels from NATO allies and the United States in the context of the alliance's defense budget commitments and the ongoing conflict. It then assesses trends in defense spending by Russia and China. The chapter concludes with a discussion of considerations that may impact defense spending levels in the future.

NATO's Budgetary Response to the Ukraine War

European governments responded to Russia's 2022 invasion of Ukraine by increasing their defense budgets, a clear indication that their perception of the threat environment has grown starker since Russia's initial aggression in 2014. While the United States has

PHOTO: BEATA ZAWRZEL/NURPHOTO/GETTY IMAGES

appropriated additional resources to backfill equipment stocks sent as assistance to Ukraine, it has also imposed budgetary limits on its own defense funds, highlighting the impact of fiscal and political considerations on defense spending.

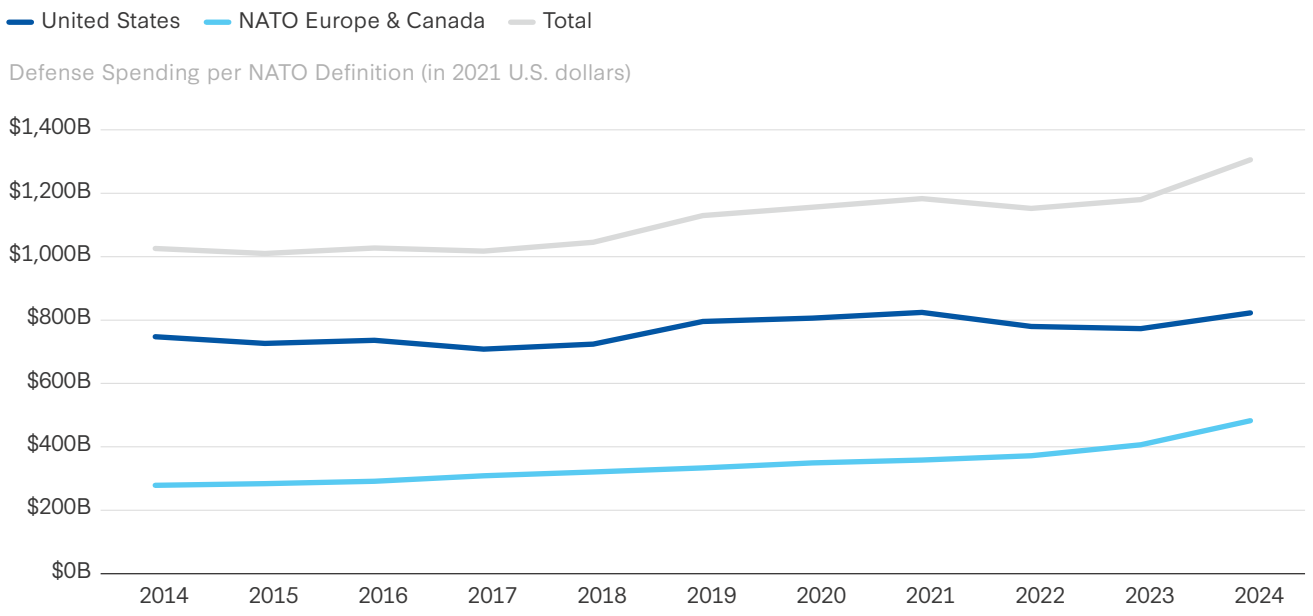
In response to Russia's 2014 annexation of Crimea, NATO allies at the Wales Summit later that year agreed to a benchmark to increase their defense spending and military capabilities to counter the Russian threat. NATO allies agreed to aim to spend the equivalent of 2 percent of each state's GDP on defense and 20 percent of defense budgets on equipment.[2]

However, total defense spending by the alliance increased only incrementally following the declaration of that agreement. Between 2014 and 2022, NATO's total defense spending, as reported by the alliance, increased 12 percent in real terms at a compound annual growth rate of 1.3 percent.[3] Notably, as Figure 13.1 shows, spending by European allies and Canada (excluding the United States) grew by 34 percent, adjusted for inflation, over that nine-year period, a 3.3 percent growth rate each year. The number of allies meeting the 2 percent of GDP benchmark rose from 3 out of 27 NATO members in 2014 to 7 out of 29 in 2022 (members meeting the threshold peaked at 9 in 2020, but this was a product of declining GDP from the Covid-19 crisis).[4]

Russia's official invasion of Ukraine in 2022 prompted a more immediate reaction from NATO members in terms of spending, as governments perceived a more tangible threat to their borders. Total defense spending is estimated to increase 22 percent in real terms between 2022 and 2025. That includes an estimated 50 percent increase in spending by European members and Canada.

In the wake of Russia's invasion, several allies announced notable shifts in their defense policy or spending plans. Just days after the war began, then-Chancellor Olaf Scholz announced a *Zeitenwende*, or "historical turning point," in German foreign and defense policy to rethink relations with Russia and called for a €100 billion fund to invest in the military.[5] While implementation of the policy has been described as "lackluster" and others have questioned whether the fund was sufficient to transform the military, the focus on bolstering national secu-

Figure 13.1: NATO Reported Defense Spending



Note: 2024 and 2025 based on estimated data.

Source: "Defence Expenditure of NATO Countries (2014-2025)," NATO, August 28, 2025, https://www.nato.int/cps/en/natohq/news_237171.htm.

rity has continued in Germany.[6] In March 2025, the Bundestag voted to exempt defense spending from its strict constitutional debt limit, and in May that year, then-Chancellor-elect Friedrich Merz promised to transform the German military into the "strongest conventional army in Europe."[7]

Poland dramatically boosted its spending as it undertook a military modernization initiative to upgrade its capabilities.[8] The increase was funded by growth within the budget as well as an extra-budgetary mechanism known as the Armed Forces Support Fund, established in 2022, with the main funding derived from issuing bonds.[9] Prime Minister Keir Starmer also announced in February 2025 that the United Kingdom would spend 2.5 percent of GDP on defense by April 2027 in what he touted as the "biggest sustained increase in defence spending since the end of the Cold War."[10]

The European Commission has additionally taken measures that will allow EU members to increase defense spending during what Commission President Ursula von der Leyen described as the "most momentous and dangerous of times."[11] Under the ReArm Europe Plan/Readiness 2030 announced in March 2025, EU member states have greater flexibility to increase their defense spending against the European Union's strict debt limitations in light of Russia's invasion of Ukraine. The European Commission also established a new financial mechanism called the Security Action for Europe (SAFE), which allows member states to access loans for defense spending from a €150 billion fund.[12] Finally, the plan seeks to increase investments from the European Investment Bank for defense projects and mobilize private capital.[13] Taken together, these different measures could provide up to an additional €800 billion in defense funding, according to the European Commission.

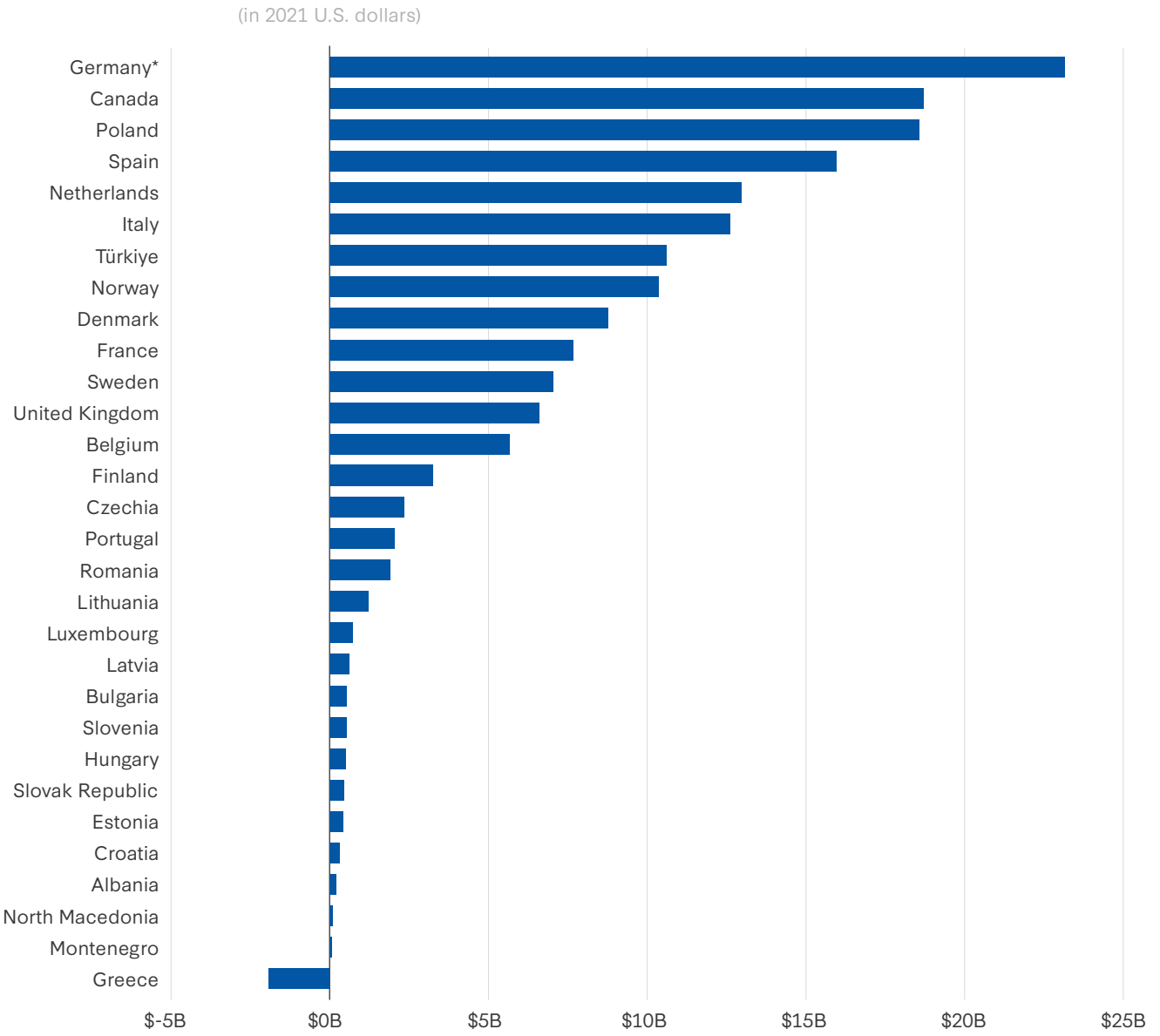
Figure 13.2 shows the estimated change in defense spending by European NATO members and Canada from 2022 to 2025 in constant 2021 dollars. NATO allies, with the exception of Greece, increased spending over that period. While the NATO data did not provide a 2025 estimate for German spending, Germany's defense spending increased by over $23 billion between 2022 and 2024. Canada and Poland both increased their defense spending by over $18 billion, followed by Spain with a boost of nearly $16 billion. The Netherlands and Italy both increased their spending by over $12 billion each.

The boost in NATO defense spending following Russia's 2022 invasion also led to a significant increase in the number of member states meeting the 2 percent of GDP benchmark, as shown in Figure 13.3. In 2023, 10 members met the threshold—up from 7 in 2022—while notably all 31 NATO allies are expected to reach the benchmark in 2025. According to the 2025 estimates, Poland is estimated to have spent the greatest percentage of its GDP on defense of all member states, at 4.5 percent, followed by Lithuania (4.0 percent), Latvia (3.7 percent), and Estonia (3.4 percent). Luxembourg, Spain, North Macedonia, and Czechia are estimated to spend the smallest percentage of their GDP on defense.

Despite these increases, the United States under the second Trump administration has pushed for greater burden sharing among NATO allies and an increased spending threshold. President Trump first called for a 5 percent of GDP benchmark prior to taking office and has continued to make that demand in office.[14] NATO Secretary General Mark Rutte proposed a plan for allies to eventually match that target, calling for an increase to 3.5 percent of GDP spending on classic defense activities with an additional 1.5 percent of spending on other security-related investments.[15] NATO heads of state agreed to the new threshold at the Hague Summit in June 2025, with the goal of meeting the 5 percent level by 2035 and a requirement to submit annual plans of how each state would reach it (differentiating it from the Wales Summit's 2 percent plan).[16]

While topline defense spending measured as a percentage of GDP represents one metric for assessing burden sharing in the alliance, the second benchmark agreed to at the Wales Summit—percentage of defense expenditure allocated toward equipment—provides a measure of the capabilities in which states are investing. The Wales Summit agreement called on NATO members to allocate 20 percent of their defense budgets toward procuring major equipment, as well as conducting research and development.[17] The NATO

Figure 13.2: Real Change in Defense Spending, 2022–2025



*Germany data shows 2022-2024 real change as no 2025 data reported.

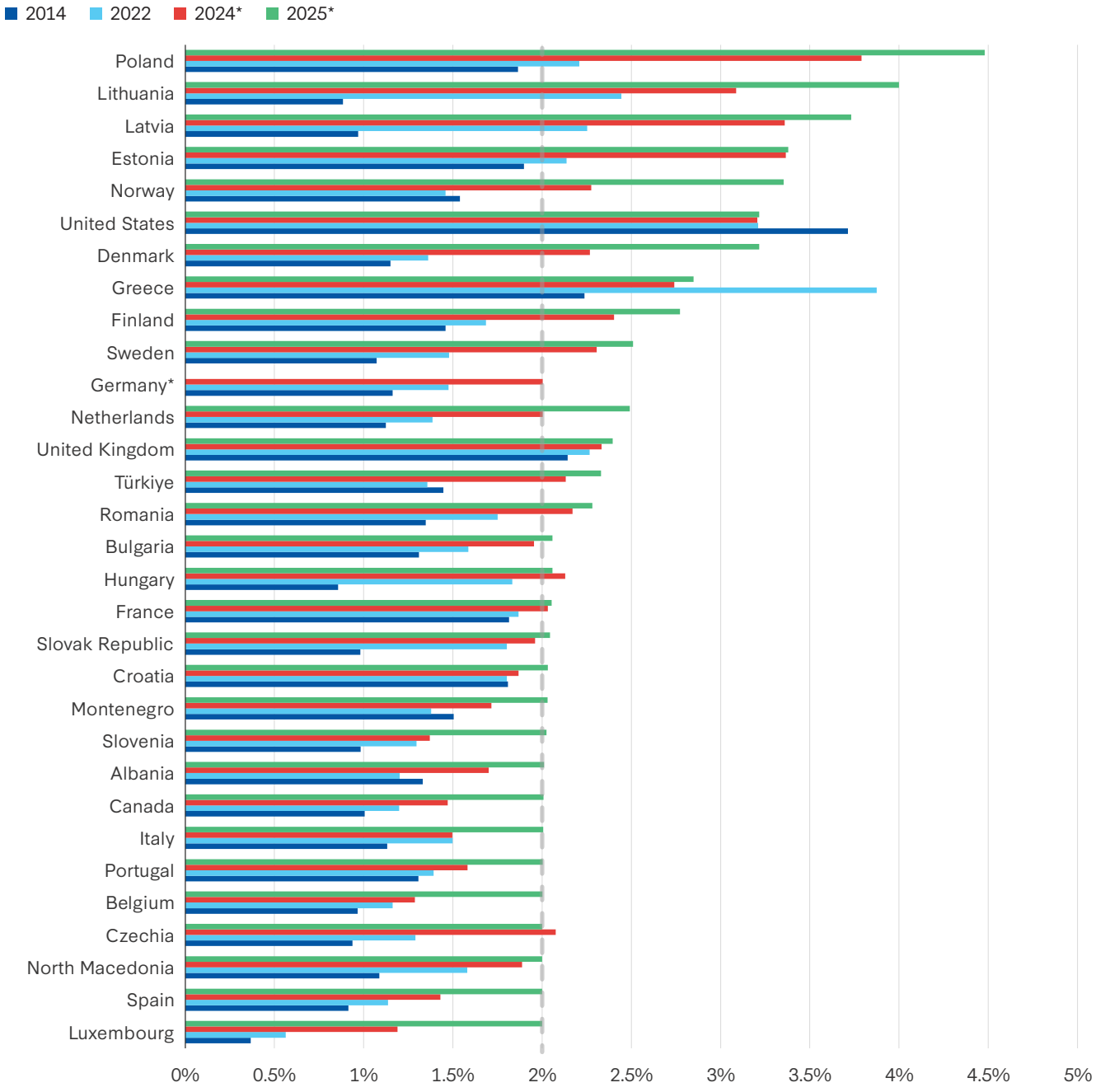
Source: "Defence Expenditure of NATO Countries (2014-2025)," NATO, August 28, 2025, https://www.nato.int/cps/en/natohq/news_237171.htm.

data tracks spending in three additional categories, including personnel expenses, infrastructure, and other. However, spending on equipment provides added capabilities and warfighting potential for the alliance collectively as opposed to spending on the military personnel of individual states.

As Figure 13.4 shows, the average percentage of defense spending NATO members allocate to equipment has risen steadily since 2014 relative to other investment areas. States allocated on average 13 percent in 2014, rising to 27 percent in 2023, and an estimated 33 percent in 2025.

While Russia's invasion of Ukraine and the heightened threat environment have directly contributed to European NATO members increased defense budgets, trends in U.S. defense spending have also been shaped significantly by broader political and economic developments. Figure 13.5 shows U.S. national defense spending from FY 2014 through FY 2025. While funding did peak in FY 2024 based on

Figure 13.3: NATO Members' Percentage of GDP Spent on Defense



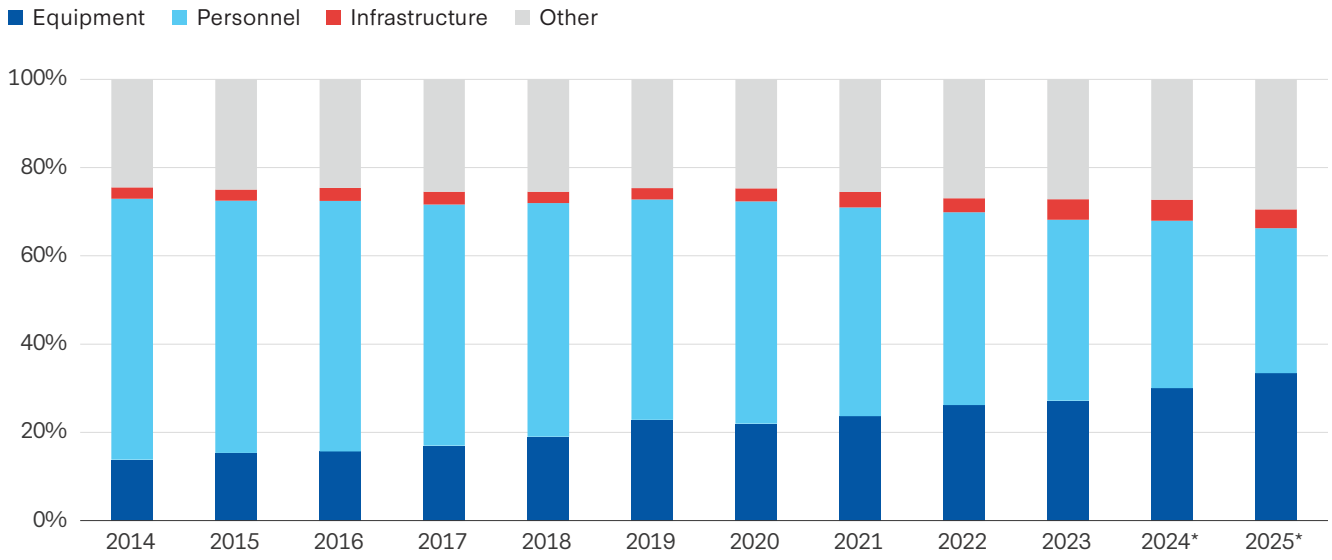
*No 2025 data reported for Germany.

Note: 2024 and 2025 based on estimated data.

Source: "Defence Expenditure of NATO Countries (2014-2025)," NATO, August 28, 2025, https://www.nato.int/cps/en/natohq/news_237171.htm.

the provision of military aid to Ukraine and the subsequent replacement of U.S. stocks, yearly fluctuations in spending levels are consistently shaped by fiscal limitations imposed by Congress. From FY 2012 to FY 2021, the Department of Defense (DOD) operated under budget caps imposed by the Budget Control Act of 2011 to limit federal deficits and the national debt. However, a series of budget deals passed over that time increased funding levels above the original mandated caps.[18] Congress similarly imposed the Fiscal Responsibility Act of 2023 to cap spending levels in FY 2024 and FY 2025.[19] Yet military aid to Ukraine

Figure 13.4: Average Percentage of NATO Members' Defense Spending by Category



Note: 2024 and 2025 based on estimated data.

Source: Defence Expenditure of NATO Countries (2014-2025)," NATO, August 28, 2025, https://www.nato.int/cps/en/natohq/news_237171.htm.

and other supplemental funds did not apply to the spending under the cap level.

Fiscal concerns, however, may be overcome by political prerogatives. In July 2025, congressional Republicans passed reconciliation legislation to extend and expand tax cuts, increase defense and border security funding, slash non-defense spending priorities, and raise the debt ceiling. These measures, enacted reluctantly by budget hawks within the Republican party, is estimated to increase the federal deficit by $4.1 trillion between 2025 and 2034.[20] The legislation included $156 billion to provide a one-time supplemental boost in funding intended by Congress to enhance U.S. military capabilities between FY 2025 and FY 2029.

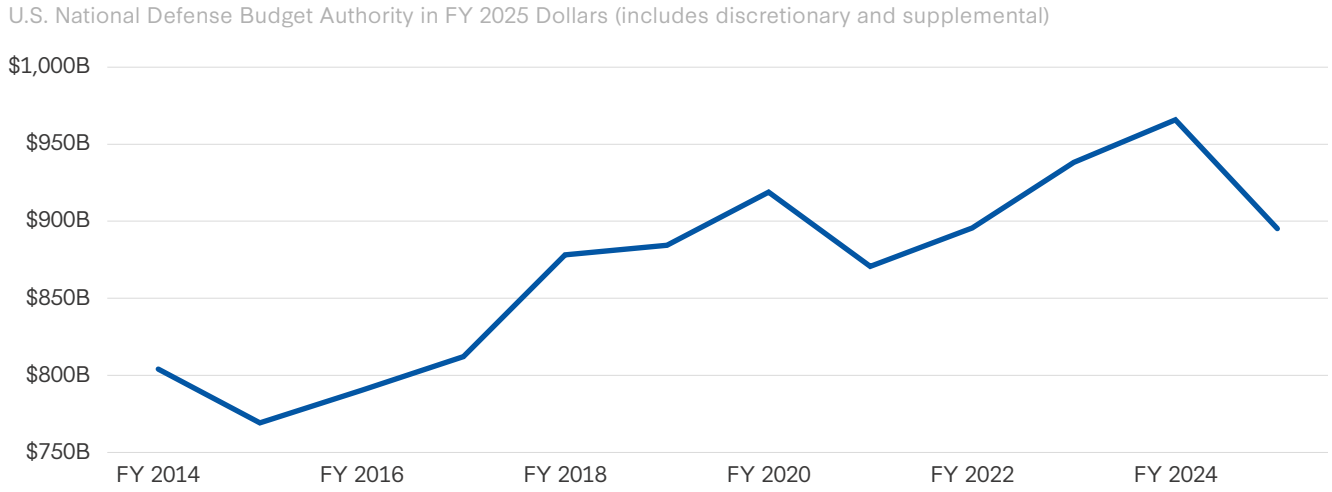
Yet fiscal concerns persist which, coupled with political divisions, may limit further growth in U.S. defense spending. In its FY 2026 defense budget request, the Trump administration touted the first-ever trillion-dollar defense budget. However, the administration only requested $892.6 billion in discretionary funding from Congress, proposing to use $119 billion from the reconciliation funding in FY 2026. This could signal that the administration does not intend to pursue further increases in defense spending, to the dismay of congressional defense hawks who criticized the White House and DOD for its budget request and apparent misuse of the reconciliation funds.[21] Moreover, cuts and rescissions to non-defense funding pursued by the White House and congressional Republicans could make Democrats reluctant to grow defense spending without guarantees over non-defense priorities.

Growth in Russian and Chinese Defense Spending

Russian and Chinese defense spending has also increased since the outbreak of the 2022 war. Russia's spending, unsurprisingly, has been driven by the cost of conducting operations in Ukraine and reconstituting its military capabilities. China's defense budget marks a continuation of its strategic priority to modernize its military forces.

Analysis of Russia's and China's defense spending, the United States' principal competitors, is constrained by a lack of both available data and limited transparency in the data that is released by each government. Both states' official defense budgets do not appear to be inclusive of all military-related funding. However, the limited data available clearly

Figure 13.5: U.S. Defense Spending, FY 2014–FY 2025

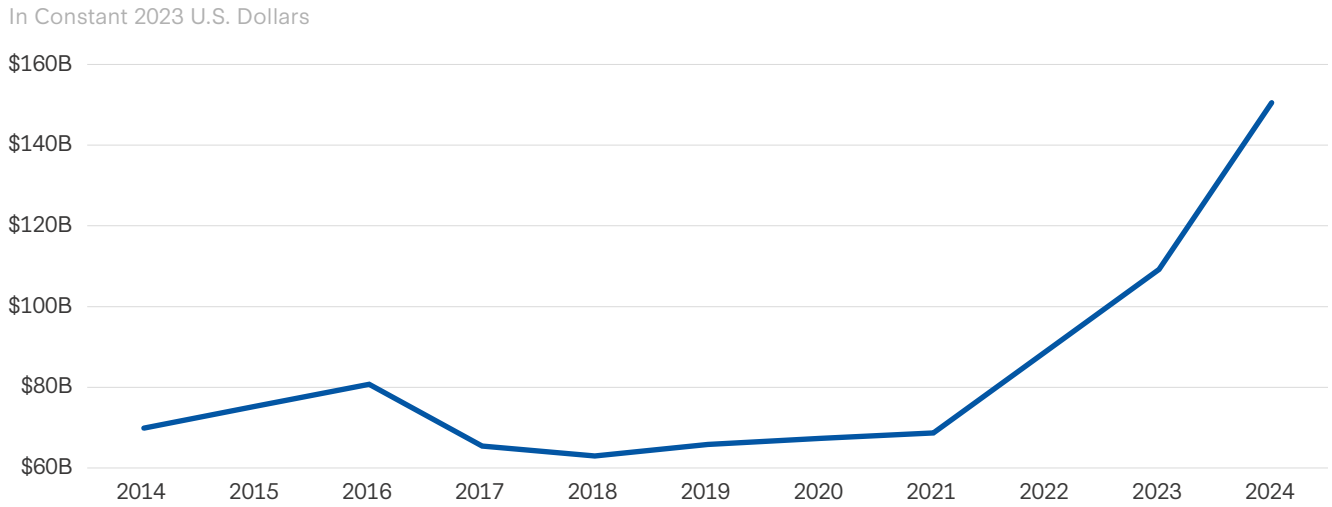


Source: Author's analysis of "Fiscal Year 2025 Public Budget Database," Office of Management and Budget, March 11, 2024, https://www.govinfo.gov/app/collection/budget/2025/BUDGET-2025-DB.

indicates that Russian and Chinese defense spending is increasing in parallel with NATO budgets: Russia as a direct result of its invasion and continued war in Ukraine, and China through its consistent and sustained approach to modernizing its military.

Russian defense spending has unsurprisingly increased dramatically year-on-year from its invasion of Ukraine. Figure 13.6 shows Russian spending from 2014 to 2024 as estimated by the Stockholm International Peace Research Institute (SIPRI).[22] Defense funds fell significantly—by almost 19 percent in real terms—from 2016 to 2017 and largely stayed flat for the next several years. However, the war in Ukraine led Russia to increase its defense expenditures dramatically above inflation. Spending is estimated to have increased by 69 percent in real terms between 2021 and 2024, with annual increases of approximately 29 percent (2021-2022), 23 percent (2022-2023), and 38 percent (2023-2024). One alternative estimate of Russia's defense spending calculated a 53 percent increase in total mili-

Figure 13.6: Russian Defense Spending, 2014–2024



Source: "SIPRI Military Expenditure Database, 1949-2024," Stockholm International Peace Research Institute, https://www.sipri.org/databases/milex.

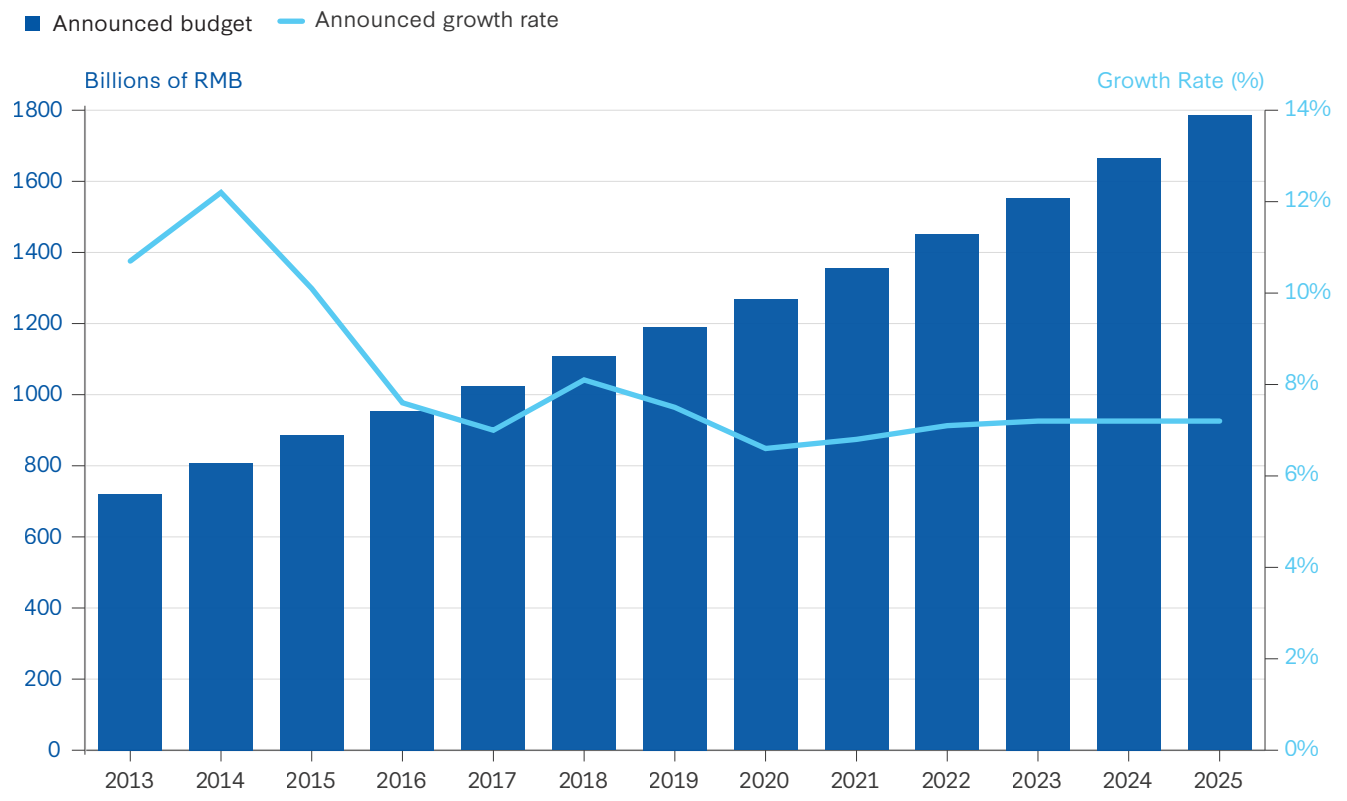
tary-related expenditures from 2023 to 2024, adjusting for inflation.[23] The Russian defense budget is expected to grow again in 2025, although at a more meager 3.4 percent, according to the latter estimate.[24]

Analyzing Russia's defense spending is further challenged by the declining levels of transparency since its 2022 invasion of Ukraine, with 30 percent of the 2024 budget designated as classified in 2024 and budget changes that made it difficult to estimate actual spending over the year.[25] Nevertheless, Russia spent a significant amount of its 2024 funding on procuring new weapons systems for the war in Ukraine, supporting its defense industry, and covering military personnel costs, according to the Stockholm International Peace Research.[26] Another source notes that Russia has doubled its armored vehicle output and dramatically increased munitions production since 2022.[27]

Analyses of China's defense budget suffer from an even larger dearth of reliable source material regarding the makeup of spending, as official estimates are understood to routinely report lower levels of funding. Consequently, estimates of China's topline spending vary considerably, ranging from the government-reported $245 billion level announced in March 2025 to an estimated $700 billion from some analysts.[28] Figure 13.7 shows China's reported defense budget in current RMB and the announced annual growth rate. While the announced growth rate fell dramatically from a 2014 peak to 2017, it has remained steadily consistent over the last several years, despite the Chinese economy facing significant fiscal headwinds.[29]

Estimates of actual Chinese defense spending also demonstrate sustained growth over time. Data from SIPRI, shown in Figure 13.8, depicts steady growth in military expenditures adjusted for inflation. According to SIPRI, Chinese defense spending grew over 70 percent in real terms between 2014 and 2024, or at a compound annual growth rate of 5 percent. That

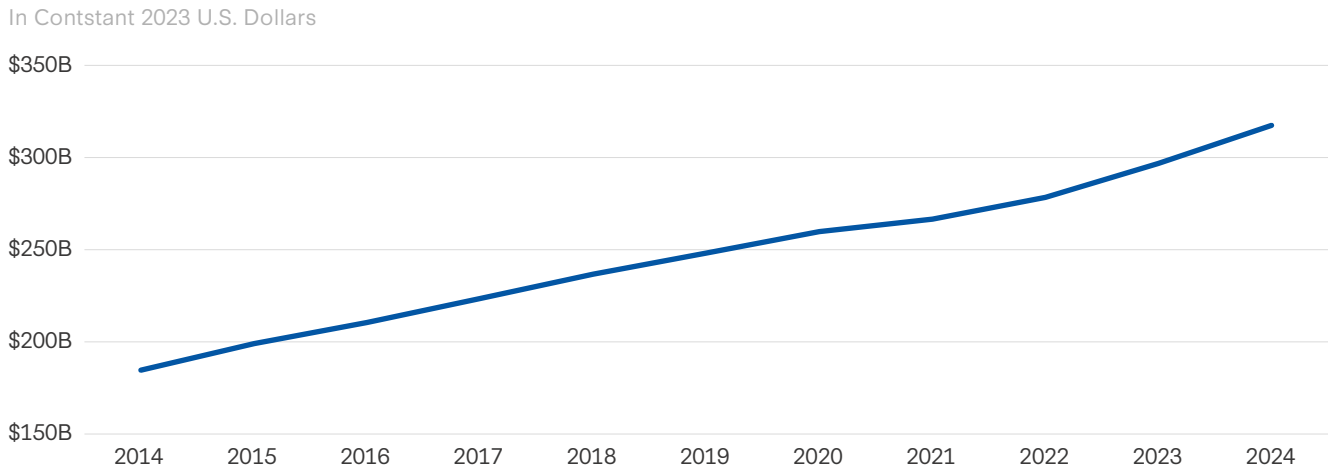
Figure 13.7: China's Reported Defense Budget and Announced Growth Rate



Note: Take from: https://chinapower.csis.org/military-spending/.

Source: "What Does China Really Spend on its Military?," CSIS, ChinaPower, updated March 5, 2025, https://chinapower.csis.org/military-spending/.

Figure 13.8: Chinese Defense Spending, 2014–2024



Source: "SIPRI Military Expenditure Database, 1949-2024," Stockholm International Peace Research Institute, https://www.sipri.org/databases/milex.

growth has funded an impressive military modernization campaign to produce advanced capabilities and platforms across a range of domains as well as various reform initiatives.

Conclusion: Prospects for Continued Defense Spending Growth

The deteriorating global security environment and ongoing war in Ukraine have contributed to significant increases in defense spending across the world. The growth in NATO members' budgets demonstrates the clear impact of the threat landscape on defense spending decisions. The dramatic growth in Russian military expenditures shows the costs required to maintain complex military operations at scale. However, as the case of the United States demonstrates, fiscal and political factors also determine defense funding.

Changes in the threat environment will shape global defense spending levels in the near future as states weigh how to allocate resources between defense and other spending and political priorities. While a resolution to the war in Ukraine has the potential to slow spending growth from European states and Russia, the cessation of combat operations alone will not guarantee a moderation of defense spending levels. European states, particularly those in the Baltics and Eastern Europe, must also perceive that the threat on their borders has significantly lessened, which seems unlikely should Russia continue to reconstitute and rebuild its military after the war.

Yet, questions remain as to whether Russia can sustain its current defense spending levels. The lower growth rate in its 2025 budget and potential decreases in real terms for 2026 and 2027 suggest a decline could be on the horizon.[30] At an economic forum in June 2025, the Russian economy minister suggested that the country was headed toward a recession, with some commentators suggesting defense cuts could be on the line.[31] However, other analysts suggest that Putin's will to modernize and empower the country's military will take priority over preventing an economic downturn.[32]

While a change in the threat landscape could shift European defense spending trends, economic trends could have an impact as well. European states also face fiscal challenges which could hinder their ability to meet the new NATO spending threshold and their willingness to allocate more resources to defense at the expense of other priorities.[33] An economic downturn could force states to limit defense spending growth and allocate a greater percentage of funding toward non-defense priorities.

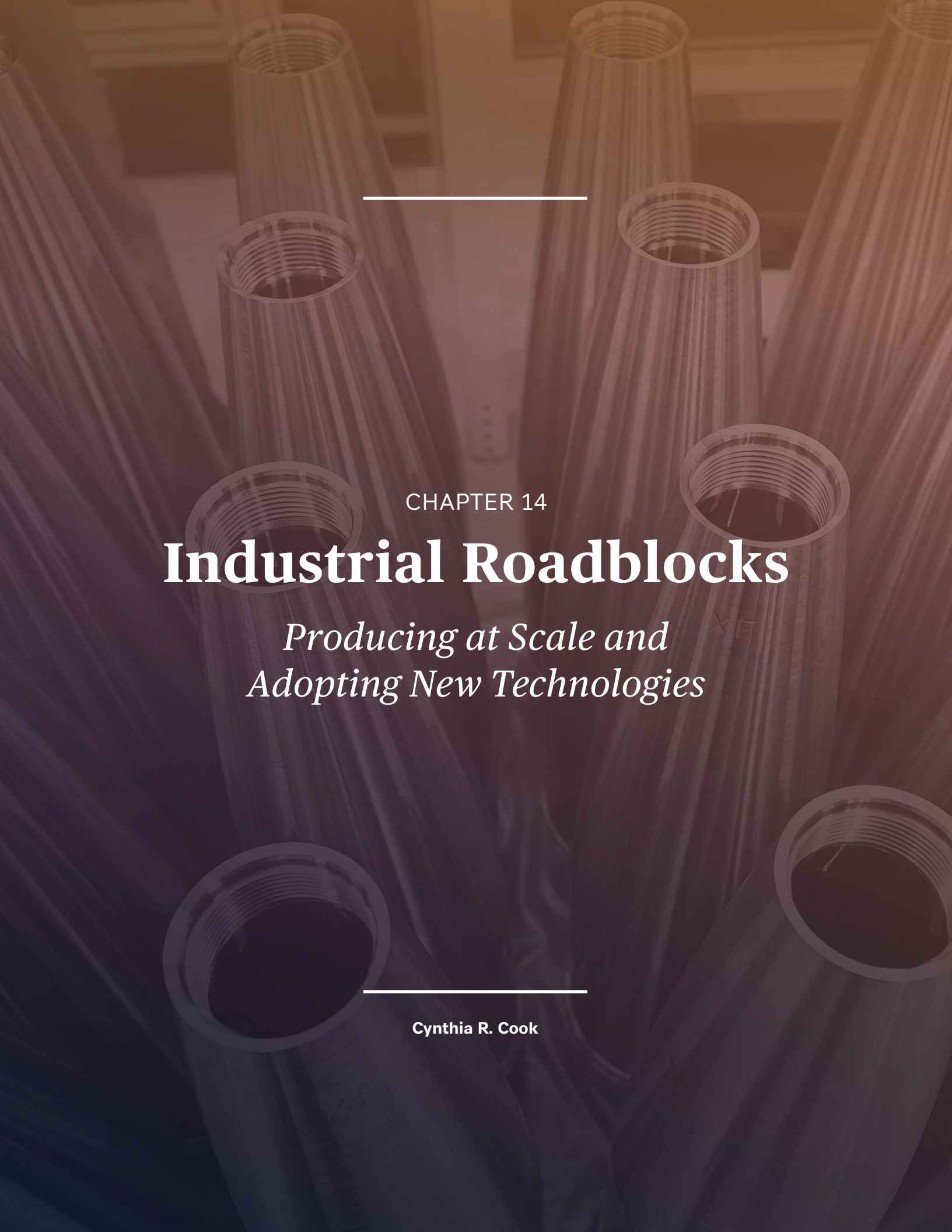
Barring a major change in the security environment that directly affects the United States or its allies or partners, political and fiscal realities will continue

Barring a major change in the security environment that directly affects the United States or its allies or partners, political and fiscal realities will continue to have a major impact on U.S. defense spending levels in the near future.

to have a major impact on U.S. defense spending levels in the near future. Historically, the federal deficit has been a driver in the most recent downturns in U.S. defense spending in the late 1980s and early 2010s.[34] Moreover, slim Republican majorities in both chambers of Congress necessitate Democratic support for passing additional increases in regular defense appropriations, which may be unlikely given the current partisan divide on spending. However, as the United States' reaction to Russia's 2022 invasion demonstrated—in which it rapidly distributed aid to Ukraine, increased its military posture in Europe, and passed supplemental funding to backfill equipment stocks—a sudden threat to the homeland, U.S. allies and partners, or U.S. interests could push the government to take immediate action.

Fiscal headwinds are less likely to slow China's consistent and sustained spending growth as it continues its ambitious military modernization program. However, as the PLA develops, procures, and fields more exquisite and advanced weapons systems in its force structure, it will be forced to spend additional funds to operate and sustain those platforms. Absent continued increases in defense spending over time, operation and sustainment as well as personnel costs may consume a larger portion of China's defense budget.

International defense spending levels have grown dramatically in light of increasing conflicts and the deteriorating global security environment. While economic and fiscal realities may challenge additional growth, further escalation of conflicts globally could nevertheless lead to even greater spending levels.



CHAPTER 14

Industrial Roadblocks

Producing at Scale and Adopting New Technologies

Cynthia R. Cook

A rethink of industrial posture is necessary—not just to ensure peacetime readiness but to be able to sustain and surge to support combat operations against a near-peer adversary in the case of protracted war.

Russia's full-scale invasion of Ukraine in February 2022 was the starting point for a long-overdue refocus on defense industrial base issues. The United States led the allied effort to supply Ukraine with systems and weapons that it could use for self-defense against Russian aggression. Within the first year of the war, this support illuminated worrisome vulnerabilities in the U.S. and European defense industrial bases, especially in terms of preparedness for sustained conflict generally and in munitions production specifically.[1] Russia similarly began the fight without understanding the likely strains on its industrial base and the need to ensure adequate stockpiles and production capacity. Along with limitations on defense production, the war has revealed constraints throughout the supply chain and in the production workforce. It has also demonstrated the benefits of working with allies and partners, which has sustained both Ukraine and Russia during the long conflict. The risks of potential adversaries controlling key supply chain inputs, including China's dominance of critical minerals processing, have become clearer. And the speed with which both sides have incorporated innovation in what they bring to the fight suggests that the industrial base, along with the government bureaucracies that set and fund requirements, must be agile enough to ensure that equipment delivered to the battlefield incorporates updated technology that refreshes at the rate of weeks or days, not years.

A clear lesson has emerged: Defense industrial readiness needs to be in sync with the possibility of high-intensity, prolonged conflict in which there is rapid technical refresh.[2] The industrial base needs to be robust, resilient, and ready to surge, especially given the risk of lengthy conflicts. There is a renewed understanding that "production is deterrence."[3] Thus, investments in production and in surge capability and capacity throughout the supply chain, especially for munitions, will be necessary to support future war. The challenge of surging production means that nations must be willing to produce for stockpiles in times of peace to have the capabilities

PHOTO: JEAN-FRANCOIS MONIER/AFP/GETTY IMAGES

they need ready in case of conflict. Equally important is working with allies and partners to build a more integrated and resilient industrial base through coproduction, shared stockpiles, and coordinated supply chains. A rethink of industrial posture is necessary—not just to ensure peacetime readiness but to be able to sustain and surge to support combat operations against a near-peer adversary in the case of protracted war. This posture needs to include considerations of the possibility of *economic* warfare, whereby potential adversaries control the production of and withhold inputs to necessary-to-manufacturing defense components.

Future war will require the industrial base to be responsive to the unprecedented, persistent innovation loop of technology on the battlefield. Russia's war in Ukraine has showcased a level of technological integration whereby lessons from the front lines are shaping what is produced within days or weeks. The war has demonstrated the efficacy of dual-use technologies, such as drones that are widely available on the commercial market and simple enough to build in small factories; an increased use of electronic warfare, requiring the continual evolution of system technologies; and an increased availability of intelligence, surveillance, and reconnaissance (ISR) technologies (both drone- and space-based), removing the element of surprise. All of these factors will require updating acquisition approaches for any nation working to maintain its warfighting effectiveness. Slow and deliberate processes that prioritize cost efficiency will not deliver capabilities at the pace of warfighting necessity.

Lessons from Current Wars

The Importance of Production

Russia's war in Ukraine has resulted in staggering levels of materiel consumption. Both sides have burned through artillery shells, precision-guided munitions, drones, and other equipment at rates that dwarf peacetime forecasts. Similarly, Israel's operations in Gaza since late 2023 in response to Hamas's October 7, 2023, attack have demonstrated the pace at which a modern military can expend munitions, even in a small geographic area, and risk depleting national munitions stocks.[4]

The challenge of ensuring adequate stockpiles is also a significant finding from wargames, including those examining a potential conflict over Taiwan. In these simulations, forces often run out of critical munitions—particularly long-range precision weapons—within days.[5] For the United States, demand in these scenarios often exceeds current industrial capacity, suggesting the need for a significant reimagining of stockpiles and surge capabilities. Analysis shows that rebuilding U.S. inventories for some systems provided to Ukraine will take years.[6] European industry has worked to build capacity, but it still faces supply constraints.[7] Russia has invested in growing its industrial base to meet the demands of its war but has still benefited from imports of dual-use components.[8]

Surging manufacturing is not merely a matter of sending orders to prime contractors, or of increasing orders at government owned factories. Entire defense supply chains need to be ready to expand production.[9] Supply chain complexity muddles this effort, since prime contractors may not even know who supplies components at the lowest level of supply chains, with the additional risk that adversaries may control production of necessary inputs, such as critical minerals.[10] The defense industrial bases of most major powers are not incentivized for resilience during peacetime and will face challenges surging during wartime, especially during initial phases. Market-based defense industries prioritize efficiency and profit, rather than excess capacity, which increases costs. Nations with centralized planning—like China and North Korea—are the most able to direct sustained defense production in peacetime.

China's industrial policy has supported its development into the world's manufacturing powerhouse, with as much as 50 percent of its manufacturing potentially dual-use.[11] It has invested heavily in its defense industrial base, including in munitions and shipbuilding, with some analysts assessing that the nation's defense industrial base is on a "wartime footing."[12]

China also dominates in a number of necessary sub-tier parts of the supply chain, including critical

minerals processing, which raises the question of supply chain security. Industrial readiness requires attention to a production ecosystem that includes both systems integrators and suppliers. Component, subcomponent, and material suppliers face the same challenges of expanding manufacturing as prime contractors, including workforce and facility constraints. Complex supply chains may have 10 levels or more, so it may be difficult to assess risks, including risks posed by single-source suppliers or dependencies on unreliable international sources.[13] Investments in readiness must apply to the entire supply chain, and a consistent focus on supply chain illumination to identify and remediate sources of risk needs to be part of an industrial base strategy.

The Need to Overcome Inertia and Invest Consistently

The importance of the defense industrial base is not a new concept, but many nations have underinvested in capability and capacity. Even before the end of the Cold War, one analyst offered that "the US defense industry in 1988 bears little resemblance to the 'Arsenal of Democracy' that turned out tanks and airplanes in legendary numbers during World War II. American industry today cannot meet surge or wartime mobilization needs. It even has difficulty with peacetime defense requirements."[14] The reasons stated then remain familiar today—increased outsourcing, workforce challenges, and smaller defense budgets.

Recent U.S. administrations have highlighted industrial base and supply chain risks. The 2010 Quadrennial DefenseReview included a call to revitalize the defense industrial base.[15] During the first Trump administration, Executive Order 13806 called for an assessment on how to strengthen the defense industrial base, which was published in 2018.[16] Even before Russia's invasion of Ukraine, the Biden administration published a report on the security of defense-critical supply chains, highlighting limitations in kinetic capabilities, among other inputs.[17] Repeated warnings about defense industrial base challenges have yielded some action, including the development of the first ever National Defense Industrial Strategy in 2023.[18]

Most of the rest of the world has similarly underinvested in production capacity over time. One analysis found that "the uncomfortable truth emerging from the ongoing war on European soil is that European countries have barely prepared for war at all. Russia's war of aggression against Ukraine has revealed significant shortcomings in the capacity of European NATO governments to supply and arm a neighbouring partner, much less fight a major war themselves."[19] Many European nations focused on social spending instead of investing in their national defenses at the NATO target of 2 percent developed in 2014, and only after Russia began its attack on Ukraine did the number of nations at that target increase from 6 in 2021 to 23 in 2024.[20] The European Union issued a defense industrial strategy in March 2024, with the goal of enhancing defense industrial capacity by 2024, hoping to address challenges of "fragmentation and limited collaboration, exacerbated by EU Member States' dependency on non-EU defence equipment."[21]

The Australian government's relatively small requirement has meant that maintaining consistent production over time has been difficult.[22] It released a Defence Industry Development Strategy in 2024 to address long-standing production challenges.[23] Until recently, Japan banned defense exports, which limited industry to Japan's small defense market and made the country less well-postured to surge.[24] In contrast, South Korea's defense industry grown over time, with investments spurred by the proximity of nuclear-armed North Korea and enhanced by strong government partnerships with industry.[25] South Korea's strong industrial base has postured the country to win contracts with new customers, such as Poland.[26]

One nation has followed a dramatically different approach. Over the last decade, China has visibly expanded its defense industrial base and made investments in capabilities, such as shipbuilding, that have dual-use potential.[27] Chinese production of key platforms and munitions now far outpaces that of the United States, reinforcing that planning for a short war is a gamble unless the U.S. industrial base is transformed.[28]

Not all the industrial base lessons from Russia's war in Ukraine are stories of persistent challenges

and unaddressed gaps. One takeaway is that conflict generates the urgency for putting an industrial base on a wartime footing. Russia has pivoted its economy toward the production of weapons, and while its industrial base has been assessed as a continuing weakness, one recent analysis suggests that Russia's economy has been resilient.[29] Ukraine has vastly expanded its network of factories, drawing on the labor of women of all ages, along with some men who are able to work in defense factories rather than serving on the front lines.

Allies and Partners as Force Multipliers

Even beyond offering second sources of supply and the potential for surge capacity, current conflicts have highlighted the importance of allies and partners. In Russia's war in Ukraine, both sides have relied on material and technical know-how provided by other nations. Materiel provided by allies and partners sustained Ukraine in the early part of the war even more than its own industrial base, which had been underinvested in before the invasion.[30] A Ukrainian economic nongovernmental organization reported that $118 billion of aid has come from abroad, with the United States and EU nations being the most important sources.[31] The United States and NATO allies have a wide range of offensive and defensive systems, including ammunition, artillery, bombs and rockets, air defense systems, ground vehicles, drones and aircraft (including F-16s), and a range of other systems.[32]

Russia has also benefited from being able to access the industrial bases of other nations, following a more transactional approach. China, Iran, and North Korea have made components, capabilities, and other forms of support available to Russia, which has strengthened its supply chain and its ability to sustain its war against Ukraine. A statement from U.S. Indo-Pacific Command in the spring of 2025 suggests that China has provided 70 percent of the machine tools and 90 percent of the legacy chips that Russia needed to reset its industrial base and ramp up production.[33] Iran initially supplied Russia with drones and then later provided Russia the technical and production knowledge necessary to expand its indigenous production of military drones.[34] Iran has also supplied Russia with short-range ballistic missiles.[35] North Korea has provided millions of rounds of ammunition, at least 100 ballistic missiles, and "elements of three brigade sets of heavy artillery, including DPRK-origin 170mm long range self-propelled artillery pieces, 240mm long-range multiple rocket launchers, more than 200 total vehicles, self-propelled guns, multiple rocket launchers, and reload vehicles for both types of weapons," according to an multilateral monitoring body.[36] In return for this support, Russia has provided its more advanced military technologies to its partners.[37] Along with insight into how their equipment performed on the battlefield, China may get advanced equipment and technology, including relating to aerospace; Iran is getting a range of equipment, including helicopters, radars, and fighter aircraft; and North Korea is accessing information on missiles and satellite technology.[38]

The Role of Innovation

Russia's war in Ukraine has showcased a level of technological integration that marks a step change in modern warfare, with implications for the industrial base. Ukraine has pioneered a variety of innovations in what has been termed "the first full-scale drone war."[39] Even early in the war it was clear that "Ukraine's widespread and successful use of newer systems [was] placing emerging tech into the military mainstream."[40] Ensuring that warfighters have capabilities that are keeping pace with the evolution of adversary systems requires an approach to acquisition that is fast, flexible, technically informed, and able to work with a range of defense contractors—from traditional primes focused on systems integration to cutting-edge innovation providers. Ukraine's distributed model of technology development has allowed for the emergence of new ideas from the private sector, with battlefield demands driving innovation, but has also made these innovations harder to scale.[41] Russia has responded with investments in its own innovation ecosystem, with recent analysis suggesting that a more centralized planning and production approach has enabled it to outpace Ukraine in its ability to develop, scale production of, and field

new systems.[42] The ability to nimbly incorporate technology evolution is important, but it does not outweigh the ability to produce systems in the quantities needed for industrial war.

The ability to nimbly incorporate technology evolution is important, but it does not outweigh the ability to produce systems in the quantities needed for industrial war.

Drones offer a useful case study on the role innovation has played. Ukrainian forces have used drones for ISR and strike, with some analysis suggesting that over the first three years of the war, drone attacks were responsible for 70 percent of Russian casualties and 90 percent of equipment losses.[43] These strikes were enabled by other capabilities, as Ukraine has taken commercially available drones and coupled them with electronic warfare and ISR systems. Over the course of the war, Ukraine has expanded its factory network, and the production of drones has risen dramatically, reducing the nation's import dependencies on commercially available drones.[44] This has reduced Ukraine's supply risk, given that China leads the world in commercial drone production and has also supported Russia in the war. Production in Ukraine has been decentralized, which has allowed for an increase in facilities and reduced risk from Russian precision attacks on defense factories.[45] Military units have maintained and repaired these systems on the front lines.[46] This also brings an advantage because systems need to be updated rapidly to address changes in adversary capabilities, including in electronic warfare.

The war has also cast some doubt on the utility—or at least the survivability—of expensive and exquisite weapons systems.[47] The sinking of Russia's *Moskva* cruiser by Ukrainian missiles early in the war offers a notable example of a strategy of cost imposition.[48] This aligns with other analysis, including from wargames, which suggests that technological evolution puts a wider variety of systems at risk.[49] The challenge going forward will be using these lessons to reshape larger acquisition programs, which have constituencies with other objectives including maintaining industrial production at current facilities and ensuring local employment levels. While these may be worthy goals, there needs to be balance to ensure that resources are available to invest in new types of systems with greater battlefield effectiveness.

Conclusion

Russia's war in Ukraine has lasted three-and-a-half years as of this writing. It has become a grinding conflict featuring the heavy expenditure of munitions and the adoption of new technology, including the increased use of drones. The defense industrial bases of both nations have been dramatically reshaped, moving to a wartime footing and incorporating more rapid innovation. Both nations have also relied on partners and allies for the provision of munitions and other capabilities as well as for supply chain inputs. Neither nation's industrial base was prepared for protracted war, and support for Ukraine has strained allied production.

In the Israel-Hamas conflict, Israel has much more robust military capabilities and has dominated the battlefield, but it has relied on its ally the United States for munitions, missiles, and other systems being used in the protracted fight.

These conflicts, along with recent wargames, have highlighted concerns about the availability of capabilities necessary to stay in the fight in the case of protracted war. Even in times of peace, nations must focus on the industrial base to ensure they have the capabilities and capacity when needed in the case of a long conflict. This includes paying attention to risks in the entire supply chain, including by continually investing in supply chain visibility to look for constraints and for chokeholds potential adversaries may have on the production of necessary inputs. A robust defense industrial base is expensive and must be defended even in times of peace in order to be ready in times of war. Working with allies and

partners is a strategy that strengthens ties and offers expanded production capacity while spreading the investment burden.

These lessons are not new, and the risks of an inadequate defense industrial base have been highlighted over the decades. In democratic nations with market economies, addressing industrial base challenges will require considerable senior leadership support, funding, and efforts to identify and eliminate policies that limit flexibility. Nations with centralized planning—or ones that face ongoing threats, such as South Korea—are better able to support industrial base investment.

Recent conflict, especially Russia's war in Ukraine, has featured an increasingly rapid refresh of technology on the battlefield. More flexible acquisition approaches that partner operators with acquisition professionals will enable better access to innovation.[50] Open-systems approaches that allow for the rapid refresh of subcomponents can offer advantages over large, "exquisite" systems that are more difficult to update.[51] Rigid approaches where funders apply resources to specific programs limit the ability to move funds to new innovations as the need arises. During wartime, many of the more formalized acquisition regulations often are traded for the flexibility of "urgent operational needs," but allowing and practicing this flexibility in advance could create a more innovative defense sector, and one that is more rapidly adaptable in case of conflict.

As dramatically different as they are, Russia's war in Ukraine and the Israel-Hamas conflict both show the likelihood of conflicts becoming protracted. Nations that are concerned about being pulled into combat must focus on strategies to ensure they have the weapons they need to compete on the battlefield. Munitions are a particularly important investment, yet one that has been harder to justify when nations are not drawing on stockpiles in their own defense or to support partners. Peacetime approaches to defense industrial production that prioritize managing cost over ensuring capability will be insufficient to meet the needs of modern war. Planning and resourcing for conflict with the expectation that it will be over quickly creates the risk that nations will not have the capabilities they need to win, or even to stay in the fight over the long term. The nations with the stronger industrial bases, with the more robust supply chains, and with the closer defense industrial ties with allies and partners will prevail, and those that do not deliberately focus on these capabilities during peacetime will fail during war.

CHAPTER 15

Power Projection and the Logistics of Modern War

Cynthia R. Cook

In future conflicts, robust logistics will continue to help win wars—and contested logistics will determine who can fight at all.

Warfighting readiness and resilience have always been central to securing victory during conflict. Even as warfare evolves and the concepts, equipment, and supplies develop and change, there can be no success in warfare without the logistics enterprise. There is a persistent cliché that amateurs study strategy and experts talk logistics. A more exact formulation would be that experts understand the importance of logistics and readiness to their strategy, and plan and resource accordingly.

There is increasing recognition of the possibility of protracted war requiring larger stockpiles of—or the ability to rapidly surge—a wide range of supplies. There are new challenges to power projection, including contested environments with persistent surveillance and adversaries with long-range, precision-guided munitions. Resource challenges can lead to underinvestment in regular maintenance, limiting readiness. Whether nations are supporting an ally (e.g., the United States reinforcing Ukraine and Israel or China backing Russia) or are engaged directly in a major conflict, successfully addressing logistics challenges determines the feasibility and tempo of military operations.

Technological change, including automation, advanced manufacturing, and AI, offers the potential to enhance planning and reduce logistical pressures. But these innovations cannot eliminate the fundamental problem of sustaining high-intensity operations across thousands of miles. Current conflicts show that nations continue to see the operational value in attacking each other's logistics enterprises. Strong relationships with allies and partners allow for pre-positioning, industrial base support and mobilization, forward locations for sustainment, and enhanced transportation networks. In other words, these relationships are force multipliers.

This chapter begins with a short overview of the components of the logistics enterprise to set the stage. It examines lessons from recent ongoing conflicts, including Russia's war in Ukraine and the Israel-Gaza war, and evaluates their applicability to

PHOTO: JOHN MACDOUGALL/AFP/GETTY IMAGES

future war, drawing out readiness and sustainment implications. It concludes with recommendations for innovations specific to projecting and sustaining forces in a contested environment, with a focus on technological innovation, industrial cooperation, and allied partnerships.

However, logistics enterprises by nature are very complicated and diverse, making a thorough review of lessons learned and insights for future war an impossible task. The literature on these conflicts is extensive. Even a subset of current experiences is enough to stress the imperative that operators and planners focusing on contested logistics ensure the enterprise is adequately resourced and available to support future plans. Assessing whether strategy leads logistics or logistics has the primacy over strategy is less important that taking the steps to invest in and ensure readiness.[1]

The Nature of the Power Projection Challenge

Power projection is a function not only of capabilities, but also of context: Is the nation directly engaged, or is it supporting an ally? Is the theater permissive or contested? Is the objective short-term crisis response or sustained deterrence and warfighting? In almost every case, forward support is necessary. Transportation networks must be defined and defended. Plans for weapon system maintenance and battle damage repair—preferably forward closer to the flight, to avoid the challenge of contested logistics when sending equipment to be fixed—must be developed in advance, an effort which may include engaging with allies and partners and contracting with industry. Military logistics also encompasses the life-cycle management of necessary materiel; this includes requirements setting, acquisi-

Table 15.1: Class of Supply

Class	Description
I	**Subsistence**, including food and food-related supplies, including condiments, utensils, paper products and bottled water
II	**Clothing**, individual equipment, tentage, organizational tool kits, hand tools, and administrative and housekeeping supplies and equipment
III	**Petroleum fuels**, lubricants, hydraulic and insulating oils, preservatives, liquid and compressed gases, bulk chemical products, coolants, de-icing and antifreeze components, together with components and additives of such products, and coal
IV	**Construction materials** including installed equipment and all fortification or barrier materials
V	**Ammunition**, to include military munitions, of all types (including chemical, biological, radiological, and special weapons), bombs, explosives, mines, fuses, detonators, pyrotechnics, missiles, rockets, propellants, and other assorted items
VI	**Personal demand items** (non-military sales items)
VII	**Major end items.** A final combination of end products that is ready for its intended use (e.g., launchers, tanks, mobile machine shop, and vehicles)
VIII	**Medical materiel**, including medical-peculiar repair parts
IX	**Repair parts and components**, including kits, assemblies and subassemblies, and reparable and consumable items required for maintenance support of all equipment, excluding medical-peculiar repair parts
X	**Materiel to support non-military programs**, such as agricultural and economic development, not included in classes I through IX.

Note: Taken directly from source. Bold formatting added.

Source: Office of the Under Secretary of Defense for Acquisition and Sustainment, "DoD Supply Chain Management Procedures: Material Returns, Retention and Disposition," *DoD Manual* 4140.01, vol. 6 (Washington, DC: U.S. Department of Defense, 2022), https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/414001m/414001m_vol06.PDF?ver=aF45YIqclvKJK3Z8Cu3GQw%3D%3D.

tion, distribution, maintenance, and disposition. Planners must ensure warfighters and support personnel can make it to the conflict zone, where there needs to be adequate facilities, services, and medical support.

Understanding the challenge of readiness begins with a recognition of the types of materiel necessary to support the fight. For reference, the United States military divides this into classes of supply, each of which has its own procurement challenges. Table 15.1 lists the 10 classes of supply. Of particular note is Class V, or ammunition, which includes munitions of all types. The readiness enterprise thus overlaps with industrial base production considerations.

This granular listing of the types of materiel needed in modern war is intended to ground the understanding of the logistics challenge. In any conflict, the logistics enterprise must plan to acquire and deliver a very wide variety of materiel and equipment to the front lines.

Along with the materiel necessary for the fight, the readiness challenge extends to maintenance, repair, and overhaul of existing systems. For any type of military capability, there are always tradeoffs between the procurement of new equipment and the maintenance of existing equipment and production lines. Regulatory frameworks may limit where maintenance can occur, and who can do it. Forward-deployed assets need regular maintenance, and equipment that has suffered battle damage will need to be repaired. Ensuring adequate resources in a constrained environment—where funds too often prioritize new systems rather than sustaining the ones currently in the fleet—is an ongoing challenge.

Logistics includes transportation to the point of need, which can vary from simple containerization for items such as clothing to complex handling requirements for munitions and medical supplies. Logistics also requires the transport of personnel. Transportation of equipment, supplies, and personnel includes movement from the rear to the theater, and within the theater itself. Each of these layers has a different set of associated challenges.

Finally, effective logistics includes a significant amount of planning and coordination. Capable oversight and management are critically important for the enterprise. Each of the aspects listed above requires different expertise, draws on different sources, and, above all, requires adequate resources, including funding. For example, the different U.S. military services have varying needs and individually engage in logistics planning and operations as they organize, train, and equip for the joint force, with additional joint organizations and concepts aimed at coordinating support.[2]

Joint concepts in the United States highlight the need for adequate resources, the ability to allocate those resources appropriately using information technology, the ability to manage and prioritize logistics capability, and the necessary transportation assets.[3] These concepts call for a transportation network able to move people, equipment, and supplies to and within the theater, the capacity to pre-position supplies, and a worldwide network with multiple options.[4] More realistically, the goal of speed is challenged by the fact that movement frequently requires the use of large and relatively slow ships that transit through congested and vulnerable choke points.

Lessons from Russia's War in Ukraine and the Israel-Hamas Conflict

Recent ongoing conflicts offer valuable insights into both logistics failures and successful adaptations. These lessons show that logistics must be tailored according to the nature of the conflict, with planning shaped by the realities of geographic and operational requirements.

Russia-Ukraine

Russia's buildup on Ukraine's border prior to its attack in February 2022 meant that the eventual invasion was not a surprise.[5] The attack on Crimea eight years earlier created the opportunity and the will inside of Ukraine to invest in systems and the reforms that have contributed to its ability to sustain its self-defense over time, bolstered by allied support. Over the course of the current conflict, both sides have worked to expand sources of supply; maintain and repair equipment; move supplies, equipment and person-

nel to and around the battlefield; engage in protection of their transportation nodes and supply depots; and adapt and update their planning in response to adversary activities. The prevalence of drones and improvements in intelligence, surveillance, and reconnaissance (ISR) have made fixed logistics networks and nodes even more vulnerable than in the past, requiring ongoing adaptation. The war has reinforced the importance of the logistics enterprise to operational success, including planning and reacting to change.

Russia's plan to immediately dominate Ukraine failed in part because of assumptions related to the expected length of the conflict, which led to a lack of preparation. Early analyses pointed to a variety of logistics challenges: Russian convoys stalled without fuel, tires failed due to poor maintenance, and logistical units lacked protection and flexibility.[6] Images of stalled trucks on the road to Kyiv became iconic representations of Moscow's failures. Russian forces experienced shortages of food, water, and medical supplies.[7] But Russia's initial challenges were not simply features of its decision to attack in 2022. They were the result of long-standing issues for Russian logistics: systematic resource inefficiency, inadequate investments in supplies, and corruption in procurement.[8]

The length of the war has given Russia the opportunity to recover and adapt from its early misfires. The nation has mobilized its industrial base to support the war. Russian operational logistics now emphasize dispersed logistics nodes, greater use of rail and civilian vehicles, and battlefield repair under fire. Motorcycles that can travel across open fields are being used for troop movement and logistics support.[9] Russia is getting supplies from China and North Korea, with China supplying dual-use items such as microelectronics and machine tools that can be used for military production and North Korea notably supplying both troops and end-use items such as munitions.[10] Russia has addressed labor shortages in its industrial base in a variety of ways, including with programs to teach school children how to design, manufacture, and operate drones.[11] Moscow has also worked to create a contested environment, attacking Ukrainian logistics using drones.[12]

On the other side, U.S. and NATO support to Ukraine has been enabled by the proximity of allied territory and bases. Weapons and equipment have flowed overland from Poland and Romania, enabled by NATO's secure rear area. Nonetheless, even this relatively favorable logistics environment has required planning, adaptation, and coordination. Moving munitions from the United States across the Atlantic to the European theater and within the theater is operationally complex. Ports have quantity limits for safety reasons, requiring careful pacing of deliveries, and transportation has to be smooth across vectors.[13] Allied support has not entirely made up for the fact that Ukraine is outmatched by Russia's size and industrial capacity, and one of its responses has been to attack Russian infrastructure, including fuel storage facilities, munitions depots, and rail lines. These attacks have shown that constant pressure on supply chains can, in fact, help a smaller country compete with a bigger player's industrial might.[14]

To ensure the rapid flow of support, allies have provided Ukraine with existing rather than new systems, with one benefit for the provider countries being the opportunity to update their own fleets and support their industrial bases.[15] As a result, some of the drawdown equipment has needed to be repaired before it arrives in Ukraine, which has not always been completely carried out.[16] Early in the conflict, Ukraine needed strategies to ensure repair and maintenance of provided equipment, as well as to repair battle damage.

Additionally, the diversity of equipment provided to Ukraine by its allies means that there are a variety of repair approaches and supply chains, and sourcing adequate spare parts has been a challenge.[17] Advances in communications technology have enable tele-maintenance, with experts in the rear providing guidance, but Ukraine still faces shortfalls.[18] As one retired U.S. Army general put it, there is now a concern that Ukraine will face a situation "when the cumulative effect of sustainment shortfalls forces fundamental changes in operational posture and battlefield decision-making."[19]

Logistics support also includes medical materiel. One analysis found that the scale of munitions used in

the conflict has meant an increase in severe injuries, which has implications for the requirements for field hospitals, supplies like whole blood, and medical staff who can treat patients.[20]

Constant drone surveillance by Russia has also complicated resupply, especially to soldiers in trenches on the front lines. Ukraine has adapted drones to deliver supply packages to its forces, to reduce the risk of being located and attacked. These deliveries include food, water, ammunition, and other supplies necessary for sojourns in trenches that may last for weeks.[21]

Like Russia, Ukraine has adapted its own logistics enterprise through the course of the war and has worked to attack its adversary's logistics networks. The question now is which side will have the resources to sustain the fight longer. Adequate materiel (e.g., munitions), weapon systems sustainment, and transportation will be keys to victory.

Israel-Gaza

Unlike Russia's full-scale invasion of Ukraine, which was signaled by a military buildup and Russian leader messaging, the October 7, 2023, attack on Israel by Hamas was a strategic surprise (in spite of intelligence analysts and border sentries trying to warn leadership that an attack was imminent).[22] While Israel was not ready to immediately counter in the first few hours of the attack, it had the resources to begin extensive airstrikes on Gaza the next day and began a ground attack before the end of the month.

Israel has a much more capable military than Hamas, with a much larger end strength and high-end equipment. It has continued to press the war after two years, with the goals of eliminating the threat that Hamas represents, retrieving the remaining living hostages captured on October 7, and recovering the bodies of the hostages that have died in captivity. Hamas has committed fighters and has the advantage of a hidden tunnel network underneath Gaza to hide in and fight from, as well as access to manufacturing and storage facilities. Hamas also benefits from a global response to the wider humanitarian suffering in Gaza, which has led some nations to limit exports to Israel.[23]

Israel's ability to respond rapidly and in force has been bolstered by its close alliance with the United States. Shortly after the October 7 attack, United States Transportation Command began delivering munitions, spare parts, and interceptors directly into Israeli air bases, demonstrating the logistical power of U.S. airlift.[24] Attacks on ships by Houthi rebels in Yemen led the command to reach out to commercial sealift partners to plan how to mitigate such risk.[25]

The United States' simultaneous provision of munitions to Israel and Ukraine has led to questions as to whether the nation has sufficient stockpiles to support both conflicts while simultaneously preparing for other potential wars.[26] Israel has faced industrial base and stockpile challenges, including for its Iron Dome interceptors.[27] Ensuring the adequacy of munitions stockpiles and being ready to mobilize the industrial base are difficult but necessary problems to solve.

Hamas's munitions supply chain has included scavenging materiel left behind on battlefields by Israeli soldiers and taking unexploded Israeli ordnance, including bombs, missiles, and artillery shells, and remanufacturing them into improvised explosives, rockets, and missiles in factories in its underground tunnel network.[28]

A related conflict has also showed the risk of supply chain attacks and the importance of protecting sources of supply from infiltration—a lesson that applies to information systems as well as the industrial base. Israel's infiltration of Hezbollah's pager supply chain enabled the inclusion of a small amount of explosives, which were then detonated in an operation in September 2024.[29] Information systems need to be protected to ensure that adversaries do not have access to sensitive information (e.g., where supplies are stored or transportation plans) and also cannot inject false data (e.g., inflating readiness numbers or misdirecting supplies).

The particularities of Israel's case reveal the limits of using specific lessons learned for other conflicts. Israel is a small country with dense infrastructure and has been able to use relatively permissive airspace in its attacks. Many of the engagements in

Gaza have taken place in urban areas with an extensive underground tunnel network. These physical characteristics will not apply to other situations, particularly those in the Indo-Pacific in any potential conflict with China. The distances would be vastly greater, the adversary more capable, and the logistics far more complex.

Implications for the Future of Warfare

While the Ukraine and Israel cases underscore the enduring centrality of logistics, they also demonstrate that each conflict is unique and that the lessons from one may be only partially applicable to the other. For example, any Indo-Pacific conflict or war over Taiwan would be fought at sea and in the air, across thousands of nautical miles, and against a peer adversary with robust ISR and precision strike capabilities. Nations participating in that or any other conflict could not assume secure overflight rights, permissive air bases, or nearby overland supply routes. Logistics would be contested, and the persistence of satellite surveillance means that operating in secrecy is increasingly impossible.

Along with the warfighting capabilities of potential adversaries, nations should look to understand an enemy's logistics capabilities and investments as an indicator of how challenging any engagement might be.

Along with the warfighting capabilities of potential adversaries, nations should look to understand an enemy's logistics capabilities and investments as an indicator of how challenging any engagement might be. China's preeminent role in global shipbuilding and dual-use shipyards has enabled the People's Liberation Army to draw on commercial infrastructure, investment, and intellectual property for naval shipbuilding.[30] China is producing an increasing number of roll-on/roll off (Ro-Ro) ships that are used to transport vehicles, including military vehicles.[31] The nation is also reportedly stockpiling commodities, including grain, oil, and gas, and is making global investments in logistics to allow for expeditionary operations.[32]

Though the comparison is not one-to-one, several lessons from the ongoing conflicts should be taken into consideration by the United States:

- **Make logistics readiness an ongoing priority.** As seen by Russia's initial experience in Ukraine, waiting for the test of war to identify logistics gaps can have disastrous consequences. Investments in weapons systems readiness, stockpiles, industrial surge capacity, and appropriate planning capabilities must be developed and in place before the fight begins. Israel's relative level of readiness led it to be able to respond to the attack quickly, although it has relied on support from an ally to have the materiel necessary to continue the fight. The challenge is in having adequate resources and managing the trade-offs between supporting existing systems and making plans to procure newer ones.
- **Assume supply lines will be targeted.** Attacks on logistics and supply degrade opponents' ability to wage war, and these types of attacks have been and will continue to be a feature of modern war. Just as Ukraine has targeted Russian ammunition depots, transportation networks, and logistics hubs, and Russia has responded in kind, modern war will likely include strikes on fuel depots, ports, and airfields. Pre-positioning materiel in areas of potential conflict can help reduce this risk, although developing "iron mountains" of materiel offers valuable targets for adversaries.
- **Make partnerships a priority.** Support from its partners has enhanced Ukraine's ability to stay in the fight, and Russia has similarly benefited from supplies delivered by other nations, especially China. In a fight in the Indo-Pacific, Australia, Japan, and others could offer sup-

port for the United States—but only if planning, access agreements, and co-location efforts occur in advance. These agreements can include pre-positioning materiel, including consumable supplies arrangements, to support weapons system sustainment. The United States has developed a variety of agreements along these lines, including the Regional Sustainment Framework, the Partnership for Indo-Pacific Industrial Resilience, and the Defense Industrial Cooperation Framework between the United States and Japan.[33] China, Iran, and North Korea have supported Russia in a variety of ways, including by bolstering the country's logistics and readiness enterprise with materiel such as spare parts. Those relationships seem to be more transactional, with each of Russia's supporters receiving funding, technology, or other kinds of information or access in return for assistance.

- **Partner with industry to ensure adequate capacity—including surge—of all aspects of logistics support.** In a conflict, industry will likely need to mobilize to surge production of all classes of supply, along with expanding transportation. Stockpiles of consumables and spare parts will provide the initial ability to fight back and allow time to engage the industry base. Creating agreements in advance to surge when necessary, rather than scrambling to do so in the hour of need, will enable smoother and more effective support. In one example, the United States' Civil Reserve Air Fleet can be tapped to transport personnel and cargo if necessary, with airlines getting payments to participate in the program on an ongoing basis. Additionally, the Defense Production Act offers a set of authorities to engage the industrial base for national defense purposes.[34] These and similar laws and arraignments should be reauthorized when necessary and adequately resourced.

There are also several emerging technologies that the United States should engage with that offer pathways to reduce vulnerability and enhance readiness:

- **Additive Manufacturing:** The 3D printing of spare parts can reduce dependence on long supply chains, reduce contested logistics related to getting the supplies to the fight, and speed the availability of spare parts. Intellectual property considerations relating to the ownership of design and approaches to qualify parts should be addressed in advance, as should the training of those expected to serve toward the front, to ensure effective maintenance and repair.
- **Tele-maintenance:** Modern information systems can allow rear maintainers to deliver training and information to the front lines.
- **New Approaches to Resupply:** Uncrewed ships and aircraft can deliver parts to the point of need, reducing the risk to personnel and allowing for a more distributed transportation network. Nontraditional systems like motorcycles are smaller than trucks and can bring goods closer to the front lines in some contexts.
- **Alternative Energy and Energy Networks:** Reducing fuel dependency by investing in hybrid platforms and renewable generation at forward bases will reduce the need to transport fuel to forward locations. It will also reduce the necessity to bring fuel transportation equipment such as tanker trucks and drivers, the additional security forces to protect those convoys, and the food, water, clothes, medical support, and other supplies that will be needed as part of that supply chain. Planning for energy availability, including developing contractual on-demand relationships with civilian suppliers in advance of conflict, can help ensure resiliency.
- **AI and Automation:** The equation of logistics includes determining what and how much is needed, and how to transport it to the fight. AI has the potential to increase the efficiency of planning for supply and to dynamically route and reroute logistics flows in contested environments. The concepts underpinning dynamic rerouting are not new, but the approach is facilitated by the dramatic increases in information

technology. But these approaches also expand the digital attack surface of logistics, which requires further investments in cybersecurity.

- **Cybersecure Logistics:** The information technology used in logistics planning and systems is critical. Nations must assume that cyberattacks will aim to cripple sustainment networks, either by limiting access to logistics systems or by injecting false information that can negatively impact planning and outcomes.

Investment in logistics innovation will not eliminate challenges, but it can reduce the necessary footprint, complicate adversary targeting, and increase responsiveness.

Conclusion

The importance of logistics and readiness is not a new lesson from the conflicts of this decade. The importance of sustainment and the need for effective logistics and supply are the lessons of every war. In future conflicts, robust logistics will continue to help win wars—and contested logistics will determine who can fight at all. Thus, readiness and sustainment should not be considered as back-office support functions, but as critical to operational readiness and to the fight. Lessons from recent conflicts are not proprietary, nor are they necessarily pertinent to all future scenarios. Competitors around the world are watching the same failures and adaptations, drawing their own conclusions. Relying on legacy assumptions of uncontested movement, protected infrastructure, and industrial dominance will be a recipe for failure.

Industrial capacity, logistics resilience, and allied coordination take years to build. Nations cannot wait until war is imminent to invest in sustainment technologies, forward partnerships, and stockpiling strategies. For future wars, states should consider the following actions:

1. **Continue to invest in approaches that address the issue of contested logistics.**
    - Expand pre-positioning of key consumables in likely conflict zones, with redundancy and deception built in.
    - Harden and disperse logistics nodes, including through mobile and sea-based systems. Ensure these are flexible rather than fixed. Trains can quickly transport large quantities of goods but are easier to target than motorcycles.
    - Develop and scale allied sustainment frameworks, with joint training and common standards. Build and strengthen these frameworks in times of peace so they are ready in times of war.
2. **Enhance planning for logistics, sustainment, and resilience.**
    - Make industrial base investments to ensure adequate access to munitions and spare parts. Engage industry in planning for sustainment in advance of conflict.
    - Invest in AI-enabled logistics planning, with resilience against cyber disruption.
    - Ensure that operators and planners are focused on logistics, not just the fight. Fund wargames and exercises focused on contested logistics as part of the warfighting framework. Ensure that these wargames can include the possibility of losing based on logistics shortfalls to ensure operators understand their importance.
3. **Plan for change during the conflict.**
    - Expect adversaries to adapt during the fight. Plan to capture lessons and insights on an ongoing basis to be able to adapt as effectively.

The future of deterrence and warfighting hinges not just on the operational concepts underpinning the fight and the capabilities that are used in it, but also on whether competitors can get to the fight at all. The lessons from Russia's war in Ukraine and the Israel-Gaza conflict suggest that protracted war should be part of planning scenarios. As a result, states should plan to sustain readiness through a conflict that may drag out for years, and where investments in logistics, readiness, and resilience determine the winner.

Conclusion

The Next Offset

Winning the Fight Before It Starts

Seth G. Jones

The United States is not adequately prepared for the future of warfare.

As the chapters in this volume highlight, the United States and its allies face one of the most dangerous international security environments in recent history, with war raging in Europe and the Middle East and tensions high in the Taiwan Strait, South China Sea, East China Sea, and Korean Peninsula. In this environment, some aspects of warfare are largely unchanged. As the Prussian general and military theorist Carl von Clausewitz argues, war is still at its core "an act of violence intended to compel our opponent to fulfill our will."[1]

Yet the character of warfare is evolving. There is an expansion of unmanned and autonomous systems—air, undersea, surface, and ground—that can be used for "precise mass," in which large numbers of inexpensive, accurate, and technologically advanced systems can be deployed together to target an opponent.[2] There will likely continue to be an explosion of open-source intelligence, and AI, quantum, and other technologies may be increasingly important on the battlefield. Thanks to commercial technology, there is a growing democratization of space that is shifting traditional notions of who can wield space capabilities in war, creating new motivations for adversaries to deny the advantages that space provides, and increasing counterspace capabilities.

Despite these developments, the United States is not adequately prepared for the future of warfare. It is not prepared to fight and win two or more major theater wars at the same time, its defense industrial base is not ready for a protracted conflict, and its defense budget is significantly lower than at any point during the Cold War as a percentage of gross domestic product.

One of the most urgent priorities—and the focus of this chapter—is the need to develop an *offset* to defeat and deter China, which has some advantages over the United States in mass and scale. An offset refers to an effort to affordably counter—or offset—an adversary's advantages through a combination of operational concepts and technology.[3] The focus on emerging technology, such as autonomous systems,

PHOTO: SHENG KIAPENG/CHINA NEWS SERVICE/VCG/GETTY IMAGES

cheap precision-guided missiles, and AI, has crowded out the development of a sound operational concept. Technology is important, but it has never been sufficient to win wars. Successful warfighting has required the establishment of an effective operational concept, which is then supported by relevant technologies. As Andrew Marshall, the long-time head of the Pentagon's Office of Net Assessment argued, "technology makes possible the revolution, but the revolution itself takes place only when new concepts of operation develop."[4]

A joint U.S. operational concept against a rapidly modernizing China should focus on preventing the People's Liberation Army (PLA) from conducting a successful invasion of Taiwan by swiftly striking at the center of gravity of the PLA's invasion force. Specific examples include PLA amphibious assault ships, landing craft, air assault helicopters, and airborne delivery planes carrying PLA soldiers, weapons systems, and equipment as part of an invasion. Based on this concept, the United States needs several types of capabilities: a mix of large nuclear-powered attack submarines and cheap underwater drones, since the PLA is relatively weak in the undersea domain; sufficient quantities of long-range missiles and cheap unmanned and autonomous systems to sink PLA ships and destroy other targets; and a combination of bombers and stealthy fifth- and sixth-generation aircraft to conduct penetrating attacks. But there is a lot the United States will not need in the quantities it has required in the past, such as large, expensive surface vessels and heavy land systems.

The rest of this chapter is divided into seven sections. The first examines Eisenhower's New Look and the first offset in the 1950s. The second section shifts to Air-Land Battle and the second offset, which began in the 1970s. The third provides a brief overview of the third offset in the mid-2010s. The fourth section explores the China challenge, including PLA modernization and an industrial base that is on a wartime footing. The fifth outlines a new offset and an operational concept designed to defeat a PLA amphibious invasion. The sixth section discusses the key capabilities needed for a new offset. And the seventh section provides a brief conclusion.

New Look

The first offset took place during the Eisenhower administration in the 1950s, when the United States faced a major Soviet threat in Europe. The Soviet Union had nearly three times the number of ground forces in Europe as the United States and its allies, and it was building a formidable industrial base. As the Eisenhower administration's top-secret policy paper NSC 162/2 concluded, "The USSR has sufficient bombs and aircraft, using one-way missions, to inflict serious damage on the United States, especially by surprise attack. The USSR soon may have the capability of dealing a crippling blow to our industrial base and our continued ability to prosecute a war."[5]

President Eisenhower concluded that deploying and sustaining a large U.S. force in Europe would likely weaken the U.S. economy, which at the time was recovering from the Korean War. Instead, his administration developed an offset strategy called New Look, which was designed to counter Soviet advantages in conventional forces. New Look involved building an overwhelming nuclear advantage and, in a war, using tactical nuclear weapons against Red Army troops—including inside West Germany. As described in NSC 162/2, the United States would develop the capability to inflict "massive retaliatory damage by offensive striking power," including with tactical and strategic nuclear weapons.[6] For officials like Secretary of State John Foster Dulles, this doctrine of "massive retaliation" meant that the United States would respond disproportionately to a conventional attack.[7] The U.S. Army fielded infantry and airborne divisions, including the Pentomic Division, that were designed to fight and win a nuclear war. The goal was to strengthen deterrence and persuade the Soviet Union *not* to start a war, but to nevertheless be prepared in case of a conflict.

Consequently, New Look led to a major investment in two areas: nuclear weapons and long-range bombers. The first involved a rapid increase in the development and production of nuclear weapons and delivery vehicles, especially intercontinental ballistic missiles (ICBMs). The U.S. Air Force ramped up development of the liquid-fueled Atlas ICBM and multistage Titan I, as well as two types of guided missiles:

the subsonic, ground-launched Snark cruise missile and the supersonic Navaho cruise missile. Testifying before Congress in 1956, Chairman of the Joint Chiefs of Staff General Nathan Twining explained that the Pentagon gave "the very highest priority" to Atlas production to offset Soviet military capabilities.[8] The United States also developed several other missiles capable of carrying nuclear warheads: the Polaris submarine-launched ballistic missile, the Thor intermediate-range ballistic missile, and the Jupiter medium-range ballistic missile.[9]

The second priority was long-range bombers that could carry nuclear weapons. The backbone was the B-52, a long-range bomber capable of flying at subsonic speeds that could carry nuclear and conventional ordnance. The B-52 could also perform a range of missions, including strategic attack, close air support, air interdiction, and offensive counter-air operations. In 1956, President Eisenhower and Secretary of Defense Charles E. Wilson asked Congress for an additional $248.5 million to increase B-52 production from 17 aircraft per month to 20 per month. They also requested another $128 million to expand air base infrastructure necessary for the B-52 force.[10]

The result was impressive. The Soviet Union was deterred in Central Europe, and the United States held a commanding lead over the Soviet Union in missiles by the 1960s—including nuclear missiles.

Air-Land Battle

By the 1970s, however, the United States was in danger of losing deterrence in Central Europe, thanks to U.S. defense cuts and Soviet advancements. The Soviet Union had reached nuclear parity with the United States and also had a three-to-one advantage in conventional capabilities in Central Europe.

U.S. Department of Defense officials sparked a fundamental shift in U.S. defense policy during the Carter administration—a second offset—led by such individuals as Secretary of Defense Harold Brown and Undersecretary of Defense for Research and Engineering William Perry. The U.S. Army was also pivotal, including such individuals as General Donn Starry. At the core of Air-Land Battle was the concept of integrating land and air forces to conduct attacks against the Soviet military in three areas: close (at the front line of troops), rear (immediately behind the front line of troops), and deep.[11] As Air-Land Battle doctrine stated, "Successful attack will require isolation of the battle area in great depth as well as the defeat of enemy forces in deeply echeloned defensive areas. Successful defense will require early detection of attacking forces, prompt massing of fires, interdiction of follow-on forces, and the containment of large formations by fire and maneuver."[12]

One of the most significant complementary concepts was Assault Breaker, which was developed under the oversight of the Defense Advanced Research Projects Agency (DARPA).[13] Assault Breaker focused on offsetting Soviet capabilities by destroying waves of Soviet forces that broke through U.S. and other NATO defenses. Implementing Assault Breaker involved the research, development, production, and deployment of sensors, computer programs, stealth capabilities, high-speed digital communications, and precision weapons to strike hardened mobile targets, such as tanks.[14] As Perry noted in a memo to Brown in August 1978, "In order to stop the second and third echelons [of a Soviet and broader Warsaw Pact attack against Western Europe] with conventional weapons, we need to 'see deep' and 'shoot deep'; that is, detect and place precision weapons on targets 30 to 50 KM behind the FEBA [forward edge of the battle area]."[15]

The efforts of Brown, Perry, and other Pentagon officials led to the production of an array of smart weapons, such as stealth platforms like the F-117 attack aircraft; artillery shells, such as the Copperhead 155 mm caliber cannon-launched guided projectile; precision-guided bombs and missiles, such as Paveway and Maverick; and long-range cruise missiles, such as the air-launched cruise missile and Tomahawk Land Attack Missile.[16] The United States also developed a series of satellite-based systems, such as the Global Positioning System (GPS), and smart sensors, such as the Joint Surveillance Target Attack Radar System. President Reagan continued the efforts to support Assault Breaker and other concepts—including Air-Land Battle. The U.S. defense budget rose by almost $100 billion between 1981 and January 1985, defense sales increased by 60 percent in real terms in the early

1980s, and the aerospace workforce grew by 15 percent from 1983 to 1986.[17]

Moscow viewed Assault Breaker and the U.S. development of sensors, stealth, and precision weapons with alarm. General Nikolai Ogarkov and other Soviet leaders conducted a massive exercise in 1981, called Zapad-81, to respond to Assault Breaker and became increasingly concerned that the Soviet Union was falling behind. Minister of Defense Dmitri Ustinov told a meeting of the Warsaw Pact Committee of Defense Ministers that the military balance between NATO and the Warsaw Pact was "at the moment not in our favor" because of Assault Breaker and other U.S. defense efforts.[18] Yet again, U.S. defense leaders combined concepts of operation with advanced technologies to defeat (and ultimately deter) Soviet forces in Europe.

Third Offset

By the mid-2010s, Pentagon officials led by Deputy Secretary of Defense Bob Work developed the "third offset." One of Work's most significant concerns was that China and Russia had made progress in achieving parity with the United States in such areas as theater-level battle networks, precision-guided munitions, and long-range, ground-based fires. Work was particularly concerned about China, which he assessed was trying to achieve military technical parity with the United States. China had developed the DF-21D, an antiship ballistic missile with a range of nearly 1,000 miles, dubbed the "carrier killer," which posed a serious threat to U.S. surface ships—including aircraft carriers—in the Pacific. China and Russia were also investing in cyber, space and counterspace, and electronic warfare capabilities.

The solution for Work and others, including Secretary of Defense Ashton Carter, was to identify and develop operational concepts and technology to ensure that the United States could win a war. One critical component was the development of new warfighting operational concepts, such as the U.S. Navy's Distributed Maritime Operations, U.S. Marine Corps' Expeditionary Advanced Base Operations, U.S. Army's Multi-Domain Operations, and U.S. Air Force's Agile Combat Employment. In addition, the United States began to invest in new space capabilities, advanced sensors, missile defense, cyber capabilities, and a range of promising technologies: unmanned underwater systems, advanced sea mines, high-speed strike weapons, AI, advanced aeronautics, electromagnetic rail guns, and high-energy lasers. The third offset, as Work described it, was a "combination of technology, operational concepts, and organizational constructs—different ways of organizing our forces—to maintain our ability to project combat power into any area at the time and place of our own choosing."[19]

Despite these efforts, however, there was no actual offset. Neither China nor Russia possessed a significant military advantage over the United States—at least not yet. The United States enjoyed a preponderance of military power. It spent $647.8 billion on defense in 2014, compared to $182.1 billion for China and a measly $84.7 billion for Russia.[20] This reality made the situation fundamentally different from the first and second offsets, when the Soviet Union had considerable advantages that the United States needed to offset or risk losing deterrence. In many ways, Work's third offset was a decade ahead of its time.

The China Challenge

But the situation is different today. China has become a formidable military challenger of the United States. Its defense industrial base is on a wartime footing and is producing a growing number of highly capable surface and subsurface vessels, aircraft, missiles (including those capable of carrying nuclear warheads), space-based and offensive cyber capabilities, and land systems. China's long-range missile capabilities have significantly expanded over the past two decades, creating a major challenge for the United States in parts of the Indo-Pacific. Commensurate with its burgeoning land attack capacity, China has grown its inventory of ballistic and cruise missiles that can engage surface ships. As a result, U.S. forward-based forces on land and at sea are now vulnerable to being damaged or destroyed before they even get to the fight. The PLA's ballistic and cruise missiles can be launched from a broad spectrum of air, land, and maritime platforms. The concepts that emerged from the third offset envisioned China as a potential

future challenge, but now China presents a near-term challenge with some advantages in mass and scale.

China has also invested in advanced surface-to-air missile systems with powerful tracking and guidance radars equipped with electronic countermeasures and missiles able to engage fighter aircraft at long ranges. The radars and missile launchers can be mounted on vehicles, making them challenging to locate, target, and destroy. Suppressing China's integrated air defense systems would be difficult and time consuming for U.S. pilots, especially if deployed in dense arrays and aided by survivable C2 facilities. China complements its surface-based air defenses with substantial numbers of fourth- and fifth-generation fighter aircraft, such as the J-20 and J-35 fighters, along with H-6J, H-6K, and H-6N bombers. China has also fielded the KJ-500, the country's most advance airborne early warning and control aircraft, which enables the PLA Air Force (PLAAF) to detect, track, and target U.S. and partner capabilities at greater ranges.

The PLA Navy (PLAN) has made major strides in modernizing its surface and subsurface fleets. As a result of these investments, China's surface fleet features growing numbers of destroyers and frigates with modern combat management systems and sensors, as well as long-range SAMs and surface-to-surface missiles. Similarly, the PLAN is modernizing its submarine fleet with growing numbers of nuclear-powered vessels and more capable antiship cruise missiles. Furthermore, the PLAN has embarked on a long-term effort to develop and deploy several aircraft carriers, including the Type 003 carrier *Fujian*. The result is that the United States is losing deterrence in the Indo-Pacific, particularly around such areas as the Taiwan Strait, where the PLA can gain advantages in mass and scale.

Like the Soviet Union during the Cold War, however, China has vulnerabilities that can be exploited which need to be integrated into an offset strategy. One major weakness is antisubmarine warfare, where the PLAN still struggles to detect, identify, and track U.S. submarines. While China has made significant improvements in antisubmarine warfare, the United States remains dominant in the undersea domain. In addition, the PLAN and PLAAF would likely face challenges extending operations outside the first island chain due to logistical constraints, corruption, and inexperience in blue-water operations. More broadly, the PLA suffers from "peace disease" (和平病), a lack of combat experience since the 1979 Sino-Vietnamese War.[21] With no serious combat experience for over 50 years, PLA soldiers, equipment, and doctrine are not battle-tested.

These weaknesses suggest opportunities for the United States.

A New Offset

A U.S. offset needs to be based on solving a specific operational problem.[22] A PLA amphibious invasion of Taiwan offers a useful test case since reuniting the island nation is a major priority for Xi Jinping and a war so close to the Chinese mainland would be a major challenge for the U.S. military. The primary goal of a U.S. operational concept should be stopping such an invasion.

An operational concept to defeat the PLA in the Taiwan Strait would also be relevant to conflicts in other areas, including in the South China Sea, East China Sea, and Yellow Sea. An offset that focuses on China does not exclude preparing for contingencies elsewhere, such as against Russia in Eastern Europe, Iran in the Middle East, or North Korea on the Korean Peninsula. But it does mean that the United States needs to prioritize defeating and deterring China, much like the United States focused primarily on the Soviet Union during the Cold War.

A successful PLA invasion would require quickly moving massive amounts of troops, weapons, and materiel onto Taiwan or another territory through an amphibious landing, air assault, or airborne landings, or most likely a combination of these means, in the shortest time possible. The PLA would likely need hundreds of thousands of soldiers—from the PLA Army (PLAA), PLAN Marine Corps, and PLAAF Airborne Corps—and vast amounts of materiel.[23] It would then need to bring those forces to Taiwan using amphibious assault ships, landing craft, civilian roll-on/roll-off (Ro-Ro) ferries, air assault helicopters, and transport aircraft.[24] These platforms would transport first echelon troops to seize and hold a lodgment,

allowing follow-on PLA forces to flow into Taiwan. The PLAA would likely take the lead in attempting to break through Taiwan's coastal defenses, establishing one or more beachheads, overrunning entrenched defenders, and establishing conditions for second-echelon PLA forces.[25] In addition, the PLA would likely need thousands of ballistic and cruise missiles, rockets, drones, and strike aircraft capable of hitting enemy forces and infrastructure, supported by cyber, space, and air defense capabilities. The initial phases of a PLA campaign would also likely involve a blockade and cyber and space operations.[26] Throughout the process, the PLA's joint logistics and national defense mobilization systems would play key roles.[27]

Consequently, a U.S. operational concept needs to include several components.

The first is to preposition equipment to move with urgency and speed, which is beginning to occur. The United States would need to act within hours or days to prevent a territorial fait accompli. There may not be sufficient time for a slow and steady build-up of forces, much like the United States did before Operation Desert Storm in 1991. Consequently, the United States needs to posture its forces, munitions, and equipment today for a rapid engagement. Examples include deploying sufficient bombers to Australia and Alaska, hardening shelters for aircraft, establishing active defenses for missiles, and stockpiling sufficient quantities of fuel, spare parts, munitions, and other materiel that can be used for a fight now.[28]

Second, U.S. forces would need to rapidly strike at the center of gravity of the PLA's invasion force and cripple its offensive. This would require identifying high-value targets, including amphibious assault ships, landing craft, air assault helicopters, and airborne delivery planes carrying PLA soldiers, weapons systems, and equipment. It would also involve precisely hitting and destroying PLA air defenses, air and missile bases, artillery, and operational C2 centers supporting the invasion force.[29] While many of these strikes might occur in transit from the mainland to Taiwan, the United States would also need to weigh striking targets in ports, airfields, and bases on the Chinese mainland, raising important questions about escalation.

To quickly target the heart of the PLA's invasion force, the United States would need to generate combat power that can operate both inside and outside the reach of China's strike systems. As Admiral Samuel Paparo, commander of Indo-Pacific Command, remarked, "I want to turn the Taiwan Strait into an unmanned hellscape using a number of classified capabilities so I can make their lives utterly miserable for a month, which buys me the time for the rest of everything."[30]

In the short run, the United States would need to ensure that U.S. and allied forces could withstand initial PLA attacks; blind PLA battle networks and command, control, communications, computers, cyber, intelligence, surveillance, and reconnaissance systems (C5ISR); execute a suppression campaign against PLA long-range missiles; and target PLA air defense systems. As Admiral Paparo acknowledged, the U.S. military badly needs "counter-C5ISR capabilities in cyber, space, counterspace, to ensure that the United States can see, understand, decide, act, assess, learn faster than the PRC can, to enhance our ability to blind, to deceive, and to destroy the adversary's ability to see and sense."[31]

In the long run, the United States would need to be prepared for a protracted campaign, maintain operational logistics, and increase defense industrial production for critical munitions and weapons systems, including air defense and long-range strike. Allies such as Japan, Australia, South Korea, and the Philippines would be helpful, though not necessarily assured.

A Mix of Capabilities

Several types of capabilities are important to defeat PLA forces as part of this operational concept—and should drive research, development, and production of the U.S. defense industrial base.

The first includes capabilities that allow the United States to maintain its undersea advantage. Of particular value are attack submarines, such as *Virginia*-class nuclear-powered submarines, and relatively cheap underwater drones. PLA capabilities are still relatively weak in antisubmarine warfare, and the PLA has serious difficulties finding U.S. submarines.

In multiple iterations of CSIS wargames, U.S. submarines wreak havoc against Chinese ships, including large amphibious vessels, escorts, and logistics vessels. Submarines are also needed to screen against Chinese submarines exiting the first island chain.[32]

The United States should also prioritize autonomous underwater drones. There will be substantial U.S. submarine attrition in a fight against China, such as in the relatively shallow waters of the Taiwan Strait.[33] Each loss would be tough, since a *Virginia*-class submarine has a crew of roughly 132 sailors and costs approximately $4.5 billion each.[34] While underwater drones are not yet as capable as attack submarines, they can be programmed to fulfill some critical missions, such as minelaying and strike against PLA submarines and surface vessels.

Second is a major increase in the U.S. inventory of precision-guided, long-range missiles—including antiship missiles—that can strike PLA vessels and aircraft. Munition usage is likely to be high in a protracted conflict with the PLA. Long Range Anti-Ship Missiles (LRASMs) are effective against PLA targets. But they are expensive at over $3 million per missile, and the United States does not have enough of them.[35] The Joint Air-to-Surface Missile-Extended Range (JASSM-ER) is also effective and comes with a price of roughly $1.5 million per missile.[36] The United States needs to ramp up the research, development, and production of long-range missiles—especially antiship missiles to strike PLA surface vessels—and do so at a lower cost.

Large numbers of relatively cheap unmanned aircraft systems, or drones, are also critical for defeating the PLA, particularly drones that do not need runways to launch. They can perform valuable missions in a war—such as intelligence, surveillance, reconnaissance, battle damage assessment, electronic warfare, and strike—within range of PLA missiles and drones. They are also expendable since they are cheaper than fourth- and fifth-generation aircraft and do not endanger a pilot or crew.

Third, manned aircraft are still important in this operational concept, especially bombers and stealthy fifth- and sixth-generation fighters. The range and high ordnance throughput of stealth bombers like the B-21 Raider presents China with a particularly daunting challenge. They can be based beyond the range of Chinese ballistic missiles, and they can carry substantial bombs to attrit Chinese forces. Some fifth- and sixth-generation stealth aircraft are also helpful because their speed, sensor packages, and strike capabilities will likely allow them to operate inside the PLA's anti-access/area denial (A2/AD) areas for air-to-air engagements, some air-to-ground missions, and overall battle management.

Other capabilities are also important, such as all-domain C2 capabilities and software that leverages next-generation AI, which allows the U.S. military to operate a battle network. So are space, cyber, electronic warfare, and some land capabilities, such as air defense systems and long-range fires. But other capabilities are not likely to be as critical for this prioritized operational concept. For example, surface ships are less likely to be useful in a war because of their vulnerability. Destroyers are highly exposed in a war, as are aircraft carriers. Many U.S. land systems, such as heavy tanks, are not helpful for this fight.

Conclusion

There is a growing chorus of voices who argue that the future of warfare hinges on the production and use of emerging technology, such as autonomous systems, cheap precision-guided missiles, and AI. As one article concludes, "Future wars will no longer be about who can mass the most people or field the best jets, ships, and tanks. Instead, they will be dominated by increasingly autonomous weapons systems and powerful algorithms."[37] Some contend that the era of large, expensive platforms is dead. As Elon Musk pronounced, the F-35 aircraft is "obsolete" and "manned fighter jets are outdated in the age of drones and only put pilots' lives at risk."[38] Another skeptic referred to these large platforms, such as bombers and fighter aircraft, as "old legacy zombie programs."[39]

But U.S. military capabilities need to be grounded in a viable joint operational concept. Inventing technologies or being the first country to use a technology in warfare does not guarantee a significant advantage on the battlefield—militaries still have to integrate the

technology into combat.[40] British engineers at William Foster & Company developed and produced the tank, including one dubbed the "Little Willie," with the support of senior British officers such as Sir John French and Douglas Haig.[41] But it was German military officers such as Heinz Guderian that effectively *used* the tank to devastating effect during blitzkrieg operations in World War II.

Bold pronouncements about obsolete and antiquated platforms and systems—such as fifth-generation aircraft and bombers—are largely meaningless unless they are connected to a joint operational concept against a specific adversary. Technology needs to support the joint concept, not the other way around. And this is exactly why it is important to develop an offset to deter and—if deterrence fails—defeat a rising China.

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Endnotes

INTRODUCTION: HOW TO THINK ABOUT MODERN WARFARE

1 For more on this theme, see Cyril Falls, *One Hundred Years of War, 1850-1950* (New York: Collier, 1953); Williamson Murray, *The Dark Path: The Structure of War and the Rise of the West* (New Haven, CT: Yale University Press, 2024).

2 Brent M. Eastwood, "Russia's Black Sea Fleet Is Now 'Functionally Inactive'," 19FortyFive, February 3, 2025, https://www.19fortyfive.com/2025/02/russias-black-sea-fleet-is-now-functionally-inactive/.

3 U.S. Government Accountability Office, *In-Space Servicing, Assembly, and Manufacturing: Benefits, Challenges, and Policy Options*, GAO-25-107555 (Washington, DC: U.S. Government Accountability Office, July 2025), https://www.gao.gov/products/gao-25-107555.

ADVERSARIES AND THE FUTURE OF COMPETITION

1 While this chapter focuses on China, Russia, Iran, and North Korea, it assumes that cooperation with other countries could also increase.

2 Andrew Radin and Clint Reach, *Russian Views of the International Order* (Santa Monica: RAND, May 2017), https://www.rand.org/pubs/research_reports/RR1826.html; and Ruonan Liu and Songpo Yang, "China and the Liberal International Order: A Pragmatic and Dynamic Approach," *International Affairs* 99, no. 4 (July 2023): 1383–1400, https://doi.org/10.1093/ia/iiad169.

3 Philip Zelikow, "Confronting Another Axis? History, Humility, and Wishful Thinking," *Texas National Security Review* 7, no. 3 (Summer 2024): 90, https://tnsr.org/2024/05/confronting-another-axis-history-humility-and-wishful-thinking/.

4 Xi Jinping, "Speech at 'The Road to Rejuvenation'," China Copyright and Media, November 29, 2012, https://chinacopyrightandmedia.wordpress.com/2012/11/29/speech-at-the-road-to-rejuvenation/.

5 Senior U.S. and European government officials, in discussion with the author, 2025; and U.S. Department of the Treasury, "Treasury Targets Actors Involved in Drone Production for Russia's War Against Ukraine," press release, October 17, 2024, https://home.treasury.gov/news/press-releases/jy2651.

6 Steve Holland and Susan Heavey, "US Says China Is Boosting Russia's War Machine in Ukraine," Reuters, April 15, 2024, https://www.reuters.com/world/us-says-china-is-boosting-russias-war-machine-ukraine-2024-04-12/.

7 See, for example, U.S. Department of the Treasury, "U.S. Continues to Degrade Russia's Military-Industrial Base and Target Third-Country Support with Nearly 300 New Sanctions," press release, May 1, 2024, https://home.treasury.gov/news/press-releases/jy2318/.

8 U.S. government officials, in discussion with the author, 2025; and Office of the Director of National Intelligence, *Support Provided by the People's Republic of China to Russia* (Washington, DC: Office of the Director of National Intelligence, July 2023), https://democrats-intelligence.house.gov/uploadedfiles/odni_report_on_chinese_support_to_russia.pdf.

9 U.S. Department of the Treasury, "U.S. Continues."

10 See, for example, Omar Al-Ghusbi and Conrad Rousseau, *Airborne Axis: Inside the Deal That Brought Iranian Drone Production to Russia* (Washington, DC: C4ADS, May 2025), https://c4ads.org/reports/airborne-axis/; U.S. Defense Intelligence Agency, "DIA Releases Updated Report on Russia's Use of Lethal Iranian Unmanned Aerial Vehicles (UAVs) in Ukraine," press release, August 25, 2023, https://www.dia.mil/News-Features/Articles/Article-View/Article/3504948/dia-releases-updated-report-on-russias-use-of-lethal-iranian-unmanned-aerial-ve/; and C. Todd Lopez, "Iran Gives Russia Short-Range Missiles, While U.S., Partners Expect to Keep Bolstering Ukrainian Air Defense," U.S. Department of Defense, September 10, 2024, https://www.defense.gov/News/News-Stories/Article/Article/3901774/iran-gives-russia-short-range-missiles-while-us-

partners-expect-to-keep-bolster/.

11 Mary Ilyushina, "Russia's Deadly Drone Industry Upgraded with Iran's Help, Report Says," *Washington Post*, May 29, 2025, https://www.washingtonpost.com/world/2025/05/29/russia-iran-drone-cooperation-industry/; and Al-Ghusbi and Rousseau, *Airborne Axis*.

12 "Iran's Revolutionary Guards Commander Says Iran Purchased Russian-Made Sukhoi 35 Fighter Jets," Reuters, January 27, 2025, https://www.reuters.com/business/aerospace-defense/irans-revolutionary-guards-commander-says-iran-purchased-russian-made-sukhoi-35-2025-01-27/; and Maya Carlin, "Iran Finally Admits to Buying Russian Su-35 Fighters," *National Interest*, January 28, 2025, https://nationalinterest.org/blog/buzz/iran-finally-admits-to-buying-russian-su-35-fighters.

13 Justin McCurry, "From Ammunition to Ballistic Missiles: How North Korea Arms Russia in the Ukraine War," *The Guardian*, April 25, 2025, https://www.theguardian.com/world/2025/apr/25/how-north-korea-arms-russia-in-ukraine-war; Tom Balmforth and Mariano Zafra, "Thousands of Troops, Millions of Shells," Reuters, April 15, 2025, https://www.reuters.com/graphics/UKRAINE-CRISIS/NORTHKOREA-RUSSIA/lgvdxqjwbvo/; Dasl Yoon and Matthew Luxmoore, "Satellite Images Show North Korea Boosting Arms Flow to Russia," *Wall Street Journal*, December 23, 2024, https://www.wsj.com/world/russia-north-korea-weapons-shipment-676d7f52; and U.S. Defense Intelligence Agency, *North Korea: Enabling Russian Missile Strikes Against Ukraine* (Washington, DC: Defense Intelligence Agency, May 2024), https://www.dia.mil/Portals/110/Documents/News/Military_Power_Publications/DPRK_Russia_NK_Enabling_Russian_Missile_Strikes_Against_Ukraine.pdf.

14 See, for example, Brian Spegele, "The Chinese Satellite Firm Washington Accuses of Helping U.S. Foes," *Wall Street Journal*, April 26, 2025, https://www.wsj.com/world/china/the-chinese-satellite-firm-washington-accuses-of-helping-u-s-foes-b5e68d2e; and Sudarsan Raghavan, Saleh al-Batati, and Benoit Faucon, "U.S. Accuses China of Helping the Houthis Target Their Attacks," *Wall Street Journal*, April 18, 2025, https://www.wsj.com/world/middle-east/u-s-accuses-china-of-helping-the-houthis-target-their-attacks-e56264da.

15 Christy Lee, "Analysts: Russia-North Korea Military Ties Pose Dilemma for China," Voice of America, February 1, 2024, https://www.voanews.com/a/analysts-russia-north-korea-military-ties-pose-dilemma-for-china/7467749.html; and Lingling Wei, Ann M. Simmons, and Timothy W. Martin, "Behind Putin Visit, Unease in Beijing over His Potential Next Stop: North Korea," *Wall Street Journal*, May 19, 2024, https://www.wsj.com/world/behind-putin-visit-unease-in-beijing-over-his-potential-next-stop-north-korea-28b82cf5.

16 Bruce W. Bennett, "North Korea and China Aren't the Allies You Think They Are," RAND, *Commentary*, September 27, 2023, https://www.rand.org/pubs/commentary/2023/09/north-korea-and-china-arent-the-allies-you-think-they.html.

17 Reuters, "China Maintains Stance on Disputed Gulf Islands Despite Iran's Anger," Reuters, June 3, 2024, https://www.reuters.com/world/china-maintains-stance-disputed-gulf-islands-despite-irans-anger-2024-06-03/; Associated Press, "Iran Summons Russian Envoy over Statement on Persian Gulf Disputed Islands," Reuters, December 24, 2023, https://www.voanews.com/a/iran-summons-russian-envoy-over-statement-on-persian-gulf-disputed-islands-/7410524.html; and Tala Taslimi, "Iran Grows Wary of Russia amid Moscow's Support for UAE in Island Spat," Nikkei Asia, July 23, 2023, https://asia.nikkei.com/Politics/International-relations/Iran-grows-wary-of-Russia-amid-Moscow-s-support-for-UAE-in-island-spat.

18 Stephen M. Walt, *The Origins of Alliances* (Ithaca: Cornell University Press, 1987), 17–49. Also see John J. Mearsheimer, *The Tragedy of Great Power Politics* (New York: W. W. Norton, 2001), 48, 156, 269.

19 As used here, "ideologies" refers to the principles of governance to which policymakers are dedicated, including the core institutional, economic, or social goals they attempt to implement in their countries. Examples include whether leaders support authoritarian or democratic political institutions, capitalist or socialist

economic systems, or religious or secular values. See, for example, Mark L. Haas, "When Do Ideological Enemies Ally?," *International Security* 46, no. 1 (Summer 2021): 104–46, https://doi.org/10.1162/isec_a_00413.

20 Hans J. Morgenthau, *Politics Among Nations: The Struggle for Power and Peace*, Fourth Edition (New York: Alfred A. Knopf, 1967), 177–78.

21 See, for example, Kenneth N. Waltz, *Man, the State, and War: A Theoretical Analysis* (New York: Columbia University Press, 2001).

22 Christopher S. Chivvis and Jack Keating, "How Evil? Deconstructing the New Russia-China-Iran-North Korea Axis," *Survival* 66, no. 6 (December 2024): 51–66, https://doi.org/10.1080/00396338.2024.2432198.

23 See, for example, Walt, *Origins*.

24 Mathew George et al., *Trends in International Arms Transfers, 2024* (Stockholm: SIPRI, March 2025), 7, https://www.sipri.org/sites/default/files/2025-03/fs_2503_at_2024_0.pdf.

25 Derek Solen, *The Truth About the Sino-Russian Combined Patrols* (Tokyo: JASDF Air and Space Institute, July 2025), https://www.mod.go.jp/asdf/meguro/center/Eimg/EJASIreport20250630.pdf.

26 "Iran, Russia, China Conduct Joint Naval Drills in Gulf of Oman," Al Jazeera, March 12, 2025, https://www.aljazeera.com/news/2025/3/12/iran-russia-china-conduct-joint-naval-drills-in-gulf-of-oman.

27 Brian G. Carlson, "The Growing Significance of China-Russia Defense Cooperation," Strategic Studies Institute, U.S. Army War College, September 18, 2024, https://ssi.armywarcollege.edu/SSI-Media/Recent-Publications/Display/Article/3908561/the-growing-significance-of-china-russia-defense-cooperation/.

28 Antoni Slodkowski and Laurie Chen, "China's Xi Affirms 'No Limits' Partnership with Putin in Call on Ukraine War Anniversary," Reuters, February 24, 2025, https://www.reuters.com/world/xi-putin-hold-phone-call-ukraine-war-anniversary-state-media-says-2025-02-24/.

29 "Iran and China Sign 25-Year Cooperation Agreement," Reuters, March 27, 2021, https://www.reuters.com/world/china/iran-china-sign-25-year-cooperation-agreement-2021-03-27/.

30 Hyonhee Shin, "Key Points of North Korea, Russia Landmark Strategic Partnership Treaty," Reuters, June 20, 2024, https://www.reuters.com/world/asia-pacific/key-points-north-korea-russia-landmark-strategic-partnership-treaty-2024-06-20/.

31 "Treaty on the Comprehensive Strategic Partnership between the Islamic Republic of Iran and the Russian Federation," President of the Islamic Republic of Iran, January 17, 2025, https://president.ir/en/156874.

32 Marc Santora, "With Drones and North Korean Troops, Russia Pushes Back Ukraine's Offensive," *New York Times*, March 8, 2025, https://www.nytimes.com/2025/03/08/world/europe/ukraine-russia-north-korea-kursk.html; and Lex Harvey, "North Korea Has Sent 3,000 More Soldiers to Bolster Russia's War on Ukraine, South Korea Says," CNN, March 27, 2025, https://www.cnn.com/2025/03/27/europe/north-korea-russia-ukraine-soldiers-intl-hnk.

33 Stephen Hadley, "Xi Jinping's Axis of Losers," *Foreign Affairs*, November 1, 2024, https://www.foreignaffairs.com/china/xi-jinpings-axis-losers.

34 As used here, an alliance is a formal or informal relationship of security cooperation between two or more sovereign states. This definition assumes some level of commitment and an exchange of benefits for the parties; severing the relationship or failing to honor the agreement would presumably cost something. Walt, *Origins*, 1.

35 Morgenthau, *Politics*, 177. Another potential example is the Treaty of the Arab League of 1945.

36 See, for example, Director of Central Intelligence, *Eastern Europe and the Warsaw*

Pact, National Intelligence Estimate No. 12-65 (Washington, DC: CIA, August 26, 1965), https://www.cia.gov/readingroom/docs/DOC_0000273191.pdf; and Joan Bird and John Bird, eds., *CIA Analysis of the Warsaw Pact Forces: The Importance of Clandestine Reporting* (Langley, VA: CIA, 2012), https://www.cia.gov/static/CIA-Analysis-of-the-Warsaw-Pact-Forces-The-Importance-of-Clandestine-Reporting.pdf.

37 Fenella McGerty and Karl Dewey, "Global Defense Spending Soars to New High," Military Balance Blog, International Institute for Strategic Studies, February 12, 2025, https://www.iiss.org/online-analysis/military-balance/2025/02/global-defence-spending-soars-to-new-high/.

38 "How Much Will Rising Defense Spending Boost Europe's Economy?," Goldman Sachs, March 6, 2025, https://www.goldmansachs.com/insights/articles/how-much-will-rising-defense-spending-boost-europes-economy.

39 Mark Rutte, "Building a Better NATO," NATO, June 9, 2025, https://www.nato.int/cps/en/natohq/opinions_235867.htm.

40 McGerty and Dewey, "Global Defense Spending Soars to New High."

41 Andrea Kendall-Taylor and Richard Fontaine, "The Axis of Upheaval: How America's Adversaries Are Uniting to Overturn the Global Order," *Foreign Affairs* 103, no. 3 (May/June 2024), 50–63, https://www.foreignaffairs.com/china/axis-upheaval-russia-iran-north-korea-taylor-fontaine.

42 See, for example, David S. Cloud and Aresu Eqbali, "Iran's Supreme Leader Ali Khamenei Emerges in Public amid Health Speculation," *Wall Street Journal*, September 17, 2022, https://www.wsj.com/articles/irans-supreme-leader-ali-khamenei-emerges-in-public-amid-health-speculation-11663414072.

43 RAND, *Commission on the National Defense Strategy* (Santa Monica, CA: RAND, July 2024), vii, https://www.rand.org/nsrd/projects/NDS-commission.html; Raphael S. Cohen, *The History and Politics of Defense Reviews* (Santa Monica, CA: RAND, April 2018), https://www.rand.org/pubs/research_reports/RR2278.html.

44 U.S. Department of Defense, "Sustaining U.S. Global Leadership: Priorities for 21st Century Defense," January 2012, 4, https://apps.dtic.mil/sti/pdfs/ADA554328.pdf.

WILL, COHESION, RESILIENCE, AND THE WARS OF THE FUTURE

1 Carl von Clausewitz, *On War* (London: Penguin Group, 2003).

2 Shelby Butt and Daniel Byman, "Right-wing extremism: the Russian connection,=" *Survival* 62, no. 2 (April-May 2020), 137–151, https://www.tandfonline.com/toc/tsur20/62/2.

3 Dmytro Basmat, "Over 45,000 Ukrainian Soldiers Killed Since Start of War, Zelensky Says," *Kyiv Independent*, February 5, 2025, https://kyivindependent.com/over-45-000-ukrainian-soldiers-killed-since-start-of-war-zelensky-says/; Bojan Pancevski, "One Million Are Now Dead or Injured in the Russia-Ukraine War," *Wall Street Journal*, September 17, 2024, https://www.wsj.com/world/one-million-are-now-dead-or-injured-in-the-russia-ukraine-war-b09d04e5; and Anatoly Kurmanaev and Constant Meheut, "Ukraine Is Losing Fewer Soldiers Than Russia—but It's Still Losing the War," *New York Times*, January 23, 2025, https://www.nytimes.com/2025/01/23/world/europe/ukraine-russia-soldiers-loss.html.

4 "Number of Civilian Casualties in Ukraine During Russia's Invasion Verified by OHCHR from February 24, 2022 to March 31, 2025," Statista, April 11, 2025, https://www.statista.com/statistics/1293492/ukraine-war-casualties/.

5 Jyri Raitasalo, "Finnish Defense 'Left of Bang'," *PRISM* 10, no. 2 (March 10, 2023): 86, https://ndupress.ndu.edu/Media/News/News-Article-View/Article/3323915/finnish-defense-left-of-bang/.

6 Seth G. Jones, "Russia's Shadow War Against the West," CSIS, *CSIS Briefs*, March 18, 2025, https://www.csis.org/analysis/russias-shadow-war-against-west.

7 Jakub Przetacznik and Linda Tothova, *Russia's War on Ukraine: Military Balance of Power* (Brussels: European Parliamentary Research Service, March 2022), 1, https://www.europarl.europa.eu/RegData/etudes/ATAG/2022/729292/EPRS_ATA(2022)729292_EN.pdf; Constantine Atlamazoglou, "After a Year of Heavy Losses, Ukraine's Military Is Juggling a 'Very Uneven' Force as It Prepares for Major Fighting, Expert Says," Business Insider, April 28, 2023, https://www.businessinsider.com/ukraines-military-balances-uneven-training-levels-after-year-of-war-2023-4; and "Ukraine War Latest: Ukraine's Military Now Totals 880,000 Soldiers, Facing 600,000 Russian Troops, Kyiv Claims," *Kyiv Independent*, January 15, 2025, https://kyivindependent.com/ukraine-war-latest-ukraines-military-now-totals-880-000-soldiers-facing-600-000-russian-troops-kyiv-claims/.

8 Jennifer Hassan and Adam Taylor, "Israel's Massive Mobilization of 360,000 Reservists Upends Lives," *Washington Post*, October 10, 2023, https://www.washingtonpost.com/world/2023/10/10/israel-military-draft-reservists/; and Joel Gunter, "'A Lot of Adrenaline, A Lot of Unknowns': Reservists Flock to Join Israel's Fight," BBC, October 10, 2023, https://www.bbc.com/news/world-middle-east-67067595.

9 Hassan and Taylor, "Israel's Massive Mobilization."

10 Gunter, "'A Lot of Adrenaline'"; and Dan Williams, "Israel to Pull Some Troops from Gaza as War Enters New Phase," Reuters, January 1, 2024, https://www.reuters.com/world/middle-east/israel-pull-some-troops-gaza-war-enters-new-phase-2024-01-01/.

11 Bar Peleg, "Third of Israeli Reservists Have Served More Than 150 Days Since War's Start," *Haaretz*, November 8, 2024, https://www.haaretz.com/israel-news/2024-11-08/ty-article/.premium/third-of-israeli-reservists-have-served-more-than-150-days-since-wars-start/00000193-0b6d-d599-a7f7-0b7f0a960000.

12 "Ukraine Deploys over One Million Drones in Active Support of Its Forces Since 2022," lobal Defense News, December 19, 2024, https://armyrecognition.com/focus-analysis-conflicts/army/analysis-defense-and-security-industry/ukraine-deploys-over-one-million-drones-in-active-support-of-its-forces-since-2022.

13 "Ukraine Can and Will Create the Best Weapons—President's Speech at the Second International Defense Industries Forum," President of Ukraine, October 1, 2024, https://www.president.gov.ua/en/news/ukrayina-mozhe-j-bude-stvoryuvati-najkrashi-zrazki-zbroyi-vi-93613.

14 Graeme Baker, "Ukraine Claims Drone Strike on Russian Oil Refinery," BBC, January 24, 2025, https://www.bbc.com/news/articles/cvg84r5g8d0o.

15 Emily Rose, "Israeli Startups Make Global Plans After Key Role in War," Reuters, January 31, 2025, https://www.reuters.com/world/middle-east/israeli-startups-make-global-plans-after-key-role-war-2025-01-31/.

16 Ibid.

17 Ibid.

18 Raphael S. Cohen, "Israel's 'People's Army' at War," *Foreign Policy*, January 13, 2024, https://foreignpolicy.com/2024/01/13/israel-hamas-war-gaza-idf-october-7-military/.

19 Steven Scheer, "Israeli Tech Sector Resilient but Faces Funding Uncertainty amid War with Hamas," Reuters, September 23, 2024, https://www.reuters.com/world/middle-east/israeli-tech-sector-resilient-faces-funding-uncertainty-amid-war-with-hamas-2024-09-23/.

20 David E. Sanger, Julian E. Barnes, and Kate Conger, "As Tanks Rolled into Ukraine, So Did Malware. Then Microsoft Entered the War," *New York Times*, February 28, 2022, https://www.nytimes.com/2022/02/28/us/politics/ukraine-russia-microsoft.html.

21 Nate Ostiller, "Minister: Microsoft to Provide Free Cloud Services to Ukrainian Government for Another Year," *Kyiv Independent*, November 29, 2023, https://kyivindependent.com/minister-microsoft-to-provide-free-cloud-services-to-ukrainian-government-for-another-year/.

22 Keren Setton, "Despite Constant Rocket Threat, Many Israelis Remain Without Shelters," *Jerusalem Post*, May 19, 2023, https://www.jpost.com/israel-news/article-743572.

23 Yahya Abou-Ghazala, "In Gaza, Palestinians Have No Safe Place from Israel's Bombs," CNN, October 12, 2023, https://www.cnn.com/2023/10/12/middleeast/gaza-airstrikes-warnings-invs/index.html.

24 International Criminal Court, "Situation in the State of Palestine: ICC Pre-Trial Chamber I Rejects the State of Israel's Challenges to Jurisdiction and Issues Warrants of Arrest for Benjamin Netanyahu and Yoav Gallant," press release, November 21, 2024, https://www.icc-cpi.int/news/situation-state-palestine-icc-pre-trial-chamber-i-rejects-state-israels-challenges.

25 Anna Gordon, "New Polling Shows How Much Global Support Israel Has Lost," *Time*, January 17, 2024, https://time.com/6559293/morning-consult-israel-global-opinion/.

26 Jeffrey M. Jones, "Majority in U.S. Now Disapprove of Israeli Action in Gaza," Gallup, March 27, 2024, https://news.gallup.com/poll/642695/majority-disapprove-israeli-action-gaza.aspx; and Laura Silver, "Younger Americans Stand Out in Their Views of the Israel-Hamas War," Pew Research Center, April 2, 2024, https://www.pewresearch.org/short-reads/2024/04/02/younger-americans-stand-out-in-their-views-of-the-israel-hamas-war/.

27 Silver, "Younger Americans."

28 Brandon Boatwright, "How Ukraine's Savvy Official Social Media Rallied the World and Raised the Bar for National Propaganda," Clemson News, August 18, 2023, https://news.clemson.edu/how-ukraines-savvy-official-social-media-rallied-the-world-and-raised-the-bar-for-national-propaganda/.

29 "General Assembly Holds Emergency Special Session on Ukraine," UN News, February 28, 2022, https://news.un.org/en/story/2022/02/1112912; and "General Assembly Overwhelmingly Adopts Resolution Demanding Russian Federation Immediately End Illegal Use of Force in Ukraine, Withdraw All Troops," United Nations, March 2, 2022, https://press.un.org/en/2022/ga12407.doc.htm.

30 Mary Blankenship and Aloysius Uche Ordu, "Russia's Narratives About Its Invasion of Ukraine Are Lingering in Africa," Brookings, June 27, 2022, https://www.brookings.edu/articles/russias-narratives-about-its-invasion-of-ukraine-are-lingering-in-africa/.

31 "Mapping a Surge of Disinformation in Africa," Africa Center for Strategic Studies, March 13, 2024, https://africacenter.org/spotlight/mapping-a-surge-of-disinformation-in-africa/.

32 Charles Millon, "Russia Will Unleash Chaos in the Sahel," GIS Reports, March 29, 2024, https://www.gisreportsonline.com/r/russia-africa-propaganda/.

33 Mari Saito et al., "Russia-Linked Propaganda Campaign Pushes to Undercut German Support for Ukraine," Reuters, February 18, 2025, https://www.reuters.com/investigations/russia-linked-propaganda-campaign-pushes-undercut-german-support-ukraine-2025-02-18/.

34 Jamie Dettmer, "Netanyahu Trapped by Clashing Demands from War Cabinet and Hawks," *Politico*, January 21, 2024, https://www.politico.eu/article/israel-prime-minister-benjamin-netanyahu-trapped-clash-demands-war-gaza-palestine-cabinet-hawks/.

35 Jaroslav Lukiv, "Israeli Ministers Threaten to Quit over Ceasefire Plan," BBC, June 2, 2024, https://www.bbc.com/news/articles/cz55y6k0p5go.

36 Jim Garamone, "Russian Forces Invading Ukraine Suffer Low Morale," U.S. Department of Defense, March 23, 2022, https://www.defense.gov/news/news-stories/article/article/2975508/russian-forces-invading-ukraine-suffer-low-morale/.

37 Roberto Foa and Roula Nezi, *Piercing the Fog of War: Measuring Russian Public Opinion via Online Search Data* (Cambridge, UK: Bennett Institute for Public Policy, April 2023),

3, https://www.bennettinstitute.cam.ac.uk/publications/piercing-the-fog-of-war/.

38 Adam Rasgon, "Hamas After Cease-Fire: Weakened, Isolated but Still Standing," *New York Times*, January 17, 2025, https://www.nytimes.com/2025/01/16/world/middleeast/hamas-gaza-cease-fire-palestinian-future.html.

RETURNING TO AN ERA OF COMPETITION AND NUCLEAR RISK

1 Heather Williams et al., "Deter and Divide: Russia's Nuclear Rhetoric and Escalation Risks in Ukraine," CSIS, January 11, 2024, https://features.csis.org/deter-and-divide-russia-nuclear-rhetoric/.

2 U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2024* (Washington, DC: Department of Defense, 2024), https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF; and Chris Andrews and Justin Anderson, *China's Theater-Range, Dual-Capable Delivery Systems: Integrated Deterrence and Risk Reduction Approaches to Counter a Growing Threat* (Washington, DC: NDU INSS Center for the Study of WMD, August 2024), https://inss.ndu.edu/Portals/82/HDTRA1344728_NDU%20INSS%20CSWMD_TECREP_unclass_Final.pdf.

3 Lolita C. Baldor and Didi Tang, "Chinese and Russian Bombers Patrolling off Alaska Raise Concerns About Growing Military Cooperation," Associated Press, July 25, 2024, https://apnews.com/article/china-russia-us-military-planes-norad-alaska-4994b489e75ae636b4a4cd5bb40f91ac; Jonathan Tirone, "China's Imports of Russian Uranium Spark Fear of New Arms Race," Bloomberg News, February 28, 2023, https://www.bloomberg.com/news/articles/2023-03-01/china-nuclear-trade-with-russia-risks-tipping-military-balance; and "Security Council Fails to Extend Mandate for Expert Panel Assisting Sanctions Committee on Democratic People's Republic of Korea," United Nations, March 28, 2024, https://press.un.org/en/2024/sc15648.doc.htm.

4 Joseph Ataman and Jessie Yeung, "France to Consider Protecting European Allies ith Its Nuclear Arsenal, Macron Says," CNN, March 6, 2025, https://www.cnn.com/2025/03/05/europe/macron-france-nuclear-arsenal-ukraine-intl-hnk/index.html.

5 "Poland's Leader Says His Country Is Ready to Host NATO Members' Nuclear Weapons to Counter Russia," Associated Press, April 22, 2024, https://apnews.com/article/poland-nuclear-weapons-nato-russia-ukraine-d92c508d6ff53683a25f1bc62d256f86.

6 Kyu-Jin Shin, "72.8% of Koreans Support S. Korea's Nuclear Weapon Development," *Dong-A Ilbo*, February 6, 2024, https://www.donga.com/en/article/all/20240206/4731163/1.

7 William Burr, ed., "Preoccupations with West Germany's Nuclear Weapons Potential Shaped Kennedy-Era Diplomacy," National Security Archive, George Washington University, February 2, 2018, https://nsarchive.gwu.edu/briefing-book/nuclear-vault/2018-02-02/german-nuclear-question-nonproliferation-treaty; and William Burr, ed., "The U.S. Nuclear Presence in Western Europe, 1954-1962, Part I," National Security Archive, George Washington University, July 21, 2020, https://nsarchive.gwu.edu/briefing-book/nuclear-vault/2020-07-21/us-nuclear-presence-western-europe-1954-1962.

8 W. J. Hennigan, "The Price," *New York Times*, October 10, 2024, https://www.nytimes.com/interactive/2024/10/10/opinion/nuclear-weapons-us-price.html.

9 U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2024*.

10 Williams et al., "Deter and Divide."

11 Heather Williams, "What Trump's Submarine Threat and Russia's INF Exit Really Mean," CSIS, *Commentary*, August 7, 2025, https://www.csis.org/analysis/what-trumps-submarine-threat-and-russias-inf-exit-really-mean.

12 Yoonjung Seo and Lex Harvey, "North Korea's Kim Jong Un Threatens to Destroy the

South with Nuclear Weapons If Provoked," CNN, October 4, 2024, https://www.cnn.com/2024/10/04/asia/north-korea-kim-jong-un-nuclear-weapons-intl-hnk/index.html.

13 James H. Anderson, "The Next Taiwan Crisis Will (Almost) Certainly Involve Nuclear Threats," U.S. Naval Institute, *Proceedings* 150, no. 3 (March 2024), https://www.usni.org/magazines/proceedings/2024/march/next-taiwan-crisis-will-almost-certainly-involve-nuclear-threats.

14 Office of the Director of National Intelligence, *Annual Threat Assessment of the U.S. Intelligence Community* (Washington, DC: Office of the Director of National Intelligence, February 2023), 14, https://www.dni.gov/files/ODNI/documents/assessments/ATA-2023-Unclassified-Report.pdf.

15 Andrews and Anderson, *China's Theater-Range*, 4.

16 ODNI, *Annual Threat Assessment*, 21.

17 Björn Hagelin, "Swords into Daggers: The Origins of the SS-20 Missiles," *Bulletin of Peace Proposals* 15, no. 4 (1984): 341–53, https://www.jstor.org/stable/44481156.

18 "Special Meeting of Foreign and Defence Ministers (The 'Double-Track' Decision on Theatre Nuclear Forces) Chairman: Mr. J. Luns," NATO, December 12, 1979, https://www.nato.int/cps/en/natolive/official_texts_27040.htm.

19 "Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles (INF Treaty)," U.S. Department of State, December 8, 1987, https://2009-2017.state.gov/t/avc/trty/102360.htm.

20 U.S. Naval Institute Staff, "Report to Congress on Nuclear-Armed Sea-Launched Cruise Missile," USNI News, October 18, 2024, https://news.usni.org/2024/10/18/report-to-congress-on-nuclear-armed-sea-launched-cruise-missile.

21 Office of the Spokesperson, "Russia's Violation of the Intermediate-Range Nuclear Forces (INF) Treaty," U.S. Department of State, December 4, 2018, https://2017-2021.state.gov/russias-violation-of-the-intermediate-range-nuclear-forces-inf-treaty/.

22 Sydney J. Freedberg Jr., "Sub-Launched Nuclear Cruise Missile Will Need 'An Entirely New Industrial Base,' Warns Navy Admiral," Breaking Defense, November 15, 2024, https://breakingdefense.com/2024/11/sub-launched-nuclear-cruise-missile-will-need-an-entirely-new-industrial-base-warns-navy-admiral/.

23 DOD, *Military and Security*, 107.

24 Dzirhan Mahadzir, "Joint Russian, Chinese Pacific Bomber Flight Prompts Japan and South Korea to Scramble Fighters," U.S. Naval Institute, December 1, 2024, https://news.usni.org/2024/11/29/joint-russian-chinese-pacific-bomber-flight-prompts-japan-and-south-korea-to-scramble-fighters.

25 Helen Regan et al., "Blinken Warns Russia Is Close to Sharing Advanced Satellite Technology with North Korea," CNN, January 6, 2025, https://www.cnn.com/2025/01/06/asia/blinken-russia-satellite-technology-north-korea-intl-hnk.

26 Dan Sabbagh, "Alarm in UK and US over Possible Iran-Russia Nuclear Deal," *The Guardian*, September 14, 2024, https://www.theguardian.com/politics/2024/sep/14/alarm-in-uk-and-us-over-possible-iran-russia-nuclear-deal.

27 John Lewis Gaddis, *Strategies of Containment: A Critical Appraisal of American National Security Policy During the Cold War* (New York: Oxford University Press, 2005), 100.

28 Neal H. Petersen et al., ed., *Foreign Relations of the United States, 1950*, vol. 1, *National Security Affairs; Foreign Economic Policy* (Washington, DC: Government Publishing Office, 1977), Document 85.

29 Richard L. Kugler, *Laying the Foundations: The Evolution of NATO in the 1950s* (Santa Monica, CA: RAND, 1990), 75, https://www.rand.org/pubs/notes/N3105.html.

30 Francis P. Sempa, "Is Kissinger's Triangular Diplomacy the Answer to Sino-Russian

Rapprochement?," *The Diplomat*, August 2, 2016, https://thediplomat.com/2016/08/is-kissingers-triangular-diplomacy-the-answer-to-sino-russian-rapprochement/.

31 Jaroslaw Adamowski, "Polish President Wants NATO Nukes for Deterring Russia," Defense News, April 22, 2024, https://www.defensenews.com/global/europe/2024/04/22/polish-president-wants-nato-nukes-for-deterring-russia/.

32 Choe Sang-Hun, "Doubting America's 'Nuclear Umbrella,' Some South Koreans Want their Own," *New York Times*, August 19, 2024, https://www.nytimes.com/2024/08/17/world/asia/south-korea-nuclear-arsenal.html.

33 Aurelien Breeden, "France Open to Discussing Extension of Nuclear Deterrence, Macron Says," *New York Times*, March 5, 2025, https://www.nytimes.com/2025/03/05/world/europe/france-nuclear-europe.html.

34 In 1957, West German Defense Minister Franz Josef Strauss stated that West Germany "too must be so equipped" with nuclear weapons to ensure its security. Marc Trachtenberg, *History and Strategy* (Princeton, NJ: Princeton University Press, 1991), 182–83.

35 Burr, "U.S. Nuclear Presence."

36 This solution also reflected a desire, which Eisenhower articulated even before 1957, to create "a third great power bloc" in Western Europe. Trachtenberg, *History*, 186.

37 Doreen Horschig and Heather Williams, "The Crumbling Nuclear Order: How to Save the Norms Against Testing, Building, and Using the Ultimate Weapon," *Foreign Affairs*, September 16, 2024, https://www.foreignaffairs.com/china/crumbling-nuclear-order.

38 Williams et al., "Deter and Divide."

OPERATIONAL ART IN THE AGE OF BATTLE NETWORKS

1 Hugo Bachega and James Gregory, "'Massive' Drone Attack on Black Sea Fleet—Russia," BBC News, October 29, 2022, https://www.bbc.com/news/world-europe-63437212; Mariano Zafra and Jon McClure, "Sea Drones and the Counteroffensive in Crimea," Reuters, July 17, 2023, https://www.reuters.com/graphics/UKRAINE-CRISIS/CRIMEA/gdvzwrmrlpw/; and H. I. Sutton, "Uncrewed Platforms Have Been Critical to Ukraine's Success in the Black Sea," Royal United Services Institute, April 20, 2024, https://www.rusi.org/explore-our-research/publications/commentary/uncrewed-platforms-have-been-critical-ukraines-success-black-sea.

2 Sean J. A. Edwards, *Swarming on the Battlefield: Past, Present, and Future* (Santa Monica, CA: RAND, 2000), https://doi.org/10.7249/MR1100; and John Arquilla and David F. Ronfeldt, *Swarming and the Future of Conflict* (Santa Monica, CA: RAND, 2000), https://www.rand.org/pubs/documented_briefings/DB311.html.

3 Benjamin Jensen, "Operational Art for the Replicator Initiative: Confessions of a Swarming Addict," War on the Rocks, October 25, 2023, https://warontherocks.com/2023/10/operational-art-for-the-replicator-initiative-confessions-of-a-swarming-addict/; Benjamin Jensen, "Bringing the Swarm to Life: Roles, Missions, and Campaigns for the Replicator Initiative," War on the Rocks, February 13, 2024, https://warontherocks.com/2024/02/bringing-the-swarm-to-life-roles-missions-and-campaigns-for-the-replicator-initiative/; Benjamin Jensen and John Paschkewitz, "Mosaic Warfare: Small and Scalable Are Beautiful," War on the Rocks, December 23, 2019, http://warontherocks.com/2019/12/mosaic-warfare-small-and-scalable-are-beautiful/; and Bryan Clark, Dan Patt, and Harrison Schramm, *Mosaic Warfare: Exploiting Artificial Intelligence and Autonomous Systems to Implement Decision-Centric Operations* (Washington, DC: CSBA, 2020), https://csbaonline.org/research/publications/mosaic-warfare-exploiting-artificial-intelligence-and-autonomous-systems-to-implement-decision-centric-operations.

4 Benjamin M. Jensen, Christopher Whyte, and Scott Cuomo, *Information in War: Military Innovation, Battle Networks, and the Future of Artificial Intelligence* (Washington, DC: Georgetown University Press, 2022); Todd Harrison, "Battle Networks and the

Future Force: Part 1: A Framework for Debate," CSIS, *CSIS Briefs*, August 5, 2021, https://www.csis.org/analysis/battle-networks-and-future-force; and John Stillion and Bryan Clark, *What It Takes to Win: Succeeding in 21st Century Battle Network Competitions* (Washington, DC: CSBA, 2015), https://csbaonline.org/research/publications/what-it-takes-to-win-succeeding-in-21st-century-battle-network-competitions.

5 Carl von Clausewitz, *On War*, ed. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 2008), https://doi.org/10.1515/9781400837403; William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society Since A.D. 1000* (Chicago: University of Chicago Press, 1993), 7; and Azar Gat, *A History of Military Thought: From the Enlightenment to the Cold War* (Oxford, UK: Oxford University Press, 2001).

6 Paul R. Norwood, Benjamin M. Jensen, and Justin Barnes, "Capturing the Character of Future War," *Parameters* 46, no. 2 (June 1, 2016): 81–91, https://doi.org/10.55540/0031-1723.2922. On operational art, see U.S. Department of the Army, *ADP 3-0: Operations* (Washington, DC: Department of the Army, July 2019), https://armypubs.army.mil/epubs/DR_pubs/DR_a/ARN18010-ADP_3-0-000-WEB-2.pdf; Chairman of the Joint Chiefs of Staff, *Joint Publication 3-0: Joint Campaigns and Operations* (Arlington, VA: Joint Chiefs of Staff, 2022), https://www.benning.army.mil/mssp/security%20topics/Potential%20Adversaries/content/pdf/JP%203-0.pdf; Michael D. Krause and R. Cody Phillips, *Historical Perspective of the Operational Art* (Washington, DC: U.S. Army Center of Military History, 2005); Wilson C. Blythe Jr., "A History of Operational Art," *Military Review*, November–December 2018, 37–49, https://www.armyupress.army.mil/Portals/7/military-review/Archives/English/ND-18/Blythe-Operational-Art.pdf; Georgii Samoilovich Isserson, *The Evolution of Operational Art* (Fort Leavenworth, KS: Combat Studies Institute Press, 2013), https://www.armyupress.army.mil/Portals/7/combat-studies-institute/csi-books/OperationalArt.pdf; Huba Wass de Czege, "Thinking and Acting Like an Early Explorer: Operational Art Is Not a Level of War," *Small Wars Journal*, March 14, 2011, 4, http://smallwarsjournal.com/jrnl/art/operational-art-is-not-a-level-of-war; and Justin Kelly and Mike James Brennan, *Alien: How Operational Art Devoured Strategy* (Carlisle, PA: U.S. Army War College, September 2009), https://press.armywarcollege.edu/cgi/viewcontent.cgi?article=1619&context=monographs.

7 Gordon R. Sullivan and Michael V. Harper, *Hope Is Not a Method: What Business Leaders Can Learn from America's Army* (New York: Broadway Books, 1997); Benjamin M. Jensen, *Forging the Sword: Doctrinal Change in the U.S. Army* (Stanford, CA: Stanford Security Studies, 2016); U.S. Department of the Army, *Force XXI Operations: A Concept for the Evolution of Full-Dimensional Operations for the Strategic Army of the Early Twenty-First Century*, Tradoc Pamphlet 525-5 (Fort Monroe, VA: U.S. Army Training and Doctrine Command, August 1, 1994), https://apps.dtic.mil/sti/tr/pdf/ADA314276.pdf; Milan Vego, *Recce-Strike Complexes in Soviet Theory and Practice*, AD-A231 900 (Fort Leavenworth, KS: Department of the Army, 1990), https://apps.dtic.mil/sti/tr/pdf/ADA231900.pdf; Andrew F. Krepinevich, *The Origins of Victory: How Disruptive Military Innovation Determines the Fates of Great Powers* (New Haven, CT: Yale University Press, 2023); Michael J. Sterling, *Soviet Reactions to NATO's Emerging Technologies for Deep Attack*, N-2294-AF (Santa Monica, CA: RAND, 1985), https://www.rand.org/pubs/notes/N2294.html; and Jensen et al., *Information in War*.

8 John Antal, *Next War: Reimagining How We Fight* (New York: Casemate Publishers, 2023).

9 Jensen, *Forging the Sword*, 25.

10 Thomas R. Ryan Jr., "Warfighting: A Function of Combat Power," *Military Review*, September–October 2022, 61–71, https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/September-October-2022/Ryan/; Benjamin Jensen and Matthew Strohmeyer, "The Changing Character of Combined Arms," War on the Rocks, May 23, 2022, https://warontherocks.com/2022/05/the-changing-character-of-combined-arms/; and Jeffrey R. Cares, *An Information Age Combat Model* (Newport, RI: Alidade, 2004), http://www.dodccrp.org/events/9th_ICCRTS/CD/papers/166.pdf.

11 Stephen D. Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton, NJ: Princeton University Press, 2006); Clint Reach, Vikram Kilambi, and

Mark Cozad, *Russian Assessments and Applications of the Correlation of Forces and Means* (Santa Monica, CA: RAND, 2020), https://doi.org/10.7249/RR4235; Shawn Woodford, "How Does the U.S. Army Calculate Combat Power? ¯_( )_/¯," The Dupuy Institute, December 7, 2017, https://dupuyinstitute.org/2017/12/07/how-does-the-u-s-army-calculate-combat-power-%c2%af_%e3%83%84_-%c2%af/; Ryan Vest, "Understanding Relative Combat Power Analysis: How Planners Can Make the Most of a Powerful Tool," *MOC Warfighter* 1, no. 10 (May 2017): Article 3, https://digital-commons.usnwc.edu/moc-warfighter/vol1/iss10/3; Joshua M. Epstein, "The 3:1 Rule, the Adaptive Dynamic Model, and the Future of Security Studies," *International Security* 13, no. 4 (Spring 1989): 90–127, https://doi.org/10.2307/2538781; Joshua M. Epstein, *The Calculus of Conventional War: Dynamic Analysis Without Lanchester Theory* (Washington, DC: Brookings Institution Press, 1985); John J. Mearsheimer, "Assessing the Conventional Balance: The 3:1 Rule and Its Critics," *International Security* 13, no. 4 (Spring 1989): 54–89, https://doi.org/10.2307/2538780; John W. R. Lepingwell, "The Laws of Combat? Lanchester Reexamined," *International Security* 12, no. 1 (Summer 1987): 89–134, https://doi.org/10.2307/2538918; Barry R. Posen, "Is NATO Decisively Outnumbered?," *International Security* 12, no. 4 (Spring 1988): 186–202, https://doi.org/10.2307/2539002; and Trevor N. Dupuy, *Analysis of Factors That Have Influenced Outcomes of Battles and Wars: A Data Base of Battles and Engagements*, vol. 1, *Main Report* (Bethesda, MD: U.S. Army Concepts Analysis Agency, September 1984).

12 Michael C. Horowitz, "Battles of Precise Mass: Technology Is Remaking War—and America Must Adapt," *Foreign Affairs*, October 22, 2024, https://www.foreignaffairs.com/world/battles-precise-mass-technology-war-horowitz.

13 This process is separate from neorealist theory and Waltz's conceptualization of socialization by undifferentiated units in an anarchic system and from the English School's definition of anarchical society. Rather, it conforms to the notion of epistemic communities, definitions of professions from sociology, and work on programmatic actors. See Kenneth Waltz, *Theory of International Politics* (Reading, MA: Addison-Wesley, 1979); João Resende-Santos, *Neorealism, States, and the Modern Mass Army* (New York: Cambridge University Press, 2007); Hedley Bull, *The Anarchical Society: A Study of Order in World Politics* (New York: Columbia University Press, 2002); Emanuel Adler, "The Emergence of Cooperation: National Epistemic Communities and the International Evolution of the Idea of Nuclear Arms Control," *International Organization* 46, no. 1 (Winter 1992): 101–45, https://doi.org/10.1017/S0020818300001466; and Peter M. Haas, "Introduction: Epistemic Communities and International Policy Coordination," *International Organization* 46, no. 1 (Winter 1992): 1–35, https://doi.org/10.1017/S0020818300001442.

14 Harjeet Singh, *The Kautilya Arthaśāstra: A Military Perspective* (New Delhi: KW Publishers, 2013); R. Shamasastry, *Kautilya's Arthasastra* (Mysore, India: Sri Raghuveer Printing Press, 1951), http://archive.org/details/in.gov.ignca.900; Sun Tzu, *The Art of War*, trans. Ralph Sawyer (New York: Basic Books, 1994); and Derek M. C. Yuen, *Deciphering Sun Tzu: How to Read* The Art of War (New York: Oxford University Press, 2022).

15 Niccolò Machiavelli, *Art of War* (Chicago: University of Chicago Press, 2005).

16 Henri I. Rohan (Duc De), *Capitaine (le parfait) ou abrégé des guerres, des commentaires de César* (Paris: Legare Street Press, 2023); Patrick Speelman, *Henry Lloyd and the Military Enlightenment of Eighteenth Century* (London: Praeger, 2002); John L. Alger, *The Quest for Victory: The History of the Principles of War* (Ann Arbor: University of Michigan Press, 1982); and Azar Gat, *The History of Military Thought: From the Enlightenment to the Cold War* (New York: Oxford University Press, 2001).

17 J. F. C. Fuller, *The Foundations of the Science of War* (London: Hutchinson and Company, 1926); and Alger, *Quest for Victory*.

18 Department of the Army, *ADP 3-0: Operations*, A-1–A-5.

19 Harrison, "Battle Networks"; Stillion and Clark, *What It Takes*; and Jensen et al., *Information in War*. For additional explorations of how information changes warfare, see Jon R. Lindsay, *Information Technology and Military Power*, Cornell Studies in

Security Affairs (Ithaca: Cornell University Press, 2020), and Jeremy Black, *The Power of Knowledge: How Information and Technology Made the Modern World* (New Haven, CT: Yale University Press, 2015).

20 U.S. Government Accountability Office, *Defense Command and Control: Further Progress Hinges on Establishing a Comprehensive Framework*, GAO-25-106454 (Washington, DC: GAO, April 2025), https://www.gao.gov/assets/gao-25-106454.pdf; and U.S. Department of Defense, *Summary of the Joint All-Domain Command and Control (JADC2) Strategy* (Washington, DC: DOD, March 2022), https://media.defense.gov/2022/Mar/17/2002958406/-1/-1/1/SUMMARY-OF-THE-JOINT-ALL-DOMAIN-COMMAND-AND-CONTROL-STRATEGY.pdf.

21 Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York: Grand Central Publishing, 2022).

22 Stillion and Clark, *What It Takes*; ibid.; and Jensen and Paschkewitz, "Mosaic Warfare."

23 China Aerospace Studies Institute, *In Their Own Words: Science of Military Strategy 2020* (Montgomery, AL: China Aerospace Studies Institute, January 2022), https://www.airuniversity.af.edu/Portals/10/CASI/documents/Translations/2022-01-26%202020%20Science%20of%20Military%20Strategy.pdf; Dmitry (Dima) Adamsky, "Russian Lessons from the Syrian Operation and the Culture of Military Innovation," George C. Marshall European Center for Security Studies, February 2020, https://www.marshallcenter.org/en/publications/security-insights/russian-lessons-syrian-operation-and-culture-military-innovation; and 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/. On military diffusion, see Michael Horowitz, *The Diffusion of Military Power: Causes and Consequences for International Politics* (Princeton, NJ: Princeton University Press, 2010).

24 Lester W. Grau and Charles K. Bartles, "The Russian Reconnaissance Fire Complex Comes of Age," Changing Character of War Centre, May 30, 2018, https://www.ccw.ox.ac.uk/blog/2018/5/30/the-russian-reconnaissance-fire-complex-comes-of-age.

25 Delta COP is Ukraine's digital command and control platform that integrates battlefield intelligence from drones, satellites, electronic intercepts, and frontline observers into a real-time situational awareness tool, enabling rapid targeting and decentralized decisionmaking across units. On Delta, see Kateryna Bondar, *Does Ukraine Already Have Functional CJADC2 Technology?* (Washington, DC: CSIS, December 2024), https://www.csis.org/analysis/does-ukraine-already-have-functional-cjadc2-technology.

26 Thomas A. Walsh and Alexandra L. Huber, "A Symphony of Capabilities: How the Joint Warfighting Concept Guides Service Force Design," *Joint Force Quarterly*, October 2023, 4–15, https://ndupress.ndu.edu/Media/News/News-Article-View/Article/3568312/a-symphony-of-capabilities-how-the-joint-warfighting-concept-guides-service-for/.

27 Curt Taylor, "Preparing to Win the First Fight of the Next War," Modern War Institute, February 23, 2024, https://mwi.westpoint.edu/preparing-to-win-the-first-fight-of-the-next-war/; Timothy J. Rizza and Michel Wyss, "Hider-Finder Competition, Deception, and Ground Manoeuvre on the 'Transparent Battlefield'," *Defence Horizon Journal*, February 20, 2025, https://tdhj.org/blog/post/deception-transparent-battlefield/; and David Barno and Nora Bensahel, "The Other Big Lessons That the U.S. Army Should Learn from Ukraine," War on the Rocks, June 27, 2022, https://warontherocks.com/2022/06/the-other-big-lessons-that-the-u-s-army-should-learn-from-ukraine/. On diminishing marginal returns as an economic lens to analyze battles, see Jurgen Brauer and Hubert van Tuyll, *Castles, Battles, and Bombs: How Economics Explains Military History* (Chicago: University of Chicago Press, 2008).

28 Antal, *Next War*, 10.

29 Matthew Savill and Burcu Ozcelik, "Operation Days of Repentance: The Impact of Israel's Strikes on Iran," Royal United Services Institute, October 28, 2024, https://www.rusi.org/explore-our-research/publications/commentary/operation-days-repentance-impact-israels-strikes-iran; and Carrie Keller-Lynn, Rory Jones, and Dov Lieber, "How

Israel Pulled Off Its Largest-Ever Strike on Iran," *Wall Street Journal*, October 26, 2024, https://www.wsj.com/world/middle-east/how-israel-pulled-off-its-largest-ever-strike-on-iran-689022ca.

30 Thomas Newdick, "Israeli Strikes Knocked Out All of Iran's S-300 Air Defense Systems: Officials," The War Zone, October 28, 2024, https://www.twz.com/news-features/israeli-strikes-knocked-out-all-of-irans-s-300-air-defense-systems-officials.

31 Ronen Bergman, Mark Mazzetti, and Farnaz Fassihi, "Bomb Smuggled into Tehran Guesthouse Months Ago Killed Hamas Leader," *New York Times*, August 1, 2024, https://www.nytimes.com/2024/08/01/world/middleeast/how-hamas-leader-haniyeh-killed-iran-bomb.html.

32 Wyatte Grantham-Philips, Michael Biesecker, Sarah El Deeb, and Sarah Parvini, "What to Know About the Two Waves of Deadly Explosions That Hit Lebanon and Syria," AP News, September 19, 2024, https://apnews.com/article/lebanon-israel-hezbollah-pager-explosion-e9493409a0648b846fdcadffdb02d71e.

33 Newdick, "Israeli Strikes."

34 Annika Ganzeveld, *The Consequences of the IDF Strikes into Iran* (Washington, DC: Institute for the Study of War, November 2024), https://www.understandingwar.org/backgrounder/consequences-idf-strikes-iran.

THE EVOLUTION OF LANDPOWER

1 Oksana Torop and Svyatoslav Khomenko, "The Fight for Hostomel Airfield. How the Gates to Kyiv Stayed Locked," *The Best of BBC News Russian - in English* (blog), February 29, 2024, https://bbcrussian.substack.com/p/ukraine-war-the-fight-for-hostomel-airfield.

2 CPT Rick Chersicla, "What Free Men Can Do: The Winter War, the Use of Delay, and Lessons for the 21st Century," *Infantry Magazine* (January–March 2017), https://www.benning.army.mil/infantry/magazine/issues/2017/JAN-MAR/pdf/Chersicla_WinterWar.pdf.

3 Georgij S. Isserson, *The Evolution of Operational Art*, 2nd ed., trans. Bruce W. Menning (Fort Leavenworth, KS: Combat Studies Institute Press, 2013), https://www.armyupress.army.mil/Portals/7/combat-studies-institute/csi-books/OperationalArt.pdf; and Paul R. Norwood, Benjamin M. Jensen, and Justin Barnes, "Capturing the Character of Future War," *Parameters* 46, no. 2 (June 2016), https://doi.org/10.55540/0031-1723.2922.

4 Jack D. Kem, ed., *Deep Operations: Theoretical Approaches to Fighting Deep*, The US Army Large-Scale Combat Operations Series (Fort Leavenworth, KS: Army University Press, 2021), https://www.armyupress.army.mil/Portals/7/combat-studies-institute/images/LSCO%20DeepOps%20book%20interactive%20with%20cover%20spread%2012Nov21.pdf.

5 John F. Schmitt, "Understanding Maneuver as the Basis for a Doctrine," Marine Corps Association, August 1, 1990, https://www.mca-marines.org/gazette/understanding-maneuver-as-the-basis-for-a-doctrine/; Peter J. Vlakancic, "Marshal Tukhachevsky and the 'Deep Battle': An Analysis of Operational Level Soviet Tank and Mechanized Doctrine, 1935-1945," Institute of Land Warfare, *Land Warfare Paper* no. 14, November 1992, https://www.ausa.org/sites/default/files/LWP-14-Marshal-Tukhachevsky-and-the-Deep-Battle-An-Analysis-of-Operational-Level-Soviet-Tank-and-Mechanized-Doctrine-1935-1945.pdf; and Alex Danchev, "Liddell Hart and Manoeuvre," *RUSI Journal* 143, no. 6 (December 1998): 33–35, https://doi.org/10.1080/03071849808446325.

6 Benjamin M. Jensen, *Forging the Sword: Doctrinal Change in the U.S. Army* (Stanford, CA: Stanford University Press, 2016); Benjamin M. Jensen, Christopher Whyte, and Scott Cuomo, *Information in War: Military Innovation, Battle Networks, and the Future of Artificial Intelligence* (Washington, DC: Georgetown University Press, 2022); Department of the Army, "A Concept for the Evolution of Full-Dimensional Operations for the Strategic Army of the Early Twenty-First Century," Force Operations: Tradoc Pamphlet 525-5, August 1, 1994; and Steven Metz and Raymond Millen, *Future War/*

Future Battlespace: The Strategic Role of American Landpower (Carlisle, PA: U.S. Army War College Press, March 2003), https://press.armywarcollege.edu/cgi/viewcontent.cgi?article=1800&context=monographs.

7 Alexander Gale, "On Ukraine's 'Transparent Battlefield,' There Are Few Places Left to Hide," *19FortyFive*, April 18, 2024, https://www.19fortyfive.com/2024/04/on-ukraines-transparent-battlefield-there-are-few-places-left-to-hide/; and Timothy J. Rizza and Michel Wyss, "Hider-Finder Competition, Deception, and Ground Manoeuvre on the 'Transparent Battlefield'," *Defence Horizon Journal*, February 20, 2025, https://tdhj.org/blog/post/deception-transparent-battlefield/.

8 Marco J. Lyons and David E. Johnson, "People Who Know, Know MDO: Understanding Army Multi-Domain Operations as a Way to Make It Better," Association of the United States Army, November 14, 2022, https://www.ausa.org/publications/people-who-know-know-mdo-understanding-army-multi-domain-operations-way-make-it-better; U.S. Army Futures Command Futures and Concepts Center, *The U.S. Army Concept for Maneuver in Multi-Domain Operations, 2028-2040* (Washington, DC: U.S. Department of the Army, July 2020), https://apps.dtic.mil/sti/pdfs/AD1118627.pdf; Steven Metz, *Armed Conflict in the 21st Century: The Information Revolution and Post-Modern Warfare* (Carlisle, PA: U.S. Army War College Press, 2000); and U.S. Department of the Army, *Field Manual (FM) 3-0* (Washington, DC: U.S. Department of Defense, October 2022), https://irp.fas.org/doddir/army/fm3-0.pdf.

9 Thomas A. Walsh and Alexandra L. Huber, "A Symphony of Capabilities: How the Joint Warfighting Concept Guides Service Force Design," *Joint Force Quarterly* 111, October 30, 2023, https://ndupress.ndu.edu/Media/News/News-Article-View/Article/3568312/a-symphony-of-capabilities-how-the-joint-warfighting-concept-guides-service-for/.

10 "Strategic Landpower: Winning the Clash of Wills," Strategic Landpower Task Force, 2014, https://api.army.mil/e2/c/downloads/310007.pdf; and Charles Cleveland et al., *Military Strategy for the 21st Century: People, Connectivity, and Influence*, Cambria Rapid Communications in Conflict and Security Series (Amherst, NY: Cambria Press, 2018).

11 Philip Howard, Fen Lin, and Viktor Tuzov, "Computational Propaganda: Concepts, Methods, and Challenges," *Communication and the Public* 8, no. 2 (June 2023): 47–53, https://doi.org/10.1177/20570473231185996; Grace B. Mueller et al., "Cyber Operations during the Russo-Ukrainian War," CSIS, July 13, 2023, https://www.csis.org/analysis/cyber-operations-during-russo-ukrainian-war; and Benjamin Jensen, "The Cyber Character of Political Warfare," *Brown Journal of World Affairs* 24, no. 1 (2017): 159–72, https://www.jstor.org/stable/27119085.

12 Michael Allen Hunzeker and Alexander Lanoszka, "Landpower and American Credibility," *Parameters* 45, no. 4 (December 2015), https://doi.org/10.55540/0031-1723.2983; Christopher G. Pernin et al., *Chasing Multinational Interoperability: Benefits, Objectives, and Strategies* (Santa Monica, CA: RAND Corporation, April 2020), https://doi.org/10.7249/RR3068; and Timothy M. Bonds et al., *What Role Can Land-Based, Multi-Domain Anti-Access/Area Denial Forces Play in Deterring or Defeating Aggression?* (Santa Monica, CA: RAND Corporation, May 2017), https://doi.org/10.7249/RR1820.

13 Abby Doll et al., *The Backbone of U.S. Joint Operations: Army Roles in the Indo-Pacific* (Santa Monica, CA: RAND Corporation, May 2023), https://doi.org/10.7249/RRA1784-1.

14 Julian Stafford Corbett, *Some Principles of Maritime Strategy* (1911; Project Gutenberg, 2005), https://www.gutenberg.org/files/15076/15076-h/15076-h.htm.

15 Corbett, *Some Principles*; Michael Romero and Kevin D. McCranie, "Mahan, Corbett, and the Foundations of Naval Strategic Thought," *Naval War College Review* 76, no. 1 (May 9, 2023), https://digital-commons.usnwc.edu/nwc-review/vol76/iss1/16; A. T. Mahan, *The Influence of Sea Power Upon History, 1660-1783* (1890; Project Gutenberg, 2004), https://www.gutenberg.org/files/13529/13529-h/13529-h.htm; Kevin D. McCranie, *Mahan, Corbett, and the Foundations of Naval Strategic Thought*, Studies in Naval History and Sea Power (Annapolis, MD: Naval Institute Press, 2021); and Barry M. Gough, "Maritime Strategy: The Legacies of Mahan and Corbett as Philosophers of Sea Power," *RUSI Journal* 133, no. 4 (December 1988): 55–62, https://doi.org/10.1080/03071848808445330.

16 Jason Rivera, "A Theory of Cyberwarfare: Political and Military Objectives, Lines of Communication, and Targets," *Georgetown Security Studies Review*, June 10, 2014, https://georgetownsecuritystudiesreview.org/2014/06/10/a-theory-of-cyberwarfare-political-and-military-objectives-lines-of-communication-and-targets/; John J. Klein, "Corbett in Orbit: A Maritime Model for Strategic Space Theory," Brookings Institution, January 1, 2004, https://www.brookings.edu/articles/corbett-in-orbit-a-maritime-model-for-strategic-space-theory/; and C. Alan Meadows, "A Cyber Fleet In Being: Considering Maritime Strategy as a Basis for Cyber Strategy," Air Command and Staff College, April 2014, https://apps.dtic.mil/sti/tr/pdf/AD1023608.pdf.

17 Andrew Dorman, Mike Lawrence Smith, and Matthew R. H. Uttley, eds., *The Changing Face of Maritime Power* (London: Palgrave Macmillan, 1999), https://doi.org/10.1057/9780230509610.

18 Nicholas E. Bixby, "Joint All-Domain Operations (JADO): The Maneuver Concept for Future Conflict," *Over The Horizon Journal*, November 22, 2024, https://othjournal.com/2024/11/22/joint-all-domain-operations-jado-the-maneuver-concept-for-future-conflict/; and "Understanding a Joint All Domain Operational Concept," NATO Headquarters Rapid Deployable Corps Italy, accessed April 24, 2025, https://www.nrdc-ita.nato.int/newsroom/insights/creating-competitive-space-through-a-framework-of-joint-all-domain-maneuver.aspx.

19 Clay Bartels, Tim Tormey, and Jon Hendrickson, "Multidomain Operations and Close Air Support," *Military Review* (March–April 2017), https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/March-April-2017/ART-011/.

20 Brian J. Dunn, "The Tyranny of the Shores: Army Planning for the Asia-Pacific Theater," *Military Review* (March–April 2018), https://www.armyupress.army.mil/Portals/7/military-review/Archives/English/Dunn-Tyranny-of-Shores.pdf.

21 Andrew F. Krepinevich Jr, "How to Deter China," *Foreign Affairs*, February 16, 2015, https://www.foreignaffairs.com/articles/china/2015-02-16/how-deter-china; Benjamin Jensen, "Distributed Maritime Operations: Back to the Future?," War on the Rocks, April 9, 2015, https://warontherocks.com/2015/04/distributed-maritime-operations-an-emerging-paradigm/; Andrew F. Krepinevich, Jr., *Archipelagic Defense: The Japan-U.S. Alliance and Preserving Peace and Stability in the Western Pacific* (Washington, DC: Sasakawa Peace Foundation, August 2017), https://www.spf.org/global-data/SPF_20170810_03.pdf; Art Corbett, "Expeditionary Advanced Base Operations (EABO) Handbook : Considerations for Force Development and Employment," Marine Corps Warfighting Lab, Concepts & Plans Division, June 1, 2018, https://www.mca-marines.org/wp-content/uploads/Expeditionary-Advanced-Base-Operations-EABO-handbook-1.1.pdf; and Andrew F. Krepinevich Jr., "Archipelagic Defense 2.0," Hudson Institute, September 14, 2023, https://www.hudson.org/archipelagic-defense-2-taiwan-china-japan-australia-deterrence-us-navy-andrew-krepinevich-jr.

22 Isaac B. Kardon, "Combating the Gray Zone: Examining Chinese Threats to the Maritime Domain," Carnegie Endowment for International Peace, June 4, 2024, https://carnegieendowment.org/posts/2024/06/combating-the-gray-zone-examining-chinese-threats-to-the-maritime-domain?lang=en; and Brent Sadler and Elizabeth Lapporte, "China's Evolving Risk Tolerance and Gray-Zone Operations: From the East China Sea to the South Pacific," Heritage Foundation, September 9, 2024, https://www.heritage.org/defense/report/chinas-evolving-risk-tolerance-and-gray-zone-operations-the-east-china-sea-the-south.

23 Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century* (Washington, DC: Office of Naval Intelligence, 2015), https://apps.dtic.mil/sti/pdfs/ADA616040.pdf; and U.S. Department of Defense, *Military and Security Developments Involving the Peoples Republic of China 2024* (Washington, DC: U.S. Department of Defense, 2024), https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF.

24 Collin Koh, "Beijing's "Swiss Army Knife" in the South China Sea" in *Beijing's 'Swiss Army Knife' in the South China Sea*, ed. Collin Koh (London: Routledge, 2024), https://

doi.org/10.4324/9781003307365; and Aybars Oztuna, "Assessing The Chinese Naval Infrastructure Changes In The South China Sea Using Geospatial Intelligence" (master's capstone, Johns Hopkins University, 2024), https://jscholarship.library.jhu.edu/server/api/core/bitstreams/9a61c029-3a11-44c5-bbd4-430b94216319/content.

25 Wei-Chung Chen et al., "China's Gray Zone Actions in the East China Sea, Taiwan Strait, and South China Sea: A Comparative Study and Impact on Fisheries," *Marine Policy* 167 (September 2024): 106246, https://doi.org/10.1016/j.marpol.2024.106246; Hongzhou Zhang, "The South China Sea Fishing Crisis: The Overlooked Role of Chinese Subnational Governments," *Pacific Review* 37, no. 6 (November 2024): 1090–1119, https://doi.org/10.1080/09512748.2024.2304805; Alison McCook and Donald R. Rothwell, "Territorial Disputes and Deep-Sea Mining in the South China Sea," *Melbourne Journal of International Law* 25, no. 1 (July 2024): 95–131; Mohd Haris Abdul Rani, "Energy Dominance in the South China Sea: Legal and Geopolitical Battles over Strategic Resources," *International Journal of Research and Innovation in Social Science* VIII, no. XII (2025): 3308–16, https://doi.org/10.47772/IJRISS.2024.8120275.

26 Shaleen Khanal and Hongzhou Zhang, "Ten Years of China's Belt and Road Initiative: A Bibliometric Review," *Journal of Chinese Political Science* 29, no. 2 (June 2024): 361–95, https://doi.org/10.1007/s11366-023-09873-z; Daniel Lindley, "Assessing China's Motives: How the Belt and Road Initiative Threatens US Interests," Air University, August 1, 2022, https://www.airuniversity.af.edu/JIPA/Display/Article/3111114/assessing-chinas-motives-how-the-belt-and-road-initiative-threatens-us-interests/; "Weaponizing the Belt and Road Initiative," Asia Society Policy Institute, September 8, 2020, https://asiasociety.org/policy-institute/weaponizing-belt-and-road-initiative; and "China's Belt and Road Initiative," National Bureau of Asian Research, n.d., https://www.nbr.org/program/chinas-belt-and-road-initiative-military-and-security-implications/.

27 Fakhar Hussain et al., "The Digital Rise and Its Economic Implications for China through the Digital Silk Road under the Belt and Road Initiative," *Asian Journal of Comparative Politics* 9, no. 2 (June 2024): 238–53, https://doi.org/10.1177/20578911231174731; and Robert Greene and Paul Triolo, "Will China Control the Global Internet Via Its Digital Silk Road?," Carnegie Endowment for International Peace, May 8, 2020, https://carnegieendowment.org/posts/2020/05/will-china-control-the-global-internet-via-its-digital-silk-road?lang=en.

28 Tony Roberts and Marjoke Oosterom, "Digital Authoritarianism: A Systematic iterature Review," *Information Technology for Development*, November 24, 2024, 1–25, https://doi.org/10.1080/02681102.2024.2425352.

29 "China Regional Snapshot: Space," House Committee on Foreign Affairs; and Malcolm Davis, "The Coming of China's Space Silk Road," Australian Strategic Policy Institute, August 11, 2017, https://www.aspistrategist.org.au/coming-chinas-space-silk-road/.

30 Gareth Jennings, "Ukraine Reportedly Strikes Russian Airbase," Janes, February 25, 2022, https://www.janes.com/osint-insights/defence-news/defence/ukraine-reportedly-strikes-russian-airbase.

31 "Half of Russia's Black Sea Fleet's Combat Jets out of Operation, Western Official Says," Reuters, August 19, 2022, https://www.reuters.com/world/europe/half-russias-black-sea-fleets-combat-jets-out-operation-western-official-2022-08-19/.

32 Mark Trevelyan, "Moscow Says Three Killed in Ukrainian Drone Attacks on Air Bases Deep Inside Russia," Reuters, December 5, 2022, https://www.reuters.com/world/europe/three-killed-fuel-tanker-explosion-russian-airfield-2022-12-05/.

33 Andrew Osborn, "UK Says a Supersonic Russian Bomber Likely to Have Been Destroyed in Drone Attack," Reuters, August 22, 2023, https://www.reuters.com/world/europe/uk-says-supersonic-russian-bomber-likely-have-been-destroyed-drone-attack-2023-08-22/.

34 Benjamin Jensen, "Relative Superiority in the Drone Age: McRaven's Playbook Meets Ukraine's Airfield Assaults," CSIS, *Commentary*, June 2, 2024, https://www.csis.org/analysis/relative-superiority-drone-age-mcravens-playbook-meets-ukraines-airfield-assaults; Benjamin Jensen "Ukraine's Operation Spider Web destroyed more than

aircraft – it tore apart the old idea that bases far behind the front lines are safe," *The Conversation* June 5, 2025: https://theconversation.com/ukraines-operation-spider-web-destroyed-more-than-aircraft-it-tore-apart-the-old-idea-that-bases-far-behind-the-front-lines-are-safe-258056

35 Andrzej Wilk and Piotr Żochowski, "Ukraine Attacks with ATACMS Missiles. Day 603 of War," OSW Centre for Eastern Studies, October 20, 2023, https://www.osw.waw.pl/en/publikacje/analyses/2023-10-20/ukraine-attacks-atacms-missiles-day-603-war.

36 Igor Delanoë, "Russia's Black Sea Fleet in the 'Special Military Operation' in Ukraine," Foreign Policy Research Institute, February 7, 2024, https://www.fpri.org/article/2024/02/russias-black-sea-fleet-in-the-special-military-operation-in-ukraine/.

37 George Allison, "Ukraine Has 'Significantly Degraded' Russian Black Sea Fleet," *UK Defence Journal*, February 28, 2025, https://ukdefencejournal.org.uk/ukraine-has-significantly-degraded-russian-black-sea-fleet/.

38 Ibid.

39 "Space Wars Continue: Ukraine Hits Russian Satellite Communication Center in Yevpatoria," Defense Express, June 24, 2024, https://en.defence-ua.com/news/space_wars_continue_ukraine_hits_russian_satellite_communication_center_in_yevpatoria-10950.html.

40 Andrew Feickert, "The Army's Multi-Domain Task Force (MDTF)," Congressional Research Service, IF 11797, April 14, 2025, https://www.congress.gov/crs-product/IF11797; U.S. Naval Institute Staff, "Report to Congress on The Army's Multi-Domain Task Force," USNI News, March 18, 2025, https://news.usni.org/2025/03/18/report-to-congress-on-the-armys-multi-domain-task-force; "Multi-Domain Task Forces: A Glimpse at the Army of 2035," Association of the United States Army, March 2, 2022, https://www.ausa.org/publications/multi-domain-task-forces-glimpse-army-2035; Justin Katz, "Marines to Formally Stand up Second of 3 Marine Littoral Regiments in November," Breaking Defense, October 17, 2023, https://breakingdefense.com/2023/10/marines-to-formally-stand-up-second-of-3-marine-littoral-regiments-in-november/; "Inside the Marine Corps' First-Ever Littoral Regiment," Defense One, October 6, 2024, https://www.defenseone.com/threats/2024/10/inside-marine-corps-first-ever-littoral-regiment/400084/; and Andrew Feickert, "The U.S. Marine Corps Marine Littoral Regiment (MLR)," Congressional Research Service, IF 12200, April 23, 2025, https://www.congress.gov/crs-product/IF12200.

41 Andrew Feickert, "The U.S. Army's Typhon Mid-Range Capability (MRC) System," Congressional Research Service, IF 12145, April 22, 2025, https://www.congress.gov/crs-product/IF12135.

42 Jen Judson, "Here's How the US Army's Multidomain Task Force Is Contributing to AUKUS," Defense News, May 17, 2024, https://www.defensenews.com/land/2024/05/17/heres-how-the-us-armys-multidomain-task-force-is-contributing-to-aukus/.

43 Joe Mroszczyk, "Multi-Domain Effects Battalion: Space Integration and Effects in Multidomain Operations," *Military Review* (Space & Missile Defense 2024), https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/March-2024/Multi-Domain-Effects-Battalion/.

44 Jen Judson, "US Army Buys Long-Flying Solar Drones to Watch over Pacific Units," Defense News, October 30, 2024, https://www.defensenews.com/land/2024/10/30/us-army-buys-long-flying-solar-drones-to-watch-over-pacific-units/; and "US Army to Launch High Altitude Balloons," U.S. Army Pacific, June 6, 2024, https://www.usarpac.army.mil/Our-Story/Our-News/Article-Display/Article/3798814/us-army-to-launch-high-altitude-balloons/.

45 Jensen, "Distributed Maritime Operations"; and United States Marine Corps, *Tentative Manual for Expeditionary Advanced Base Operations*, 2nd ed. (Washington, DC: Department of the Navy, May 2023), https://www.marines.mil/Portals/1/Docs/230509-Tentative-Manual-For-Expeditionary-Advanced-Base-Operations-2nd-Edition.pdf?ver=05KvG8wWlhI7uE0amD5uYg%3D%3D.

46 Todd South, "US Marines and Japanese Military Put New Radar on Taiwan's Doorstep," *Marine Corps Times*, August 8, 2024, https://www.marinecorpstimes.com/news/your-marine-corps/2024/08/08/us-marines-and-japanese-military-put-new-radar-on-taiwans-doorstep/.

47 U.S. Marine Corps Training and Education Command, *Information in Marine Corps Operations*, MCWP 8-10 (Arlington, VA: United States Marine Corps, February 2024); Mark Pomerleau, "Marines Experimenting with Defensive Cyber Teams for Reconnaissance," DefenseScoop, May 6, 2022, https://defensescoop.com/2022/05/06/marines-experimenting-with-defensive-cyber-teams-for-reconnaissance/; Mark Pomerleau, "Here's What the Marines' Information Command Centers Will Do," C4ISRNet, December 6, 2019, https://www.c4isrnet.com/information-warfare/2019/12/06/heres-what-the-marines-information-command-centers-will-do/; and Mark Pomerleau, "The Navy and Marines Want an Integrated Force for Information Warfare," C4ISRNet, December 5, 2019, https://www.c4isrnet.com/information-warfare/2019/12/05/the-navy-and-marines-want-an-integrated-force-for-information-warfare/.

48 Walsh and Huber, "A Symphony of Capabilities"; Bixby, "Joint All-Domain Operations"; and U.S. Department of the Army, *Field Manual (FM) 3-0*.

THE ENDURING ROLE OF FIRES ON THE MODERN BATTLEFIELD

1 David Johnson, "The Tank is Dead: Long Live the Javelin, the Switchblade, the . . . ?," War on the Rocks, April 18, 2022, https://warontherocks.com/2022/04/the-tank-is-dead-long-live-the-javelin-the-switchblade-the/.

2 Joseph Trevithick and Tyler Rogoway, "How the Houthis' Rickety Air Defenses Threaten Even the F-35," The War Zone, May 14, 2025, https://www.twz.com/air/how-the-houthis-rickety-air-defenses-can-threaten-the-stealthy-f-35; John Grady, "Black Sea Conflict Informing U.S. Navy Unmanned Systems, Says Admiral," USNI News, February 28, 2025, https://news.usni.org/2025/02/28/black-sea-conclifct-informing-u-s-navy-unmanned-systems-says-admiral; Joe Cowen, "The Rise of Uncrewed Surface Vessels: How Ukraine Is Rewriting the Rules of Naval Warfare," Forces News, March 10, 2025, https://www.forcesnews.com/ukraine/rise-uncrewed-surface-vessels-how-ukraine-rewriting-rules-naval-warfare; and Brandon Weichert, "The Navy Is Freaked: The Age of Big Warships Is Just About Done," *National Interest*, October 18, 2024, https://nationalinterest.org/feature/navy-freaked-age-big-warships-just-about-done-209999.

3 Japan Ministry of Defense, *National Security Strategy of Japan* (Tokyo: Ministry of Defense, December 2022), 18-19, https://www.mod.go.jp/j/policy/agenda/guideline/pdf/security_strategy_en.pdf; and Japan Ministry of Defense, *Defense Buildup Program* (Tokyo: Ministry of Defense, December 2022), 6-7, https://www.mod.go.jp/j/policy/agenda/guideline/plan/pdf/program_en.pdf; and Australia Department of Defense, *2024 National Defence Strategy* (Canberra: Department of Defense, 2024), 38-39, https://www.defence.gov.au/about/strategic-planning/2024-national-defence-strategy-2024-integrated-investment-program.

4 "mitto," Wiktionary, Accessed July 28, 2025, https://en.wiktionary.org/wiki/mitto.

5 "missilis," Numen: The Latin Lexicon, https://latinlexicon.org/definition.php?p1=2036372&p2=m.

6 Henry Fairlie, "An Ambassador Must Be Free to Lie," *Washington Post*, August 18, 1979, https://www.washingtonpost.com/archive/opinions/1979/08/19/an-ambassador-must-be-free-to-lie/596d2de2-da64-49bb-b431-eb775577b32c/.

7 38th Commandant of the Marine Corps, *Commandant's Planning Guidance* (Washington, DC: Headquarters Marine Corps, 2019), 14, https://www.hqmc.marines.mil/Portals/142/Docs/%2038th%20Commandant%27s%20Planning%20Guidance_2019.pdf.

8 Chairman of the Joint Chiefs of Staff, *JP 3-30: Joint Air Operations* (Arlington, VA: Joint Chiefs of Staff, July 2019), https://irp.fas.org/doddir/dod/jp3_30.pdf; and "Shahed-136," Army Recognition, March 12, 2025, https://armyrecognition.com/military-products/

army/unmanned-systems/unmanned-aerial-vehicles/shahed-136-loitering-munition-kamikaze-suicide-drone-technical-data.

9 U.S. Department of Defense, *2022 National Defense Strategy of the United States of America Including the 2022 Nuclear Posture Review and the 2022 Missile Defense Review* (Washington, DC: U.S. Department of Defense, October 2022), https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.pdf; and Tom Karako, "The 2022 Missile Defense Review: Still Seeking Alignment," CSIS, *Commentary*, October 27, 2022, https://www.csis.org/analysis/2022-missile-defense-review-still-seeking-alignment.

10 Sean Gainey, "Countering Uncrewed Aerial Systems: A Conversation with General Sean Gainey," CSIS, transcript, November 14, 2023, https://www.csis.org/analysis/countering-uncrewed-aerial-systems-conversation-general-sean-gainey.

11 Ian Williams, *Putin's Missile War: Russia's Strike Campaign in Ukraine* (Washington, DC: CSIS, May 2023), 8, https://www.csis.org/analysis/putins-missile-war.

12 Ibid., 2.

13 Yasir Atalan and Benjamin Jensen, "Breaking Down Russian Missile Salvos: What Drives Neutralization?," CSIS, *Commentary*, February 24, 2025, https://www.csis.org/analysis/breaking-down-russian-missile-salvos-what-drives-neutralization.

14 Ibid.

15 Williams, *Putin's Missile War*, 15.

16 Frederik Mertens et al., *Lessons from Land Warfare: One Year of War in Ukraine* (The Hague: Hague Centre for Strategic Studies, February 2023), https://hcss.nl/wp-content/uploads/2023/02/Lessons-Learned-Paper-English-Version-Final.pdf.

17 Wes Rumbaugh, "Cost and Value in Air and Missile Defense Intercepts," CSIS, *Commentary*, February 13, 2024, https://www.csis.org/analysis/cost-and-value-air-and-missile-defense-intercepts.

18 James Holmes, "The U.S. Navy Could Soon Get Patriot Missiles," *National Interest*, October 28, 2024, https://nationalinterest.org/feature/us-navy-could-soon-get-patriot-missiles-213419.

19 Lauren Frias, "See the 2 Anti-Drone Missiles the US Navy Is Using to Defend Aircraft Carriers," Business Insider, May 18, 2025, https://www.businessinsider.com/anduril-roadrunner-raytheon-coyote-drones-us-navy-carriers-2025-5; and Daniel M. Gettinger, *Department of Defense Counter Unmanned Aircraft Systems: Background and Issues for Congress*, CRS Report No. R48477 (Washington, DC: Congressional Research Service, March 31, 2025), https://www.congress.gov/crs-product/R48477.

20 "Operations in the Red Sea: Lessons for Surface Warfare," CSIS, transcript, May 14, 2024, https://www.csis.org/analysis/operations-red-sea-lessons-surface-warfare.

21 Ibid.

22 Shaan Shaikh, "The Iran-Israel Air Conflict, One Week In," CSIS, *Critical Questions*, April 19, 2024, https://www.csis.org/analysis/iran-israel-air-conflict-one-week.

23 C. Todd Lopez, "U.S. Assets in the Mediterranean Again Helped Defend Israel Against Iranian Missiles," U.S. Department of Defense, October 1, 2024, https://www.defense.gov/News/News-Stories/Article/Article/3923123/us-assets-in-mediterranean-again-helped-defend-israel-against-iranian-missiles/.

24 Ria Reddy, Ben Rezaei, Johanna Moore, Annika Ganzeveld, and Brian Carter, "Iran Update Special Report," Institute for the Study of War and American Enterprise Institute Critical Threats Project, June 12, 2025, https://www.understandingwar.org/sites/default/files/Iran%20Nuclear%20Strikes%2C%20June%2012%2C%202025%201%20PDF.pdf.

25 Emanuel Fabian, "The Israel-Iran war by the numbers, after 12 days of fighting," *The Times of Israel*, June 24, 2025, https://www.timesofisrael.com/the-israel-iran-war-by-

the-numbers-after-12-days-of-fighting/.

26 Bilal Y. Saab and Darren D. White, "Lessons Observed from the War Between Israel and Iran," War on the Rocks, July 16, 2025, https://warontherocks.com/2025/07/lessons-observed-from-the-war-between-israel-and-iran/; Zvi Smith and Benoit Faucon, "Through Trial and Error, Iran Found Gaps in Israel's Storied Air Defenses," *Wall Street Journal*, July 15, 2025, https://www.wsj.com/world/middle-east/iran-israel-air-defense-362826e3; and Shelby Holiday, "U.S. Races to Defend Israel as It Burns Through Missile Interceptors," *Wall Street Journal*, June 20, 2025, https://www.wsj.com/world/middle-east/u-s-races-to-defend-israel-as-it-burns-through-missile-interceptors-2909e49d.

27 Shelby Holliday, Anat Peled, and Drew FitzGerald, "Israel's 12-Day War Revealed Alarming Gap in America's Missile Stockpile," *Wall Street Journal*, July 24, 2025, https://www.wsj.com/world/israel-iran-us-missile-stockpile-08a65396?mod=hp_lead_pos9.

28 Patrick Kingsley et al., "Will Israel's Interceptors Outlast Iran's Missiles? The Answer May Shape the War," *New York Times*, June 19, 2025, https://www.nytimes.com/2025/06/19/world/middleeast/israel-interceptors-iran-missiles-war-length.html.

29 Chris Gordon, "Iranian Ballistic Missile Hit US Air Base in Qatar in June, Pentagon Reveals," *Wall Street Journal*, July 11, https://www.airandspaceforces.com/iranian-ballistic-missile-hit-al-udeid-air-base-qatar/.

30 Ibid.

31 "Israel's Missile Defense Engagements Since October 7th," CSIS, Transcript, July 12, 2024, https://www.csis.org/analysis/israels-missile-defense-engagements-october-7th.

32 Ibid.

33 U.S. Government Accountability Office, *Directed Energy Weapons: DOD Should Focus on Transition Planning, GAO-23-105868* (Washington, DC: Government Accountability Office, April 2023), https://www.gao.gov/assets/gao-23-105868.pdf.

34 James Black, "Directed Energy: The Focus on Laser Weapons Intensifies," RAND, January 25, 2024, https://www.rand.org/pubs/commentary/2024/01/directed-energy-the-focus-on-laser-weapons-intensifies.html.

35 Ibid.

36 Thomas Karako, "Deterrence, Air Defense, and Munitions Production in a New Missile Age," Hoover Institution, December 23, 2022, https://www.hoover.org/research/deterrence-air-defense-and-munitions-production-new-missile-age.

37 Ibid.

38 Seth G. Jones, *Empty Bins in a Wartime Environment: The Challenge to the U.S. Defense Industrial Base* (Washington, DC: CSIS, January 2023), 1, https://www.csis.org/analysis/empty-bins-wartime-environment-challenge-us-defense-industrial-base.

39 Thomas Karako, "The Missile Defeat Review in Context," in *Missile Defense and Defeat: Considerations for the New Policy Review*, ed. Thomas Karako (Washington, DC: CSIS, March 2017), 10, https://missilethreat.csis.org/missile-defense-and-defeat/.

40 Kenneth Todorov, "A Vector Check for America's Missile Defense: Assessing the Course for the Trump Administration," in *Missile Defense and Defeat: Considerations for the New Policy Review*, ed. Thomas Karako (Washington, DC: CSIS, March 2017), 60, https://missilethreat.csis.org/missile-defense-and-defeat/.

41 Jon Harper, "U.S. Challenged to Defend Against Chinese Missiles," *National Defense*, March 7, 2022, https://www.nationaldefensemagazine.org/articles/2022/3/7/us-challenged-to-defend-against-chinese-missiles.

42 Ian Williams and Masao Dahlgren, "As Missile Threats Grow, Don't Give Up on Boost-Phase Defense," Defense News, July 22, 2022, https://www.defensenews.com/opinion/commentary/2022/07/22/as-missile-threats-grow-dont-give-up-on-boost-phase-defense/.

43 Clayton Swope and Tom Karako, "Why a Missile Shield in Space Makes Sense," SpaceNews, February 4, 2025, https://spacenews.com/why-a-missile-shield-in-space-makes-sense/.

44 Troy Meink, keynote address at 2024 Space Symposium, April 9, 2024, transcript, https://www.nro.gov/Portals/135/Documents/news/speeches/2024/Space_Symposium_Remarks_PREPARED_FOR_DELIVERY_04082024.pdf.

INTELLIGENCE IN AN TRANSPARENT WORLD

1 Joshua Yaffa, "How Bellingcat Unmasked Putin's Assassins," *New Yorker*, March 31, 2021, https://www.newyorker.com/news/dispatch/how-bellingcat-unmasked-putins-assassins.

2 U.S. Department of the Treasury, "Treasury Targets Individuals Involved in the Poisoning of Aleksey Navalny," press release, February 8, 2025, https://home.treasury.gov/news/press-releases/jy1700.

3 Yaffa, "How Bellingcat Unmasked Putin's Assassins."

4 Fabio Duarte, "Amount of Data Created Daily (2025)," Exploding Topics, last updated April 24, 2025, https://explodingtopics.com/blog/data-generated-per-day.

5 The concept of "smart cities" likely began in the late 1990s, but many point to Songdo in South Korea as the first city intentionally designed to be smart. For more, see Jeongwha Huh et al., "Who built Songdo, the 'world's first smart city?' questioning technology firms' ability to lead smart city development," *Eurasian Geography and Economics* (February 2024): 1–18, https://doi.org/10.1080/15387216.2024.2309879; and Alberto De Marco and Giulio Mangano, "Evolutionary Trends in Smart City Initiatives," *Sustainable Futures* 3, no. 100052 (May 2021): 100052, https://doi.org/10.1016/j.sftr.2021.100052.

6 "Ubiquitous Technical Surveillance Has Made Spying More Difficult," *The Economist*, July 1, 2024, https://www.economist.com/technology-quarterly/2024/07/01/ubiquitous-technical-surveillance-has-made-spying-more-difficult.

7 Ibid.

8 Ibid.

9 Senior Advisory Group Panel on Commercially Available Information, *Report to the Director of National Intelligence* (Washington, DC: Office of the Director of National Intelligence, January 2022), 2–3, https://www.dni.gov/files/ODNI/documents/assessments/ODNI-Declassified-Report-on-CAI-January2022.pdf.

10 Souad Mekhennet and Joby Warrick, "Mossad's Pager Operation: Inside Israel's Penetration of Hezbollah," *Washington Post*, October 5, 2024, https://www.washingtonpost.com/world/2024/10/05/israel-mossad-hezbollah-pagers-nasrallah/.

11 Jim Hockenhull, "How open-source intelligence has shaped the Russia-Ukraine war," UK Ministry of Defence, December 9, 2022, https://www.gov.uk/government/speeches/how-open-source-intelligence-has-shaped-the-russia-ukraine-war.

12 "Ukraine, Russia Exploit Dating and Social Media Apps to Extract Military Intel," Defense Mirror, October 19, 2024, https://www.defensemirror.com/news/37954/Ukraine__Russia_Exploit_Dating_and_Social_Media_Apps_to_Extract_Military_Intel.

13 Through the Diia app, Ukrainians can "submit location-tagged photos and videos of Russian military sightings—as well as tips on 'suspicious' people who might be invaders or saboteurs. The data . . . are aggregated onto a map visible to Ukrainian intelligence officials working on defense and counterstrikes." Drew Harwell, "Instead of Consumer Software, Ukraine's Tech Workers Build Apps of War," *Washington Post*, March 24, 2022, https://www.washingtonpost.com/technology/2022/03/24/ukraine-war-apps-russian-invasion/. For more, see "How Smartphones and Social Media Became a Key Tool for War in Ukraine | WSJ Tech News Briefing," YouTube video, posted by WSJ Podcasts, June 15, 2025, 7:34, https://youtu.be/OF-Wt4BeZE4; and Den Prystai, "From

Ukrainians to Ukrainians. 5 Digital Tools Created to Help in Wartime," war.ukraine.ua, October 5, 2022, https://war.ukraine.ua/articles/digital-tools-created-to-help-in-wartime/.

14 "Ukraine, Russia Exploit Dating and Social Media Apps to Extract Military Intel," Defense Mirror, October 19, 2024, https://www.defensemirror.com/news/37954/Ukraine_Russia_Exploit_Dating_and_Social_Media_Apps_to_Extract_Military_Intel; and David Kirichenko, *Military Lessons for NATO from the Russia-Ukraine War: Preparing for the Wars of Tomorrow* (London: The Henry Jackson Society and Centre for Russia and Eurasia Studies, October 2024), 52, https://henryjacksonsociety.org/publications/military-lessons-for-nato-from-the-russia-ukraine-war-preparing-for-the-wars-of-tomorrow/.

15 Harwell, "Instead of Consumer Software."

16 Michael Peck, "Ukrainian Troops Used 'Wedding Drones' and Google Maps to Batter Russian Forces during the War's Chaotic Early Days, Commanders Say," Business Insider, May 16, 2023, https://www.businessinsider.com/ukrainian-artillery-uses-drones-google-maps-to-find-russian-targets-2023-5.

17 "Ukraine, Russia Exploit Dating and Social Media Apps to Extract Military Intel," Defense Mirror. Also see Simon Newton, "Tinder Trap: Ukraine and Russia using fake profiles to trick soldiers into revealing intel," Forces News, October 18, 2024, https://www.forcesnews.com/ukraine/tinder-trap-ukraine-and-russia-using-women-glean-intel-enemy-soldiers.

18 "Ukraine, Russia Exploit Dating and Social Media Apps to Extract Military Intel," Defense Mirror.

19 Brad Smith, "Defending Ukraine: Early Lessons from the Cyber War," *Microsoft On the Issues* (blog), June 22, 2022, https://blogs.microsoft.com/on-the-issues/2022/06/22/defending-ukraine-early-lessons-from-the-cyber-war/.

20 Ronen Bergman and Adam Goldman, "Israel Knew Hamas's Attack Plan More Than a Year Ago," *New York Times*, November 30, 2023, https://www.nytimes.com/2023/11/30/world/middleeast/israel-hamas-attack-intelligence.html.

21 "Head of IDF Devil's Advocate Unit Tried Repeatedly in September to Warn of Possible Hamas Attack," *Times of Israel*, January 6, 2024, https://www.timesofisrael.com/liveblog_entry/head-of-idf-devils-advocate-unit-tried-repeatedly-in-september-to-warn-of-possible-hamas-attack/.

22 "Egypt Intelligence Official Says Israel Ignored Repeated Warnings of 'Something Big'," *Times of Israel*, October 9, 2023, https://www.timesofisrael.com/egypt-intelligence-official-says-israel-ignored-repeated-warnings-of-something-big/.

23 Emanuel Fabian, "Hours Before Hamas Attack, IDF Noticed Dozens of Terrorists Activating Israeli SIMs," *Times of Israel*, February 26, 2024, https://www.timesofisrael.com/hours-before-hamas-attack-idf-noticed-hundreds-of-terrorists-activating-israeli-sims/.

24 Amy B. Zegart, *Spies, Lies, and Algorithms: The History and Future of American Intelligence* (Princeton, NJ: Princeton University Press, 2022), Ch. 5: Why Analysis is so Hard: the Seven Deadly Biases.

25 Emily Harding, *Move Over JARVIS, Meet OSCAR* (Washington, DC: CSIS, January 2022), https://www.csis.org/analysis/move-over-jarvis-meet-oscar.

26 Sam Trendall, "MI6 and CIA chiefs: 'We are using generative AI to identify key information in a sea of data,'" Public Technology, September 10, 2024, https://www.publictechnology.net/2024/09/10/defence-and-security/mi6-and-cia-chiefs-we-are-using-generative-ai-to-identify-key-information-in-a-sea-of-data/; and Edward Wong et al., "Chinese Spy Agency Rising to Challenge the C.I.A.," *New York Times*, December 27, 2023, https://www.nytimes.com/2023/12/27/us/politics/china-cia-spy-mss.html.

27 For more, see the CSIS report No Front Lines, which was pending release at time of publication.

1 Mykhailo Fedorov (@FedorovMykhailo), "@elonmusk, while you try to colonize Mars—Russia try to occupy Ukraine!," X post, Feb 26, 2022, 7:06 a.m., https://x.com/FedorovMykhailo/status/1497543633293266944.

2 Specifically, the target was Viasat's KA-SAT satellite communications network. See "KA-SAT Network Cyber Attack Overview," Viasat, March 20, 2022, https://www.viasat.com/perspectives/corporate/2022/ka-sat-network-cyber-attack-overview/; UK Foreign, Commonwealth and Development Office, "Russia Behind Cyber-Attack with Europe-Wide Impact an Hour Before Ukraine Invasion," press release, May 10, 2022, https://www.gov.uk/government/news/russia-behind-cyber-attack-with-europe-wide-impact-an-hour-before-ukraine-invasion; Antony J. Blinken, "Attribution of Russia's Malicious Cyber Activity Against Ukraine," U.S. Department of State, https://2021-2025.state.gov/attribution-of-russias-malicious-cyber-activity-against-ukraine/; U.S. Department of Justice, "Russian National Charged for Conspiring with Russian Military Intelligence to Destroy Ukrainian Government Computer Systems and Data," press release, June 26, 2024, https://www.justice.gov/archives/opa/pr/russian-national-charged-conspiring-russia-military-intelligence-destroy-ukrainian; and Patrick Howell O'Neill, "Russia Hacked an American Satellite Company One Hour Before the Ukraine Invasion," *MIT Technology Review*, May 10, 2022, https://www.technologyreview.com/2022/05/10/1051973/russia-hack-viasat-satellite-ukraine- .

3 Fedorov, "@elonmusk, while you try to colonize Mars."

4 Google translation of Mykhailo Fedorov, "Ще 5 тисяч терміналів Starlink отримали від Польщі" [Another 5 thousand Starlink terminals received from Poland], Facebook post, April 3, 2025, https://www.facebook.com/mykhailofedorov.com.ua/videos/4020061868252926/.

5 Sandra Erwin, "As Russia Prepared to Invade, U.S. Opened Commercial Imagery Pipeline to Ukraine," SpaceNews, April 6, 2022, https://spacenews.com/as-russia-prepared-to-invade-u-s-government-and-satellite-imagery-suppliers-teamed-up-to-help-ukraine/.

6 Alex Horton, Serhii Korolchuk, and Eva Dou, "Russia's Illicit Starlink Terminals Help Power Its Advance in Ukraine," *Washington Post*, October 12, 2024, https://www.washingtonpost.com/world/2024/10/12/starlink-russia-ukraine-elon-musk/.

7 Sandra Erwin, "On National Security | Drawing Lessons from the First Commercial Space War," SpaceNews, May 20, 2022, https://spacenews.com/on-national-security-drawing-lessons-from-the-first-commercial-space-war/; and Kari A. Bingen, Kaitlyn Johnson, and Makena Young, *Space Threat Assessment 2023* (Washington, DC: CSIS, April 2023), foreword, https://www.csis.org/analysis/space-threat-assessment-2023.

8 For example, see global trends in commercial space-based remote sensing in Kari A. Bingen, David Gauthier, and Madeleine Chang, *Gold Rush: The 2024 Commercial Remote Sensing Global Rankings* (Washington, DC: CSIS, October 2024), https://www.csis.org/analysis/gold-rush-2024-commercial-remote-sensing-global-rankings.

9 Vera Bergengruen, "How Tech Giants Turned Ukraine into an AI War Lab," *Time*, February 8, 2024, https://time.com/6691662/ai-ukraine-war-palantir/.

10 Those companies include Maxar, Planet Labs, Blacksky, Airbus Space and Defense, Capella, ICEYE, Rheinmetall, and others.

11 "Aviation Week Names Maxar a 2022 Laureate Award Winner," Maxar Technologies, July 25, 2022, https://blog.maxar.com/for-a-better-world/2022/aviation-week-names-maxar-a-2022-laureate-award-winner; and "The Most Documented Invasion in History," Planet, n.d., https://www.planet.com/ukraine-photo-story/.

12 "Просто космос – результати використання 'народного супутника' ICEYE" [Just Space – Results of Using the 'People's Satellite' ICEYE], Defence Intelligence Agency of the Ministry of Defense of Ukraine, June 26, 2024, https://gur.gov.ua/content/prosto-kosmos-rezultaty-vykorystannia-narodnoho-suputnyka-iceye.html; and Howard Altman, "'People's Satellite' Helped Ukraine Hit Over 1,000 Targets Spy Agency Says,"

TWZ, June 26, 2024, https://www.twz.com/news-features/peoples-satellite-helped-ukraine-hit-over-1000-targets-spy-agency-says.

13 "Space and Data Domain Lessons from Russia-Ukraine | Conflict in Focus," CSIS, transcript, April 10, 2025, https://www.csis.org/analysis/space-and-data-domain-lessons-russia-ukraine-conflict-focus.

14 David Ignatius, "How the Algorithm Tipped the Balance in Ukraine," *Washington Post*, December 19, 2022, https://www.washingtonpost.com/opinions/2022/12/19/palantir-algorithm-data-ukraine-war/; and "GEOINT Lessons Being Learned from the Russian-Ukrainian War," U.S. Geospatial Intelligence Foundation, February 22, 2024, https://usgif.org/geoint-lessons-being-learned-from-the-russian-ukrainian-war/.

15 Lori Hinnant, Mstyslav Chernov, and Vasilisa Stepanenko, "AP Evidence Points to 600 Dead in Mariupol Theater Airstrike," AP News, May 4, 2022, https://apnews.com/article/russia-ukraine-war-mariupol-theater-c321a196fbd568899841b506afcac7a1.

16 Oksana Markarova, keynote address, Defense and Intelligence Space Conference 2024, February 27, 2024, Virginia, https://nssaspace.org/event/disc24/; "Ukraine Conflict Observatory," Yale School of Public Health, accessed July 22, 2025, https://medicine.yale.edu/lab/khoshnood/conflict-observatory/ukraine/.

17 Florian Vidal, *Russia's Space Policy: The Path of Decline?* (French Institute of International Relations, January 2021), https://www.ifri.org/sites/default/files/migrated_files/documents/atoms/files/vidal_russia_space_policy_2021_3.pdf.

18 Office of the Director of National Intelligence (ODNI), *Annual Threat Assessment of the U.S. Intelligence Community* (Washington, DC: ODNI, March 2025), https://www.dni.gov/files/ODNI/documents/assessments/ATA-2025-Unclassified-Report.pdf.

19 U.S. Department of the Treasury, "Treasury Sanctions Russian Proxy Wagner Group as a Transnational Criminal Organization," press release, January 26, 2023, https://home.treasury.gov/news/press-releases/jy1220; and "Russia-Related Designations; Issuance of Russia-Related General Licenses and Frequently Asked Question; Revocation of Russia-Related General License," U.S. Department of the Treasury, Office of Foreign Assets Control, April 12, 2023, https://ofac.treasury.gov/recent-actions/20230412.

20 Horton, Kkorolchuk, and Dou, "Russia's Illicit Starlink Terminals."

21 "KA-SAT Network," Viasat; "Air and Space Domain Lessons from Russia-Ukraine: Part One | Conflict in Focus," CSIS, transcript, March 20, 2025, https://www.csis.org/analysis/air-and-space-domain-lessons-russia-ukraine-part-one-conflict-focus; and O'Neill, "Russia Hacked an American Satellite Company."

22 Space-based systems include three segments: the satellites in-orbit; transmission uplinks and downlinks between the satellites and ground stations; and ground stations, infrastructure, and user equipment used to operate the satellites, receive data, and relay commands. All of these segments can be targeted by counterspace weapons that degrade satellite performance.

23 Shira Rubin and Loveday Morris, "How Hamas Broke Through Israel's Border Defenses During Oct. 7 Attack," *Washington Post*, October 27, 2023, https://www.washingtonpost.com/world/2023/10/27/hamas-attack-israel-october-7-hostages/.

24 "Watch: Netanyahu says Israel targeted Iran's nuclear and military sites," BBC, June 12, 2025, https://www.bbc.com/news/videos/cz70x722zvyo; and Thomas Newdick, "Israel Strikes Key Iranian Command And Control Sites In Tehran (Updated)," The War Zone, June 23, 2025, https://www.twz.com/news-features/israel-strikes-key-iranian-command-and-control-sites-in-tehran.

25 U.S. Department of Defense (DOD), *Military and Security Developments Involving the People's Republic of China 2024: Annual Report to Congress* (Washington, DC: DOD, 2024), 86, https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF; and DOD, *Military and Security Developments Involving the People's Republic of China 2022: Annual Report to Congress* (Washington, DC: DOD, 2022), 86, https://

media.defense.gov/2022/Nov/29/2003122279/-1/-1/1/2022-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF.

26 DOD, *Military and Security Developments Involving the People's Republic of China 2023: Annual Report to Congress* (Washington, DC: DOD, 2023), iv, 95, https://media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF.

27 The 2025 *Space Threat Assessment* noted: "Many regions of the world, from the Baltic Sea through Eastern Europe, to the Middle East and parts of South Asia, have been affected by GPS jamming and spoofing nearly every day since the publication of last year's report." See Clayton Swope et al., *Space Threat Assessment 2025* (Washington, DC: CSIS, April 2025), https://www.csis.org/analysis/space-threat-assessment-2025. For detailed definitions of jamming and spoofing, refer to past editions of *Space Threat Assessment*.

28 Courtney Kube, "Russia has figured out how to jam U.S. drones in Syria, officials say," NBC News, April 10, 2018, https://www.nbcnews.com/news/military/russia-has-figured-out-how-jam-u-s-drones-syria-n863931; and Stephen Losey, "SOCOM boss: Adversaries are disabling Air Force gunships in Syria," *Air Force Times*, April 27, 2018, https://www.airforcetimes.com/flashpoints/2018/04/27/socom-boss-adversaries-are-disabling-air-force-gunships-in-syria/.

29 Mike Eckel, "Ex-US Army Commander Warns of Russian Capabilities in Ukraine," Radio Free Europe/Radio Liberty, January 24, 2018, https://www.rferl.org/a/ukraine-drones-artillery-ukrainian-forces/28994516.html.

30 Debra Werner, "HawkEye 360 Detects GPS Interference in Ukraine," SpaceNews, March 4, 2022, https://spacenews.com/hawkeye-360-gps-ukr/.

31 "OSCE SMM Spot Report 8/2021: Forced Emergency Landing of Long-Range Unmanned Aerial Vehicle Due to Dual GPS Signal Interference," Organization for Security and Co-operation in Europe, April 9, 2021, https://www.osce.org/special-monitoring-mission-to-ukraine/483149; "Spot Report 6/2021: SMM Long-Range UAV Unable to Take Off Due to Dual GPS Signal Interference," Organization for Security and Co-operation in Europe, April 7, 2021, https://www.osce.org/special-monitoring-mission-to-ukraine/483008; and Dana Goward, "Russia Ramps up GPS Jamming Along with Troops at Ukraine Border," GPS World, April 21, 2021, https://www.gpsworld.com/russia-ramps-up-gps-jamming-along-with-troops-at-ukraine-border/.

32 Tereza Pultarova, "Ukraine's Bold Gamble on an Electronic Warfare 'Wall'," IEEE Spectrum, May 19, 2025, https://spectrum.ieee.org/electronic-warfare-ukraine; Jack Watling and Nick Reynolds, *Tactical Developments During the Third Year of the Russo-Ukrainian War* (London: Royal United Services Institute, February 2025), https://static.rusi.org/tactical-developments-third-year-russo-ukrainian-war-february-2205.pdf; and "Russia Doubles Production of Key Types of Military Equipment—PM," TASS, September 20, 2023, https://tass.com/defense/1677893.

33 Bryan Clark, "The Fall and Rise of Russian Electronic Warfare," IEEE Spectrum, July 20, 2022, https://spectrum.ieee.org/the-fall-and-rise-of-russian-electronic-warfare; and Carlotta Gall and Vladyslav Golovin, "Some U.S. Weapons Stymied by Russian Jamming in Ukraine," *New York Times*, May 25, 2024, https://www.nytimes.com/2024/05/25/world/europe/us-weapons-russia-jamming-ukraine.html.

34 Alex Marquardt, Natasha Bertrand, and Zachary Cohen, "Russia's Jamming of U.S.-Provided Rocket Systems Complicates Ukraine's War Effort," CNN, May 6, 2023, https://edition.cnn.com/2023/05/05/politics/russia-jamming-himars-rockets-ukraine; Isabelle Khurshudyan and Alex Horton, "Russian Jamming Leaves Some High-Tech U.S. Weapons Ineffective in Ukraine," *Washington Post*, May 24, 2024, https://www.washingtonpost.com/world/2024/05/24/russia-jamming-us-weapons-ukraine/; and Gall and Golovin, "Some U.S. Weapons Stymied."

35 Valerii Zaluzhnyi, "Modern Positional Warfare and How to Win in It," *The Economist*, 2023, https://infographics.economist.com/2023/ExternalContent/ZALUZHNYI_FULL_VERSION.pdf.

36 Thomas Withington, "The Underwhelming Performance of Russian Land Forces Electronic Warfare–Watt Happened?," Defence Horizon Journal, August 18, 2022, https://tdhj.org/blog/post/watt-happened/.

37 A jamming signal is broadcast at sufficient strength to overpower legitimate GPS signals. A spoofing signal is meant to appear like a legitimate GPS signal, but the spoofing signal transmits incorrect positional information. See Swope et al., *Space Threat Assessment 2025*.

38 Ibid.

39 "Space Threat Fact Sheet," Headquarters Space Force Intelligence, updated May 16, 2025, https://nssaspace.org/wp-content/uploads/2025/05/20250516-S2-Space-Threat-Fact-Sheet-v8-RELEASE.pdf.

40 Courtney Albon, "New US Space Force Jammers Aim to Disrupt China's SATCOM Signals," DefenseNews, December 19, 2024, https://www.defensenews.com/space/2024/12/19/new-us-space-force-jammers-aim-to-disrupt-chinas-satcom-signals/; and Colin Demarest, "US Army Set to Test Combined Cyber, Jamming, Signal Intelligence Tool," *Army Times*, August 15, 2023, https://www.armytimes.com/electronic-warfare/2023/08/15/us-army-set-to-test-combined-cyber-jamming-signal-intelligence-tool/.

41 Clayton Swope et al., *Space Threat Assessment 2024* (Washington, DC: CSIS, April 2024), https://www.csis.org/analysis/space-threat-assessment-2024; and Swope et al., *Space Threat Assessment 2025*.

42 "UN agencies warn of satellite navigation jamming and spoofing," International Telecommunication Union, March 26, 2025, https://www.itu.int/hub/2025/03/un-agencies-warn-of-satellite-navigation-jamming-and-spoofing/.

43 Valeria Insinna, "SpaceX Beating Russian Jamming Attack Was 'Eyewatering': DoD Official," Breaking Defense, April 20, 2022, https://breakingdefense.com/2022/04/spacex-beating-russian-jamming-attack-was-eyewatering-dod-official/.

44 For example, many drone manufacturers and operators exhibiting at the Drone Summit 2025 in Riga, Latvia, in May 28, 2025, showcased technical and operational solutions aimed at mitigating the battlefield effects of GPS interference, https://dronesummit.lv/. Watling and Reynolds, *Tactical Developments*.

45 Ibid.; and Pultarova, "Ukraine's Bold Gamble."

46 Troy Meink, David W. Allvin, and B. Chance Saltzman, "Department of the Air Force Posture Statement: Fiscal Year 2026," Presentation to the Committees and Subcommittees of the U.S. Senate and House of Representatives, 119th Cong., 1st sess., https://www.armed-services.senate.gov/imo/media/doc/saltzman_opening_statement.pdf; U.S. Space Systems Command, "U.S. Space Force Field Commands Announce Accelerated GPS III Mission to Enhance Warfighter Capabilities," press release, April 7, 2025, https://www.ssc.spaceforce.mil/Newsroom/Article/4147205/us-space-force-field-commands-announce-accelerated-gps-iii-mission-to-enhance-w; and Theresa Hitchens, "Ensured SATCOM, GPS Alternatives Tops Among Space Force Budget Wishes," Breaking Defense, September 5, 2024, https://breakingdefense.com/2024/09/ensured-satcom-gps-alternatives-tops-among-space-force-wishes/.

47 The two nascent Chinese LEO broadband satellites constellations referenced are the GuoWang constellation, led by China Satellite Network Group Co., Ltd. ("China SatNet"), and the Thousand Sails (or "Qianfan") constellation, led by Shanghai Spacecom Satellite Technology (SSST); Blaine V. Curcio, testimony submitted to the U.S.-China Economic and Security Review Commission, Hearing on Hearing on China's Ambitions in Space, April 3, 2025, https://www.uscc.gov/sites/default/files/2025-04/Blaine_Curcio_Testimony.pdf; and ODNI, *Annual Threat Assessment*, 15.

48 B. Chance Saltzman, testimony submitted to the U.S.-China Economic and Security Revision Commission, Hearing on China's Ambitions in Space, April 3, 2025, https://www.uscc.gov/sites/default/files/2025-04/Chance_Saltzman_Testimony.pdf.

49 Swope et al., *Space Threat Assessment 2025*. There are several other good references on space threats including the Secure World Foundation's *Annual Report*, the Defense Intelligence Agency's *Challenges to Security in Space*, and the U.S. Space Force's quarterly space threat update.

50 Bingen, Johnson, and Young, *Space Threat Assessment 2023*. In recent years, Russian officials have showcased the Peresvet ground-based satellite laser and Sokol-Eshelon, an airborne laser system that is a revival of a Soviet-era program, which has the stated capability to attack satellites in LEO.

51 Swope et al., *Space Threat Assessment 2024*.

52 ODNI, *Annual Threat Assessment*, 15.

53 "SDA Layered Network of Military Satellites Now Known as "Proliferated Warfighter Space Architecture," Space Development Agency, January 23, 2023, https://www.sda.mil/sda-layered-network-of-military-satellites-now-known-as-proliferated-warfighter-space-architecture/.

54 Stephen Chen, "Chinese Physicists Simulate Nuclear Blast against Satellites," *South China Morning Post*, October 20, 2022, https://www.scmp.com/news/china/science/article/3196629/chinese-physicists-simulate-nuclear-blast-against-satellites.

55 Bingen, Johnson, and Young, *Space Threat Assessment 2023*.

56 Theresa Hitchens, "'Space fires' to enable 'space superiority' are top SPACECOM priorities for FY27," Breaking Defense, August 6, 2024, https://breakingdefense.com/2024/08/space-fires-to-enable-space-superiority-are-top-spacecom-priorities-for-fy27/.

57 "Space Warfighting: A Framework for Planners," U.S. Space Force, released April 2025, https://www.spaceforce.mil/Portals/2/Documents/SAF_2025/Space_Warfighting_-_A_Framework_for_Planners_BLK2_(final_20250410).pdf.

58 Ministère des Armées [Ministry of the Armed Forces], *LPM 2024-2030: Les grandes orientations* [*LPM 2024-2030: The Major Directions*] (Paris: Government of France, 2023), 9–10, https://www.defense.gouv.fr/sites/default/files/ministere-armees/Livret%20de%20pr%C3%A9sentation%20de%20la%20Loi%20de%20programmation%20militaire%202024-2030%20%286%20avril%202023%29.pdf; and "France to launch 'fearsome' surveillance satellites to bolster space defences," Reuters, July 25, 2019, https://www.reuters.com/article/us-france-space-defence/france-to-launch-fearsome-surveillance-satellites-to-bolster-space-defenses-idUSKCN1UK1TY/.

59 "Jackal for Geosynchronous Orbit and Cislunar Space," True Anomaly, April 3, 2025, https://www.trueanomaly.space/newsroom/jackal-for-geosynchronous-orbit-and-cislunar-space.

60 For example, in May 2025, the Polish Ministry of National Defense signed an agreement with Finland's ICEYE for the company to deliver three SAR satellites to the Polish Armed Forces to advance its sovereign reconnaissance systems for ISR activities. ICEYE, "ICEYE to provide SAR satellites for the Armed Forces of Poland," press release, May 14, 2025, https://www.iceye.com/newsroom/press-releases/iceye-to-provide-sar-satellites-for-the-armed-forces-of-poland.

61 U.S. Geospatial Intelligence Foundation, "GEOINT Lessons Being Learned from the Russian-Ukrainian War."

62 "Russia warns West: We can target your commercial satellites," Reuters, October 27, 2022, https://www.reuters.com/world/russia-says-wests-commercial-satellites-could-be-targets-2022-10-27/.

63 Swope et al., *Space Threat Assessment 2024*.

TECHNOLOGICAL EVOLUTION ON THE BATTLEFIELD

1 Marc Santora, "Rise of the Dragons: Fire-Breathing Drones Duel in Ukraine," *New York Times*, October 12, 2024, https://www.nytimes.com/2024/10/12/world/europe/ukraine-

russia-dragon-drones.html.

2 "How Britain Invented The Tank In The First World War," Imperial War Museums, n.d., https://www.iwm.org.uk/history/how-britain-invented-the-tank-in-the-first-world-war; and Stephen Dowling, "The WWI tank that helped change warfare forever," BBC, May 31, 2018, https://www.bbc.com/future/article/20180531-the-wwi-tank-that-helped-change-warfare-forever.

3 The Battle of Medina Ridge was fought in February 1991 between U.S.-led coalition forces and Iraq's Republican Guard. It involved more than 3,000 tanks and is considered one of the largest tank battles of the twentieth century. See "The Untold Story of the World's Fiercest Tank Battle," *National Geographic*, last modified February 22, 2021, https://www.nationalgeographic.com/history/article/untold-story-worlds-fiercest-tank-battle-gulf-war.

4 Yaroslav Trofimov, "Drones Everywhere: How the Technological Revolution on Ukraine Battlefields Is Reshaping Modern Warfare," *Wall Street Journal*, September 28, 2023, https://www.wsj.com/world/drones-everywhere-how-the-technological-revolution-on-ukraine-battlefields-is-reshaping-modern-warfare-bf5d531b.

5 Ibid.

6 David Axe, "Bullseye! A Grenade-Tossing Ukrainian Drone Knocked Out One Russian Tank—And Then Terrorized A Second Tank That Came To The Rescue," *Forbes*, November 12, 2023, https://www.forbes.com/sites/davidaxe/2023/11/12/bullseye-a-grenade-tossing-ukrainian-drone-knocked-out-one-russian-tank-and-then-terrorized-a-second-tank-that-came-to-the-rescue/; and Jaspreet Gill, "As US Army transforms, it's gleaning lessons about high- and low-tech fighting from Ukraine, Israel," Breaking Defense, November 29, 2023, https://breakingdefense.com/2023/11/as-us-army-transforms-its-gleaning-lessons-about-high-and-low-tech-fighting-from-ukraine-israel/

7 Marc Santora, "Rise of the Dragons: Fire-Breathing Drones Duel in Ukraine," *New York Times*, October 12, 2024, https://www.nytimes.com/2024/10/12/world/europe/ukraine-russia-dragon-drones.html.

8 Trofimov, "Drones Everywhere."

9 Ibid.

10 Andrew E. Kramer, "In a Tough Year on Land, Drones Give Ukraine Some Success at Sea," *New York Times*, December 20, 2023, https://www.nytimes.com/2023/12/20/world/europe/ukraine-drones-sea.html.

11 Brian Glyn Williams, "How the Ukrainians – With No Navy – Defeated Russia's Black Sea Fleet," MarineLink, July 23, 2024, https://www.marinelink.com/news/ukrainians-navy-defeated-russias-black-515405; H. I. Sutton, "Uncrewed Platforms Have Been Critical to Ukraine's Success in the Black Sea," Royal United Services Institute, August 20, 2024, https://www.rusi.org/explore-our-research/publications/commentary/uncrewed-platforms-have-been-critical-ukraines-success-black-sea; Michael Ashcroft, "Meet a Real-Life 'Q': Mastermind Behind Ukraine's Sea Drone Warfare Success," *Kyiv Post*, December 1, 2024, https://www.kyivpost.com/post/42949; and Kramer, "In a Tough Year on Land."

12 Kateryna Zakharchenko, "Ukraine Naval Drone Shoots Down Two Russian Warplanes in 24 Hours: First-Ever USV Fighter Jet Kills (Updated)," *Kyiv Post*, May 4, 2024, https://www.kyivpost.com/post/51994; and Howard Altman, "Two Russian Su-30 Flankers Downed By AIM-9s Fired From Drone Boats: Ukrainian Intel Boss," The War Zone, May 3, 2025, https://www.twz.com/news-features/two-russian-su-30-flankers-downed-by-aim-9s-fired-from-drone-boats-ukrainian-intel-boss.

13 Vitalii Hnidyi, "Ukrainian Brigade Pioneers Remote-Controlled Ground Assaults," Reuters, January 16, 2025, https://www.reuters.com/world/europe/ukrainian-brigade-pioneers-remote-controlled-ground-assaults-2025-01-16/; and Warren Murray, "Ukraine war briefing: Gravehawk revealed as new air defence system pledged by Starmer," *The Guardian*, January 16, 2025, https://www.theguardian.com/world/2025/jan/17/ukraine-war-briefing-gravehawk-revealed-as-new-air-defence-system-pledged-by-starmer.

14 "Basic qualification levels for drone operators approved," *Odessa Journal*, January 14, 2025, https://odessa-journal.com/basic-qualification-levels-for-drone-operators-approved; Kateryna Bondar, "Why Ukraine is Establishing Unmanned Forces Across Its Defense Sector and What the United States Can Learn from It," CSIS, *Commentary*, November 19, 2024, https://www.csis.org/analysis/why-ukraine-establishing-unmanned-forces.

15 "Basic qualification levels," *Odessa Journal*.

16 Olivia Savage, "Ukraine conflict: Ukraine establishes world's first unmanned force," Janes, June 14, 2024, https://www.janes.com/osint-insights/defence-news/air/ukraine-conflict-ukraine-establishes-worlds-first-unmanned-force.

17 Sarah Young, "UK firm supports Ukrainian armed forces in drone tech race," Reuters, March 28, 2024, https://www.reuters.com/business/aerospace-defense/uk-firm-supports-ukrainian-armed-forces-drone-tech-race-2024-03-27/.

18 David Axe, "Ukraine Is Jamming Russian Glide Bombs All Along The Front Line, Erasing One Of Russia's Main Battlefield Advantages," *Forbes*, February 26, 2025, https://www.forbes.com/sites/davidaxe/2025/02/26/ukraine-is-jamming-russian-glide-bombs-all-along-the-front-line-erasing-one-of-russias-main-battlefield-advantages/; Boyko Nikolov, "Russian glide bombs fell off a cliff, a VKS insider reports," BulgarianMilitary.com, February 27, 2025, https://bulgarianmilitary.com/2025/02/27/russian-glide-bombs-fell-off-a-cliff-a-vks-insider-reports/; Axe, "Ukraine Is Jamming"; and Nikolov, "Russian glide bombs."

19 Nataliia Kushnerska, "Missiles, AI, and drone swarms: Ukraine's 2025 defense tech priorities," Atlantic Council, January 2, 2025, https://www.atlanticcouncil.org/blogs/ukrainealert/missiles-ai-and-drone-swarms-ukraines-2025-defense-tech-priorities/.

20 Guy Faulconbridge, "Russia uses new laser weapons in Ukraine, Zelenskiy mocks 'wonder weapon'," Reuters, May 18, 2022, https://www.reuters.com/world/europe/russia-touts-new-generation-blinding-laser-weapons-2022-05-18/; and Dominika Kunertova and Stephen Herzog, "Emerging and Disruptive Technologies Transform, but Do Not Lift, the Fog of War - Evidence from Russia's War on Ukraine," ETH Zurich, February 14, 2024, https://www.research-collection.ethz.ch/bitstream/handle/20.500.11850/696795/2024-09-29Kunertova-HerzogFNDUEDTs.pdf?sequence=7&isAllowed=y.

21 Kris Osborn, "Ukraine's Decentralized Command Puts Russia on the Defensive," *National Interest*, September 11, 2022, https://nationalinterest.org/blog/buzz/ukraines-decentralized-command-puts-russia-defensive-204714.

22 Alistair MacDonald and Ievgeniia Sivorka, "Russia Trots Out Its Newest Weapons in Ukraine: Horses," *Wall Street Journal*, March 9, 2025, accessed March 10, 2025, https://www.wsj.com/world/russia-ukraine-war-horses-8079ebb6.

23 Ibid.

24 Bobby Allyn, "Deepfake video of Zelenskyy could be 'tip of the iceberg' in info war, experts warn," NPR, March 16, 2022, https://www.npr.org/2022/03/16/1087062648/deepfake-video-zelenskyy-experts-war-manipulation-ukraine-russia; and Kunertova and Herzog, "Emerging and Disruptive."

25 Bryan Sicard, "Can Facial Recognition Technology Save Ukraine's Children? One Company's Strides Tracking the Perpetrators and Victims of War Crimes," *Journal of High Technology Law*, Suffolk University Law School, April 17, 2024, https://sites.suffolk.edu/jhtl/2024/04/17/can-facial-recognition-technology-save-ukraines-children-one-companys-strides-tracking-the-perpetrators-and-victims-of-war-crimes/.

26 Ibid.

27 Sicard, "Can Facial Recognition"; and Потеръ.НЕТ, https://poteru.net/. Потеръ.НЕТ [Losses.net] is the online database created by Ukraine to document deceased Russian soldiers.

28 Vera Bergengruen, "How Tech Giants Turned Ukraine Into an AI War Lab," *Time*,

February 8, 2024, https://time.com/6691662/ai-ukraine-war-palantir/.

29 Ellen Nakashima and Alex Horton, "Russian government hackers have likely penetrated critical Ukrainian computer systems, U.S. says," *Washington Post*, February 15, 2022, https://www.washingtonpost.com/national-security/2022/02/15/russia-ukraine-cyber-attacks/.

30 Jon Bateman, "Russia's Wartime Cyber Operations in Ukraine: Military Impacts, Influences, and Implications," Carnegie Endowment for International Peace, December 16, 2022, https://carnegieendowment.org/research/2022/12/russias-wartime-cyber-operations-in-ukraine-military-impacts-influences-and-implications?lang=en/.

31 Khrystyna Kvartsiana, "Ukraine's Cyber Defense: Lessons in Resilience," German Marshall Fund of the United States, December 2023, https://www.gmfus.org/sites/default/files/2023-12/Kvartsiana%20-%20Ukraine%20Cyber%20-%20Report.pdf; and Aiden Render-Katolik, "The IT Army of Ukraine," CSIS (blog), August 15, 2023, https://www.csis.org/blogs/strategic-technologies-blog/it-army-ukraine.

32 Ulrike Franke and Jenny Söderström, "Star tech enterprise: Emerging technologies in Russia's war on Ukraine," European Council on Foreign Relations, September 5, 2023, https://ecfr.eu/publication/star-tech-enterprise-emerging-technologies-in-russias-war-on-ukraine/#lesson-1-private-technology-companies-are-playing-an-ever-more-important-role-in-warfare.

33 Bergengruen, "How Tech Giants."

34 Kateryna Bondar, "How Ukraine Rebuilt Its Military Acquisition System Around Commercial Technology," CSIS, January 13, 2025, https://www.csis.org/analysis/how-ukraine-rebuilt-its-military-acquisition-system-around-commercial-technology.

35 Ibid.

36 Marta Bo and Jessica Dorsey, "Symposium on Military AI and the Law of Armed Conflict: The 'Need' for Speed – The Cost of Unregulated AI Decision-Support Systems to Civilians," OpinioJuris, April 4, 2024, https://opiniojuris.org/2024/04/04/symposium-on-military-ai-and-the-law-of-armed-conflict-the-need-for-speed-the-cost-of-unregulated-ai-decision-support-systems-to-civilians/. Companion systems Fire Factory, Depth of Wisdom, Alchemist, and Lavender have also played a role on the battlefield.

37 Harry Davies, Bethan McKernan, and Dan Sabbagh, "'The Gospel': how Israel uses AI to select bombing targets in Gaza," *The Guardian*, December 1, 2023, https://www.theguardian.com/world/2023/dec/01/the-gospel-how-israel-uses-ai-to-select-bombing-targets; Bo and Dorsey, "Symposium on Military"; and Geoff Brumfiel, "Israel is using an AI system to find targets in Gaza. Experts say it's just the start," NPR, December 14, 2023, https://www.npr.org/2023/12/14/1218643254/israel-is-using-an-ai-system-to-find-targets-in-gaza-experts-say-its-just-the-st.

38 Bo and Dorsey, "Symposium on Military"; and Brumfiel, "Israel is using."

39 Brumfiel, "Israel is using"; and Bethan McKernan and Harry Davies, "'The machine did it coldly': Israel used AI to identify 37,000 Hamas targets," *The Guardian*, April 3, 2024, https://www.theguardian.com/world/2024/apr/03/israel-gaza-ai-database-hamas-airstrikes. Separately, the Lavender system was used to rapidly identify potential "junior" Hamas and Palestinian Islamic Jihad operatives, with the AI system identifying 37,000 Palestinian men for targeting.

40 Nick Robins-Early, "How Israel uses facial-recognition systems in Gaza and beyond," *The Guardian*, April 19, 2024, https://www.theguardian.com/technology/2024/apr/19/idf-facial-recognition-surveillance-palestinians.

41 Sheera Frenkel, "Israel Deploys Expansive Facial Recognition Program in Gaza," *New York Times*, March 27, 2024, https://www.nytimes.com/2024/03/27/technology/israel-facial-recognition-gaza.html; Sophia Yan, "Israel 'using facial recognition technology to identify Hamas terrorists'," *The Telegraph*, March 28, 2024, https://www.telegraph.co.uk/world-news/2024/03/28/israel-using-facial-recognition-pinpoint-hamas-gaza/;

Meghan McCarty Carino, Jesús Alvarado, and Daniel Shin, "Facial recognition part of Israel's arsenal in Gaza war," Marketplace, April 8, 2024, https://www.marketplace.org/shows/marketplace-tech/israel-gaza-hamas-facial-recognition/; and Robins-Early, "How Israel uses."

42 Emily Rose, "Israeli Startups Make Global Plans After Key Role in War," Reuters, January 31, 2025, https://www.reuters.com/world/middle-east/israeli-startups-make-global-plans-after-key-role-war-2025-01-31/; and "Israel: Proposed 'Green Track' for R&D Centers," KPMG, November 7, 2024, https://kpmg.com/us/en/taxnewsflash/news/2024/11/tnf-israel-proposed-green-track-r-and-d-centers.html.

43 Rose, "Israeli Startups Make."

44 Ibid.

45 Ibid.

46 Sam Mednick, Garance Burke, and Michael Biesecker, "How US tech giants supplied Israel with AI models, raising questions about tech's role in warfare," AP News, February 18, 2025, https://apnews.com/article/israel-palestinians-ai-weapons-430f6f15aab420806163558732726ad9.

47 Ibid.

48 Ibid.

49 Harry Davies and Yuval Abraham, "Revealed: Microsoft Deepened Ties with Israeli Military to Provide Tech Support During Gaza War," *The Guardian*, January 23, 2025, https://www.theguardian.com/world/2025/jan/23/israeli-military-gaza-war-microsoft; and Oren Ziv, "Microsoft, OpenAI Provide Cloud Services to Israeli Army," *+972 Magazine*, April 16, 2024, https://www.972mag.com/microsoft-azure-openai-israeli-army-cloud/.

50 McKernan and Davies, "'The machine did it coldly'."

51 Ibid.

52 Ibid.

53 Frenkel, "Israel Deploys Expansive"; Robins-Early, "How Israel uses"; and Jerusalem Post Staff, "IDF enhances wartime surveillance, deploys facial recognition in Gaza," *Jerusalem Post*, March 28, 2024, https://www.jpost.com/israel-hamas-war/article-794128.

54 Frenkel, "Israel Deploys Expansive."

55 These guerrilla-style tactics are likely to take place under the canopy of a separate high-tech exchange of fire. Precision strikes have marked the conflicts in Ukraine and around Israel and are likely to be decisive in a Pacific contingency. For more on this form of war, see Chapter 6: The Enduring Role of Fires).

56 Emily Harding and Harshana Ghoorhoo, *Seven Critical Technologies for Winning the Next War* (Washington, DC: CSIS, April 2023), https://www.csis.org/analysis/seven-critical-technologies-winning-next-war; and Emily Harding and Aosheng Pusztaszeri, *Averting Strategic Surprise in Nontraditional Intelligence Domains* (Washington, DC: CSIS, October 2024) [private report].

57 Harding and Ghoorhoo, *Seven Critical Technologies*.

58 Ibid.

59 John Mike, "EOD Group One Trains on Next-Generation Communications Technology," U.S. Navy, June 12, 2023, https://www.navy.mil/Press-Office/News-Stories/display-news/Article/3426428/eod-group-one-trains-on-next-generation-communications-technology/.

60 Sicard, "Can Facial Recognition"; and David E. Sanger, Julian E. Barnes, and Kate Conger, "As Tanks Rolled Into Ukraine, So Did Malware. Then Microsoft Entered the War," *New York Times*, February 28, 2022, https://www.nytimes.com/2022/02/28/us/

politics/ukraine-russia-microsoft.html.

61 Brumfiel, "Israel is using."

62 Rob Hastings, "Israel's spies relied too much on tech over human informants before Hamas attack, ex-intelligence officer says," *The i Paper*, October 11, 2023, https://inews.co.uk/news/world/israel-spies-tech-human-informants-hamas-attack-intelligence-officer-2680503?srsltid=AfmBOoqb4cbNmxA_V6hNoY6f2ZtBmfNB_cz_GANyBTv4YY1pFWY5YXqC; Tia Goldenberg, "What went wrong? Questions emerge over Israel's intelligence prowess after Hamas attack," AP News, October 9, 2023, https://apnews.com/article/israel-hamas-gaza-attack-intel-a5287a18773232f26ca171233be01721; and Ronen Bergman, Mark Mazzetti, and Maria Abi-Habib, "How Years of Israeli Failures on Hamas Led to a Devastating Attack," *New York Times*, October 29, 2023, https://www.nytimes.com/2023/10/29/world/middleeast/israel-intelligence-hamas-attack.html.

63 Geoff Brumfiel, "U.S. Navy Brings Back Navigation By The Stars For Officers," NPR, February 22, 2016, https://www.npr.org/2016/02/22/467210492/u-s-navy-brings-back-navigation-by-the-stars-for-officers.

THE EVOLUTION OF AIRPOWER

1 Giulio Douhet, *Command of the Air*, trans. Dino Ferrari (New York: Coward-McCann Inc., 1942), https://www.airuniversity.af.edu/Portals/10/AUPress/Books/B_0160_DOUHET_THE_COMMAND_OF_THE_AIR.PDF.

2 E.J. Kingston-McCloughry, *War in Three Dimensions: The Impact of Air-Power Upon the Classical Principles of War* (London: Jonathan Cape, 1949).

3 Fred C. Kelly, *The Wright Brothers* (San Diego, CA: Harcourt, Brace and Company, 1943), https://www.gutenberg.org/files/67672/67672-h/67672-h.htm.

4 U.S. Air Force, *Air Force Doctrine Document 3-01: Counterair Operations* (Washington, DC: U.S. Air Force, June 2023), https://www.doctrine.af.mil/Portals/61/documents/AFDP_3-01/3-01-AFDP-COUNTERAIR.pdf.

5 Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms* (Washington, DC: Joint Chiefs of Staff, November 2010), https://edocs.nps.edu/2014/December/jp1_02.pdf.

6 U.S. Air Force, *Counterair Operations*.

7 David A. Deptula and Christopher J. Bowie, *The Significance of Air Superiority: The Ukraine-Russia War* (Arlington, VA: Mitchell Institute, July 2024), https://www.mitchellaerospacepower.org/the-significance-of-air-superiority-the-ukraine-russia-war/; and Douglass Barrie and Giorgio Di Mizio, "Moscow's Aerospace Forces: No Air of Superiority," *IISS Military Balance* (blog), February 2024, https://www.iiss.org/online-analysis/military-balance/2024/02/moscows-aerospace-forces-no-air-of-superiority/.

8 Yasir Atalan and Benjamin Jensen, "Breaking Down Russian Missile Salvos: What Drives Neutralization?," CSIS, *Commentary*, February 24, 2025, https://www.csis.org/analysis/breaking-down-russian-missile-salvos-what-drives-neutralization.

9 Ibid.

10 Guy Faulconbridge and Anton Kolodyazhnyy, "Three killed in biggest Ukrainian drone attack on Moscow region," Reuters, March 11, 2025, https://www.reuters.com/world/europe/ukraine-launches-drone-attacks-targeting-moscow-russia-says-2025-03-11/.

11 Kari Bingen and Clayton Swope, "Why the United States Acted Now Against Iran," CSIS, *Commentary*, June 25, 2025, https://www.csis.org/analysis/why-united-states-acted-now-against-iran.

12 Paul Iddon, "Israel's Air Force Blazes a Path to Iran's Border," Business Insider, January 2025, https://www.businessinsider.com/israeli-air-force-superiority-path-iran-border-2025-1; and Emanuel Fabian, "Israeli Air Force says it has achieved total air superiority above Syria," *Times of Israel*, December 12, 2024, https://www.timesofisrael.

com/liveblog_entry/israeli-air-force-says-it-has-achieved-total-air-superiority-above-syria/.

13 Gerry Doyle, Mariano Zafra, Adolfo Arranz, and Jitesh Chowdhury, "Israel's Iron Dome," Reuters, April 18, 2024, https://www.reuters.com/graphics/ISRAEL-PALESTINIANS/IRAN-DEFENCE/mypmkljzopr/.

14 David Horovitz, "Israel warded off a huge Iranian attack, but that success is not the same as a victory," *Times of Israel*, April 14, 2025, https://www.timesofisrael.com/israel-warded-off-a-huge-iranian-attack-but-that-success-is-not-the-same-as-a-victory/.

15 Atalan and Jensen, "Breaking Down Russian Missile Salvos."

16 Kateryna Bondar, "How Ukraine's Operation 'Spider's Web' Redefines Asymmetric Warfare," CSIS, *Critical Questions*, June 2, 2025, https://www.csis.org/analysis/why-united-states-acted-now-against-iran.

17 Steve Balestrieri, "F-35I Adir: The Isreali Fighter That Destroyed Iran's Air Defenses," 19fortyfive, March 25, 2025, https://www.19fortyfive.com/2025/03/f-35i-adir-the-isreali-fighter-that-destroyed-irans-air-defenses/; and Isaac Stanley-Becker and Shane Harris, "How Israel Executed Its Surprise Assault on Iran," *The Atlantic*, June 13, 2025, https://www.theatlantic.com/politics/archive/2025/06/how-israel-surprised-iran/683184/.

18 "IDF Reveals Full Story of How Houthi Drone Struck Tel Aviv," Viewpoint Israel, July 25, 2024, https://viewpointisrael.com/idf-reveals-full-story-of-how-houthi-drone-struck-tel-aviv/.

19 "How will mines dropped by drones change warfare?," *The Economist*, January 31, 2025, https://www.economist.com/the-economist-explains/2025/01/31/how-will-mines-dropped-by-drones-change-warfare.

20 Vikram Mittal, "Russia And Ukraine Are Using One-Time Use Drones. Future Wars May Not.," *Forbes*, May 8, 2025, https://www.csis.org/programs/futures-lab/projects/russian-firepower-strike-tracker-analyzing-missile-attacks-ukraine.

21 Ibid.; Atalan and Jensen, "Breaking Down Russian Missile Salvos."

22 Peter Dickinson, "Ukrainian drones reportedly knock out 10 percent of Russian efining capacity," Atlantic Council, February 13, 2025, https://www.atlanticcouncil.org/blogs/ukrainealert/ukrainian-drones-reportedly-knock-out-10-percent-of-russian-refining-capacity/; and Chaouki Chenai, "Countering the Growing Threat of Drone Attacks on Energy Infrastructure," New Lines Institute, May 14, 2024, https://newlinesinstitute.org/environmental-challenges/countering-the-growing-threat-of-drone-attacks-on-energy-infrastructure/.

23 Brendan Cole, "Russia Loses $4 Million Worth of Tanks, IFVs in Ukraine Strike," *Newsweek*, May 12, 2025, https://www.newsweek.com/russia-ukraine-tanks-ifvs-strike-2070894; and Francis Farrell, "'He's mine' - How Ukraine's ace drone unit hunts Russian soldiers near Kupiansk," *Kyiv Independent*, January 9, 2025, https://kyivindependent.com/lacking-manpower-to-hold-back-russia-ukraine-turns-to-its-crack-drone-units/.

24 Fabian Hinz, "Made in Yemen? Assessing the Houthis' arms-production capacity," IISS Missile Dialogue Initiative, April 10, 2025, https://www.iiss.org/online-analysis/missile-dialogue-initiative/2025/04/made-in-yemen-assessing-the-houthis-arms-production-capacity/.

25 Kerry Chávez and Ori Swed, "How Hamas innovated with drones to operate like an army," Bulletin of the Atomic Scientists, November 1, 2023, https://thebulletin.org/2023/11/how-hamas-innovated-with-drones-to-operate-like-an-army.

26 Seth J. Frantzman, "Israel's Aeronautics introduces loitering munition, surveillance drone combination," Breaking Defense, June 14, 2024, https://breakingdefense.com/2024/06/israels-aeronautics-introduces-loitering-munition-surveillance-drone-combination/.

27 Harper Ellis, "How Effective are Loitering Munitions in Real Combat Scenarios?,"

Defense Feeds, May 7, 2025, https://defensefeeds.com/analysis/weapons/loitering-munitions/.

28 Yonah Jeremy Bob, "Israeli drone power: How UAVs have taken the IDF to a new level," *Jerusalem Post*, June 2, 2023, https://www.jpost.com/israel-news/article-744845; "Qods Mohajer UAV," War Wings Daily, https://warwingsdaily.com/drones-uavs-ucavs/qods-mohajer-uav/; and Emanuel Fabian, "IDF shoots down Hezbollah surveillance drone, in first such incident since ceasefire Terror group appears to violate US-brokered truce days after IDF struck," *Times of Israel*, January 30, 2025, https://www.timesofisrael.com/idf-shoots-down-hezbollah-surveillance-drone-in-first-such-incident-since-ceasefire/.

29 Stefan Korshak, "Ukraine Drone Production Tops 2.5 Million a Year, Aircraft Numbers on Track to Grow," *Kyiv Post*, February 10, 2025, https://www.kyivpost.com/post/46892.

30 Sofiia Syngaivska, "Ukraine Deploys World's First Drone-Based Air Defense: the Nemesis Regiment Downs 60 Shahed and Geran Drones in Two Months," Defense Express, May 1, 2025, https://en.defence-ua.com/analysis/ukraine_deploys_worlds_first_drone_based_air_defense_the_nemesis_regiment_downs_60_shahed_and_geran_drones_in_two_months-14369.html.

31 "Use It, Don't Lose It: The Case for Recoverable and Reusable Loitering Munitions," Teledyne FLIR, April 28, 2025, https://www.flir.com/discover/government-defense/use-it-dont-lose-it-the-case-for-recoverable-and-reusable-loitering-munitions/.

32 "Ships, trucks, and suitcases: How Israel reportedly got its attack drones into Iran," *Times of Israel*, June 15, 2025, https://www.timesofisrael.com/ships-trucks-and-suitcases-how-israel-reportedly-got-its-attack-drones-into-iran/; and Tom Balmforth and Max Hunder, "To attack Russian air bases, Ukrainian spies hid drones in wooden sheds," Reuters, June 1, 2025, https://www.reuters.com/business/aerospace-defense/ukraine-stages-major-attack-russian-aircraft-with-drones-security-official-says-2025-06-01/.

33 Paul Mozur and Adam Satariano, "Russia, in New Push, Increasingly Disrupts Ukraine's Starlink Service," *New York Times*, May 25, 2024, https://www.nytimes.com/2024/05/24/technology/ukraine-russia-starlink.html; and Thomas Gibbons-Neff and Yurii Shyvala, "'Jamming': How Electronic Warfare Is Reshaping Ukraine's Battlefields," *New York Times*, March 12, 2024, https://www.nytimes.com/2024/03/12/world/europe/ukraine-drone-russia-jamming.html.

34 David Hambling, "Jam-Resistant American Radio Keeps Ukraine's Long-Range Drones Flying," *Forbes*, April 17, 2024, https://www.forbes.com/sites/davidhambling/2024/04/17/jam-resistant-american-radio-keeps-ukraines-long-range-drones-flying/; and David Hambling, "Inside The 'Magic Radio' Protecting Russian Drones From Jamming," *Forbes*, December 20, 2023, https://www.forbes.com/sites/davidhambling/2023/12/20/inside-the-magic-radio-protecting-russian-drones-from-jamming/.

35 "Phalanx Weapon System," RTX, https://www.rtx.com/raytheon/what-we-do/sea/phalanx-close-in-weapon-system; and "Harpy NG," IAI, https://www.iai.co.il/sites/default/files/2023-06/HARPY%20Brochure.pdf.

36 Tess Horlings, Roy Lindelauf, and Sebastiaan Rietjens, "Battling information overload in military intelligence & security organisations," in *Towards a Data-Driven Military: A Multidisciplinary Perspective*, eds. Peter B.M.J. Pijpers, Mark Voskuijl, and Robert J.M. Beeres (Leiden, Netherlands: Leiden University Press, 2023), https://www.jstor.org/stable/jj.14250136.16?seq=1.

37 Serhiy Horbatenko, "Fiber-Optic Ukrainian Ground Drones Keep Critical Supplies Moving to the Front," Radio Free Europe Radio Liberty, May 15, 2025, https://www.rferl.org/a/ukraine-war-fiber-optic-ground-drones-supplies/33415190.html; "Strategic Blindness: the Effect of Ukraine's Attack on Voronezh-M Over-the-Horizon Radar in Orsk Explained," Defense Express, May 27, 2024, https://en.defence-ua.com/news/strategic_blindness_the_effect_of_ukraines_attack_on_voronezh_m_over_the_horizon_radar_in_orsk_explained-10643.html; and "Israeli researchers develop AI-based radar

system to detect hostile drones in bad weather," All Israel News, July 24, 2024, https://allisrael.com/israeli-researchers-develop-ai-based-radar-system-to-detect-hostile-drones-in-bad-weather.

38 "Bullfrog M2," Allen Control Systems, https://www.allencontrolsystems.com/products/bullfrog-m2.

39 Avi Goldfarb and Jon R. Lindsay, "Prediction and Judgment: Why Artificial Intelligence Increases the Importance of Humans in War," *International Security* 46, no. 3 (2022), https://doi.org/10.1162/isec_a_00425.

40 Bill Hutchinson, "High-tech radar used in Ukraine-Russia war to be deployed to crack Northeast drone mystery," ABC News, December 17, 2024, https://abcnews.go.com/US/high-tech-radar-ukraine-russia-war-deployed-crack/story?id=116822053.

41 Editorial Team, "Understanding Integrated Air Defense Systems for Modern Warfare," Total Military Insight, June 25, 2024, https://totalmilitaryinsight.com/integrated-air-defense-systems/.

42 Martin Blass, Stefan Grebien, and Franz Graf, "Experimental Evaluation of Acoustic Drone Tracking using Mobile Microphone Arrays," presented at Quietdrones 2024, University of Salford, Manchester, UK, September 2024, https://www.researchgate.net/publication/383877168_Experimental_Evaluation_of_Acoustic_Drone_Tracking_using_Mobile_Microphone_Arrays; and Peter Karanja, "How to Detect a Drone in the Sky," Drone Blog, March 16, 2022, https://www.droneblog.com/detect-a-drone/.

43 Tate Nurkin, et al., *China's Remote Sensing* (Washington, DC: U.S. China-Economic and Security Review Commission, December 2024), https://www.uscc.gov/sites/default/files/2024-12/Chinas_Remote_Sensing.pdf.

44 Clayton Swope, "No Place to Hide: A Look into China's Geosynchronous Surveillance Capabilities," CSIS, *Critical Questions*, January 19, 2024, https://www.csis.org/analysis/no-place-hide-look-chinas-geosynchronous-surveillance-capabilities.

45 Theresa Hitchens and Michael Marrow, "Space Force testing space-based sensors to track airborne targets," Breaking Defense, May 15, 2025, https://breakingdefense.com/2025/05/space-force-testing-space-based-sensors-to-track-airborne-targets/.

46 "ADAPTIV - Cloak of Invisibility," BAE Systems, https://www.baesystems.com/en/feature/adativ-cloak-of-invisibility.

47 William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power—Economic and Military* (Mineola, NY: Dover Publications, 2006), 20.

THE FUTURE OF SEAPOWER

1 For a description of these successes, see Mark F. Cancian, "Ukraine's Victory at Sea: How Kyiv Subdued the Russian Fleet—and What It Will Need to Build on Naval Success," *Foreign Affairs*, February 8, 2024, https://www.foreignaffairs.com/ukraine/ukraines-victory-sea.

2 Jakub Janovsky et al., "Attack on Europe: Documenting Russian Equipment Losses During the Russian Invasion Of Ukraine," Oryx, February 24, 2022, https://www.oryxspioenkop.com/2022/02/attack-on-europe-documenting-equipment.html.

3 Mark F. Cancian, Matt Cancian, and Eric Heginbotham, *The First Battle of the Next War: Wargaming a Chinese Invasion of Taiwan* (Washington, DC: Center for Strategic and International Studies, January 2023), https://www.csis.org/analysis/first-battle-next-war-wargaming-chinese-invasion-taiwan; Bryan Clark and Timothy A. Walton, *Taking Back the Seas: Transforming the U.S. Surface Fleet for Decision-Centric Warfare* (Washington, DC: Center for Strategic and Budgetary Assessments, December 2024), https://csbaonline.org/research/publications/taking-back-the-seas-transforming-the-u.s-surface-fleet-for-decision-centric-warfare; Bryan Clark and Michael G. Roberts, *Shoring Up the Foundation: Affordable Approaches to Improve U.S. and Allied Shipbuilding and Ship Repair* (Washington, DC: Hudson Institute, December 2024), https://www.hudson.org/supply-chains/shoring-foundation-affordable-approaches-

improve-us-allied-shipbuilding-ship-repair-bryan-clark-michael-roberts; and Johannes R. Fischbach, *Closing the Gap: China Homes in on US Navy VLS Advantage* (London: International Institute for Strategic Studies, December 2024), https://www.iiss.org/online-analysis/military-balance/2024/12/closing-the-gap-china-homes-in-on-us-navy-vls-advantage/.

4 Note for the cognoscenti: Doenitz appears to be holding a model of a Type XXIII U-boat.

5 "Ship Battle Forces," Naval Vessel Registry, U.S. Navy, accessed July 27, 2025, https://www.nvr.navy.mil/nvr/getpage.htm?pagetype=shipbattleforce.

6 Ronald O'Rourke, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, CRS Report No. RL32665 (Washington, DC: Congressional Research Service, April 2025), https://sgp.fas.org/crs/weapons/RL32665.pdf.

7 Office of the Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2025* (Washington, DC: Office of the Chief of Naval Operations, March 2024), 20 (Table A1-5), https://s3.amazonaws.com/static.militarytimes.com/assets/pdfs/1710968056.pdf.

8 Sam LaGrone and Mallory Shelbourne, "New Navy Long-Range Shipbuilding Plan Details 19 Ship Decommissionings in FY 2025," U.S. Naval Institute News, March 19, 2024, https://news.usni.org/2024/03/19/new-navy-long-range-shipbuilding-plan-details-19-ship-decommissionings-in-fy-2025.

9 Thirty-five years may be optimistic. For a detailed discussion of ship service lives, see Steven Wills, "Running Ahead of the Rust: The Dangers of Extending Warship Service Lives," Center for Maritime Strategy, June 6, 2023, https://centerformaritimestrategy.org/publications/running-ahead-of-the-rust-the-dangers-of-extending-warship-service-lives/.

10 The reconciliation bill was negotiated between Congress, principally the Armed Services Committees, and the White House but drew most of its inspiration from congressional documents, for example, Sen. Wicker's "21st Century Peace Through Strength: A Generational Investment in the U.S. Military," https://www.wicker.senate.gov/services/files/BC957888-0A93-432F-A49E-6202768A9CE0.

11 International Institute for Strategic Studies, "Chapter Five: Asia," *The Military Balance* 125, no.1 (2025), 243, https://doi.org/10.1080/04597222.2025.2445477.

12 Ibid.

13 U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2024* (Washington, DC: U.S. Department of Defense, December 2024), https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF.

14 Mark F. Cancian, "Who's Responsible for the Navy's Carrier Shortage?," War on the Rocks, August 12, 2016, https://warontherocks.com/2016/08/whos-responsible-for-the-navys-carrier-shortage/.

15 Mark F. Cancian, *U.S. Military Forces in FY 2022: Peering into the Abyss* (Washington, C: Center for Strategic and International Studies, March 2022), https://www.csis.org/analysis/us-military-forces-fy-2022-peering-abyss.

16 Thomas Newdick, "HMS Queen Elizabeth Is First British Carrier To Send Jets Into Combat In Over Two Decades," The War Zone, November 17, 2021, https://www.twz.com/41213/hms-queen-elizabeth-is-first-british-carrier-to-send-jets-into-combat-in-over-two-decades; and Fred Pleitgen, "On board the French nuclear carrier battling ISIS," CNN, October 17, 2016, https://www.cnn.com/2016/10/17/middleeast/france-nuclear-carrier-mosul-iraq-isis/index.html.

17 Jonathan Beale, "On board the pride of the French navy," BBC, May 27, 2011, https://www.bbc.com/news/world-europe-13573848; and Norman Friedman, "British Aircraft Carriers Returns," *Proceedings* 147, no. 8 (August 2017), https://www.usni.org/magazines/proceedings/2017/august/british-aircraft-carriers-return.

18 For data on carrier fleets in 1975, see John Moore ed., *Jane's Fighting Ships 1974-1975*(London: Macdonald and Janes, 1975), 642.

19 Mark F. Cancian, "Penny Wise and Pound Foolish: The Navy's Carrier Construction Strategy," *Proceedings* 145, no. 3 (March 2019), https://www.usni.org/magazines/proceedings/2019/march/penny-wise-and-pound-foolish-navys-carrier-construction-strategy.

20 Mark F. Cancian, *Inflicting Surprise: Gaining Competitive Advantage in Great Power Conflicts* (Washington, DC: Center for Strategic and International Studies, January 2021), https://www.csis.org/analysis/inflicting-surprise-gaining-competitive-advantage-great-power-conflicts.

21 Geoff Ziezulewicz, "What the Navy's Massive Orca Submarine Drone Is Actually Capable Of," The War Zone, January 14, 2025, https://www.twz.com/news-features/what-the-navys-massive-orca-submarine-drone-is-actually-capable-of.

22 U.S. Government Accountability Office, *Extra Large Unmanned Undersea Vehicle: Navy Needs to Employ Better Management Practices to Ensure Swift Delivery to the Fleet*, GAO-22-105974 (Washington, DC: Government Accountability Office, September 2022), https://www.gao.gov/products/gao-22-105974.

23 The U.S. Navy's last 30-year shipbuilding program envisioned 134 "unmanned vehicles" in the fleet, but all recent Navy and DOD naval force structures have included large numbers of USVs and UUVs. See Chief of Naval Operations, *Report to Congress*, 4. The Navy has asked industry what technologies might be available, but the effort is a long way from a fielded capability. See Sam LaGrone and Aaron-Matthew Lariosa, "Pentagon Puts Out Call for Swarming Attack Drones That Could Blunt a Taiwan Invasion," U.S. Naval Institute, January 30, 2024, https://news.usni.org/2024/01/30/pentagon-puts-out-call-for-swarming-attack-drones-that-could-blunt-a-taiwan-invasion.

24 Xavier Vavasseur, "UK's CETUS XLUUV launched by MSubs in Plymouth," Naval News, May 3, 2025, https://www.navalnews.com/naval-news/2025/03/uks-cetus-xluuv-launched-by-msubs-in-plymouth/.

25 Kiran Suman-Chauhan, Nicolas Jouan, and James Black, "Navies Look to Uncrewed Systems to Counter Threats Beneath the Waves," RAND Corporation, May 21, 2024, https://www.rand.org/pubs/commentary/2024/05/navies-look-to-uncrewed-systems-to-counter-threats.html.

26 "Cole (DDG-67)," Naval History and Heritage Command, U.S. Navy, https://www.history.navy.mil/browse-by-topic/ships/modern-ships/uss-cole.html.

27 "Japanese Midget Submarines," Naval History and Heritage Command, U.S. Navy, https://www.history.navy.mil/our-collections/photography/wars-and-events/world-war-ii/pearl-harbor-raid/japanese-forces-in-the-pearl-harbor-attack/japanese-midget-submarines-used-in-the-attack-on-pearl-harbor.html.

28 I.e., a significant nonevent. See the famous incident in the Sherlock Holmes story "The Adventure of Silver Blaze," in which a dog should have barked at an intruder, but didn't.

29 Geoff Ziezulewicz, "Navy Just Revealed Tally Of Surface-To-Air Missiles Fired In Ongoing Red Sea Fight," The War Zone, January 14, 2025, https://www.twz.com/news-features/navy-just-disclosed-how-many-of-each-of-its-surface-to-air-missiles-it-fired-during-red-sea-fight.

30 Department of Defense, *Department of the Navy Fiscal Year (FY) 2025 Budget Estimates Justification Book, Weapons Procurement* (Washington, DC: Department of Defense, 2024), xiii, https://www.secnav.navy.mil/fmc/fmb/Documents/25pres/WPN_Book.pdf.

31 Cancian, Cancian and Heginbotham, *The First Battle*, 88.

32 Seth Jones, *Empty Bins in a Wartime Environment: The Challenge to the U.S. Defense Industrial Base* (Washington, DC: Center for Strategic and International Studies, January 2023), https://www.csis.org/analysis/empty-bins-wartime-environment-challenge-us-defense-industrial-base.

33 For example, Michael Brown, "The Empty Arsenal of Democracy," *Foreign Affairs*, April 22, 2025, https://www.foreignaffairs.com/united-states/empty-arsenal-democracy-michael-brown; Tyler Hacker, "Money Isn't Enough: Getting Serious About Precision Munitions," War on the Rocks, April 24, 2023, https://warontherocks.com/2023/04/money-isnt-enough-getting-serious-about-precision-munitions/; and Stacie Pettyjohn and Hannah Dennis, "The Pentagon Isn't Buying Enough Ammo," *Foreign Policy*, May 21, 2024, https://foreignpolicy.com/2024/05/21/united-states-defense-pentagon-military-industrial-base-ammunition/.

34 Sebastian Roblin, "How the Falklands War (Thanks to a Stealthy Submarine) Could Have Gone Very Differently," *National Interest*, November 28, 2016, https://nationalinterest.org/blog/buzz/how-the-falklands-war-thanks-stealthy-submarine-could-have-18495.

35 DOD, *FY 2025 Budget Estimates Justification Book*, 233.

36 Nathan Gain, "NATO countries sign MoU on Maritime Battle Decisive Munitions initiative," Naval News, June 27, 2019, https://www.navalnews.com/naval-news/2019/06/nato-countries-sign-mou-on-maritime-battle-decisive-munitions-initiative/; and Sabine Siebold, "Germany, eight other Baltic Sea nations seek to jointly buy naval mines," Reuters, July 9, 2024, https://www.reuters.com/world/europe/germany-eight-other-baltic-sea-nations-seek-jointly-buy-naval-mines-2024-07-09/.

37 Costs from DOD, *FY 2025 Budget Estimates Justification Book*, 123, 233; service life from AMRDEC Public Affairs, "Army researchers extend missile system shelf life," U.S. Army, October 19, 2015, https://www.army.mil/article/156942/army_researchers_extend_missile_system_shelf_life.

THE EVOLUTION OF IRREGULAR WARFARE

1 As used here, "irregular warfare" refers to activities short of conventional and nuclear warfare that are designed to expand a country's influence and legitimacy. These activities include information and cyber operations, support to nonstate actors like partisans and terrorists, covert action, and economic coercion. Irregular warfare can occur as a prelude to, in conjunction with, or independently from a conventional attack.

2 Oleksandr V. Danylyuk, "Against the Odds: Lessons from the Ukrainian Resistance Movement," Royal United Services Institute, July 4, 2023, https://www.rusi.org/explore-our-research/publications/commentary/against-odds-lessons-ukrainian-resistance-movement; and Jade McGlynn, *Crossing Thresholds: Ukrainian Resistance to Russian Occupation* (Washington, DC: CSIS, June 2024), https://www.csis.org/analysis/crossing-thresholds-ukrainian-resistance-russian-occupation.

3 Doug Livermore, "Ukraine's Railway Wars: How to Sabotage Russian Military Logistics," Irregular Warfare, January 10, 2025, https://irregularwarfare.org/articles/ukraines-railway-wars-how-to-sabotage-russian-military-logistics/; and Isabel van Brugen, "Russian Railway Networks Facing 'Imminent Collapse': Report," *Newsweek*, August 6, 2024, https://www.newsweek.com/russian-railway-collapse-sanctions-ukraine-war-1935049.

4 OHCHR, "Number of civilian casualties in Ukraine during Russia's invasion verified by OHCHR from February 2022 to August 2024, by month," Statista, October 1, 2024, https://www.statista.com/statistics/1318455/ukraine-war-casualties-monthly/.

5 Jessica Parker, "Ukraine Says It Blew up Railway in Eastern Russia," BBC News, December 1, 2023, https://www.bbc.com/news/world-europe-67593041.

6 "Swords of Iron: IDF Casualties," Israeli Ministry of Foreign Affairs, March 11, 2023, https://www.gov.il/en/pages/swords-of-iron-idf-casualties.

7 Jennifer Hassan and Adam Taylor, "Israel's Massive Mobilization of 360,000 Reservists Upends Lives," *Washington Post*, October 10, 2023, https://www.washingtonpost.com/world/2023/10/10/israel-military-draft-reservists/.

8 Anatoly Kurmanaev and Constant Méheut, "Ukraine Is Losing Fewer Soldiers than Russia - but It's Still Losing the War," *New York Times*, January 23, 2025, https://www.nytimes.com/2025/01/23/world/europe/ukraine-russia-soldiers-loss.html.

9 Gwyn Topham, "Thousands of Flights to and from Europe Affected by Suspected Russian Jamming," *The Guardian*, April 22, 2024, https://www.theguardian.com/business/2024/apr/22/thousands-of-flights-to-and-from-europe-affected-by-suspected-russian-jamming; Andy Greenberg, "Hackers Linked to Russia's Military Claim Credit for Sabotaging US Water Utilities," *Wired*, April 17, 2024, https://www.wired.com/story/cyber-army-of-russia-reborn-sandworm-us-cyberattacks/; and Laura Kayali et al., "Europe Is under Attack from Russia. Why Isn't It Fighting Back?," *Politico*, November 25, 2024, https://www.politico.eu/article/europe-russia-hybrid-war-vladimir-putin-germany-cyberattacks-election-interference/.

10 Sébastian Seibt, "Suspected Russian Sabotage: The Great Return of Kremlin Agents to Europe?," France 24, May 10, 2024, https://www.france24.com/en/europe/20240510-suspected-russian-sabotage-campaigns-great-return-russian-agents-europe; and Matthew M. Burke, "Trio Charged in Germany for Pro-Russia Plot Targeting US Bases in Bavaria," Stars and Stripes, December 31, 2024, https://www.stripes.com/branches/army/2024-12-31/dual-nationals-charged-spying-russia-16331452.html.

11 Ukrainian Ministry of Reintegration and the National Information Bureau, Діти війни [Children of War], https://childrenofwar.gov.ua/en; and Kristina Hook, *The Russian Federation's Escalating Commission of Genocide in Ukraine: A Legal Analysis* (Washington, DC: New Lines Institute, July 26, 2023), https://newlinesinstitute.org/wp-content/uploads/20230726-Genocide-Ukraine-Report-NISLAP_.pdf.

12 RFE/RL's Ukrainian Service and RFE/RL's Russian Service, "'Liquidated': Two 'Traitors Of Ukraine' Killed In Separate Incidents," RadioFreeEurope/RadioLiberty, December 7, 2023, https://www.rferl.org/a/ukraine-russia-kyva-popov-sbu-investigative-committee/32718964.html.

13 Kate Connolly, "US Reportedly Foiled Russian Plot to Kill Boss of German Arms Firm Supplying Ukraine," *The Guardian*, July 11, 2024, https://www.theguardian.com/world/article/2024/jul/11/us-reportedly-foiled-russian-plot-to-kill-boss-of-german-arms-firm-supplying-ukraine; and "Russian agents killed after assassinating Ukraine colonel, Kyiv Says," CBS News, July 13, 2025, https://www.cbsnews.com/news/russian-agents-killed-assassination-ukraine-colonel-kyiv-says/.

14 Edward Wong, Julian E. Barnes, and Eric Schmitt, "Israel Has Destroyed Half of Hezbollah's Arsenal, U.S. and Israeli Officials Say," *New York Times*, October 1, 2024, https://www.nytimes.com/2024/10/01/us/politics/israel-lebanon-hezbollah-airstrikes.html; and Seth G. Jones et al., *The Coming Conflict with Hezbollah* (Washington, DC: CSIS, March 21, 2024), https://www.csis.org/analysis/coming-conflict-hezbollah.

15 Becky Sullivan and Kat Lonsdorf, "3 Hostages Killed by Israeli Soldier in Gaza Were Waving a White Flag, Israel Says," NPR, December 16, 2023, https://www.npr.org/2023/12/15/1219695220/israel-soldiers-mistakenly-kill-hostages-gaza.

16 Timour Azhari, "Kataib Hezbollah: Why Iran Ally in Iraq Stood down after US Attacks," Reuters, February 1, 2024, https://www.reuters.com/world/middle-east/how-an-iranian-ally-iraq-was-made-stand-down-2024-01-31/.

17 Jack Watling, Oleksandr V. Danylyuk, and Nick Reynolds, *The Threat from Russia's Unconventional Warfare Beyond Ukraine, 2022–2024* (London: Royal United Services Institute, February 2024), https://static.rusi.org/SR-Russian-Unconventional-Weapons-final-web.pdf.

18 U.S. Army, *Army Multi-Domain Transformation: Ready to Win in Competition and Conflict* (Washington, DC: Headquarters, Department of the Army, March 16, 2021), 5, https://api.army.mil/e2/c/downloads/2021/03/23/eeac3d01/20210319-csa-paper-1-signed-print-version.pdf.

19 Eric Schmitt and Farnaz Fassihi, "Iran Likely Will Strike Israel, Not U.S. Forces, U.S. and Iranian Officials Say," *New York Times*, April 12, 2024, https://www.nytimes.com/2024/04/12/world/middleeast/american-intelligenc.html; and

I.R.IRAN Mission to UN, NY (@Iran_UN), "Conducted on the strength of Article 51 of the UN Charter pertaining to legitimate defense, Iran's military action was in response to the Zionist regime's aggression against our diplomatic premises in Damascus. The matter can be deemed concluded. However, should the Israeli regime make another mistake, Iran's response will be considerably more severe. It is a conflict between Iran and the rogue Israeli regime, from which the U.S. MUST STAY AWAY!," X post, April 13, 2024, 6:06 pm, https://x.com/iran_un/status/1779269993043022053?s=58&t=qm1hvFA9ri9r73laNoAV1w&mx=2.

DEFENSE BUDGETS IN AN UNCERTAIN SECURITY ENVIRONMENT

1 "Defense Funding in the 2025 Reconciliation Law (H.R. 1; P.L. 119-21, Title II)," Congressional Research Service, IN12580, Updated July 24, 2025, https://www.congress.gov/crs_external_products/IN/PDF/IN12580/IN12580.4.pdf.

2 "Defence expenditures and NATO's 5% commitment," NATO, August 27, 2025, https://www.nato.int/cps/en/natohq/topics_49198.htm.

3 Analysis based on data published by NATO in "Defence Expenditure of NATO Countries (2014-2025)," NATO, August 28, 2025, https://www.nato.int/cps/en/natohq/news_237171.htm

4 Iceland is not represented on any figures in this report as it has no armed forces.

5 Bastian Giegerich and Ben Schreer, "Zeitenwende one year on," International Institute for Strategic Studies, February 27, 2023, https://www.iiss.org/ar-BH/online-analysis/online-analysis/2023/02/zeitenwende-one-year-on/

6 Ibid.; Sebastian Shukla, Claudia Otto, and Nadine Schmidt, "Germany is unlocking billions to supercharge its military at a seismic moment for Europe," *CNN*, March 23, 2025, https://www.cnn.com/2025/03/23/europe/germany-military-investment-intl.

7 Ibid.; Frank Gardner and Toby Luckhurst, "Germany votes for historic boost to defence spending," *BBC*, March 18, 2025, https://www.bbc.com/news/articles/c62z6gljv2yo; Saim Dušan Inayatullah, "Germany aims to have 'strongest' military in Europe – Merz," *DW*, May 5, 2025, https://www.dw.com/en/germany-aims-to-have-strongest-military-in-europe-merz/a-72546478.

8 Michał Oleksiejuk, "Sharing the burden: How Poland and Germany are shifting the dial on European defence expenditure," *NATO Review*, April 18, 2025, https://www.nato.int/docu/review/articles/2025/04/14/sharing-the-burden-how-poland-and-germany-are-shifting-the-dial-on-european-defence-expenditure/index.html.

9 Ibid.; Kateryna Kvasha, ""Security, Europe!": Poland's Rise as NATO's Defense Spending Leader," Wilson Center, March 6, 2025, https://www.wilsoncenter.org/article/security-europe-polands-rise-natos-defense-spending-leader.

10 Prime Minister's Office, "Prime Minister sets out biggest sustained increase in defence spending since the Cold War, protecting British people in new era for national security," press release, February 25, 2025, https://www.gov.uk/government/news/prime-minister-sets-out-biggest-sustained-increase-in-defence-spending-since-the-cold-war-protecting-british-people-in-new-era-for-national-security; and Keir Starmer, "PM statement on defence spending: 25 February 2025," Prime Minister's Office, February 25, 2025, https://www.gov.uk/government/speeches/pm-statement-on-defence-spending-25-february-2025.

11 "Press statement by President von der Leyen on the defence package," European Commission, March 3, 2025, https://ec.europa.eu/commission/presscorner/detail/et/statement_25_673.

12 "ReArm Europe Plan / Readiness 2030," European Commission, 2025, https://defence-industry-space.ec.europa.eu/document/download/13ec18d2-8366-4fc8-a4ff-2bdfdf8e1f5f_en?filename=REARM%20Europe%20factsheet%20v17_1.pdf; "Press statement by President von der Leyen on the defence package," March 3, 2025; Sophie Kiderlin and Silvia Amaro, "European leaders push for even more defense spending –

despite plans for $867 billion 'ReArm' package," *CNBC*, March 20, 2025, https://www.cnbc.com/2025/03/20/european-leaders-push-for-even-more-defense-spending.html.

13 Ibid.

14 Holly Ellyatt, "Can Trump force the hand of NATO allies to spend up to 5% of GDP on defense?," CNBC, January 23, 2025, https://www.cnbc.com/2025/01/23/can-trump-get-nato-allies-to-spend-more-on-defense.html.

15 Laura Kayali and Antoaneta Roussi, "NATO allies agree to boost weapon inventories ahead of Trump-pleasing Summit," *POLITICO*, June 5, 2025, https://www.politico.eu/article/nato-allies-weapon-inventories-defense-spending-donald-trump/.

16 *The Hague Summit Declaration*, NATO, June 25, 2025, https://www.nato.int/cps/en/atohq/official_texts_236705.htm; Mark Rutte, NATO Press Conference, June 5, 2025, https://www.nato.int/cps/en/natohq/opinions_235894.htm.

17 "Defence Expenditure of NATO Countries (2014-2025)," NATO, August 28, 2025, https://www.nato.int/cps/en/natohq/news_226465.htm.

18 Seamus P. Daniels and Todd Harrison, "What Does the Bipartisan Budget Act of 2019 Mean for Defense?" Center for Strategic and International Studies, August 5, 2019, https://www.csis.org/analysis/what-does-bipartisan-budget-act-2019-mean-defense.

19 Seamus P. Daniels, "What the Fiscal Responsibility Act of 2023 Means for Defense Spending," Center for Strategic and International Studies, June 15, 2023, https://www.csis.org/analysis/what-fiscal-responsibility-act-2023-means-defense-spending.

20 Letter, CBO to Senator Jeff Merkley, "Effects on Deficits and the Debt of Public Law 119-21 and of Making Certain Tax Policies in the Act Permanent," Congressional Budget Office, August 4, 2025, https://www.cbo.gov/system/files/2025-08/61466-DebtService.pdf.

21 Roger Wicker, "Chairman Wicker Releases Statement on the FY26 Budget Proposal," May 2, 2025, https://www.wicker.senate.gov/2025/5/chairman-wicker-releases-statement-on-the-fy26-budget-proposal.

22 "SIPRI Military Expenditure Database, 1949-2024," Stockholm International Peace Research Institute, https://www.sipri.org/databases/milex.

23 See Julian Cooper, *Preparing for a Fourth Year of War: Military Spending in Russia's Budget for 2025*, SIPRI Insights on Peace and Security, No. 2025/04, Stockholm International Peace Research Institute, April 2025, https://www.sipri.org/sites/default/files/2025-04/preparing_for_a_fourth_year_of_war-military_spending_in_russias_budget_for_2025_1.pdf.

24 Ibid.

25 Xiao Liang, et. al., *Trends in World Military Expenditure, 2024*, SIPRI Fact Sheet, Stockholm International Peace Research Institute, April 2025, https://www.sipri.org/sites/default/files/2025-04/2504_fs_milex_2024.pdf.

26 Ibid., 5.

27 Alexandra Prokopenko, "Putin's insatiable appetite for war," *Financial Times*, June 5, 2025, https://www.ft.com/content/2278e8c6-d8c9-4860-89e0-fc6c7d69b2e1.

28 Christopher Bodeen, "China will increase its defense Budget 7.2% this year," *AP*, March 5, 2025, https://apnews.com/article/china-defense-budget-taiwan-4ac7cbdc7d5b889732cd55916ff7eb36; M. Taylor Fravel, George J. Gilboy, Eric Heginbotham, "Estimating China's Defense Spending: How to Get It Wrong (and Right)," *Texas National Security Review*, Vol. 7, Issue 3, Summer 2024, 40-54, https://tnsr.org/2024/06/estimating-chinas-defense-spending-how-to-get-it-wrong-and-right/.

29 "What Does China Really Spend on its Military?," CSIS, ChinaPower, updated March 5, 2025, https://chinapower.csis.org/ military-spending/.

30 Cooper, *Preparing for a Fourth Year of War*.

31 Mary Ilyushina, "Putin says he won't allow Russia to fall into recession amid warnings," *Washington Post*, June 20, 2025, https://www.washingtonpost.com/world/2025/06/20/putin-says-he-wont-allow-russia-fall-into-recession-amid-gloomy-economy/; "Russia's Year of Truth: The Runaway Military Budget," Center for European Policy Analysis, January 22, 2025, https://cepa.org/article/russias-year-of-truth-the-runaway-military-budget/.

32 Prokopenko, "Putin's insatiable appetite for war."

33 Fenella McGerty, "European defence funding: fiscal manoeuvres," International Institute for Strategic Studies, March 13, 2025, https://www.iiss.org/online-analysis/military-balance/2025/03/european-defence-funding-fiscal-manoeuvres/.

34 Todd Harrison and Seamus P. Daniels, *Analysis of the FY 2021 Defense Budget*, Center for Strategic and International Studies, August 2020, https://defense360.csis.org/wp-content/uploads/2020/08/Analysis-of-the-FY-2021-Defense-Budget.pdf.

INDUSTRIAL ROADBLOCKS: PRODUCING AT A SCALE AND ADOPTING NEW TECHNOLOGIES

1 Seth G. Jones, *Empty Bins in a Wartime Environment* (Washington, DC: CSIS, January 23, 2023), https://www.csis.org/analysis/empty-bins-wartime-environment-challenge-us-defense-industrial-base; and Cynthia R. Cook, et al., *Transatlantic Defense during Wartime* (Washington, DC: CSIS, September 2023), https://www.csis.org/analysis/transatlantic-defense-during-wartime.

2 Numerous think tank assessments have shed light on the challenge, including: Becca Wasser and Philip Sheers, *From Production Lines to Front Lines: Revitalizing the U.S. Defense Industrial Base for Future Great Power Conflict* (Washington, DC: Center for a New American Security, April 3, 2025), https://www.cnas.org/publications/reports/from-production-lines-to-front-lines; William C. Greenwalt, *The Decline of the United States Defense Industrial Base and the Need to Restore Industrial Deterrence* (Washington, DC: American Enterprise Institute, December 5, 2024), https://aei.org/wp-content/uploads/2024/12/The-Decline-of-the-United-States-Defense-Industrial-Base-and-the-Need-to-Restore-Industrial-Deterrence.pdf?x85095; and Robert Greenway, *A Strategy to Revitalize the Defense Industrial Base for the 21st Century* (Washington, DC: Heritage Foundation, 2019), https://www.heritage.org/defense/report/strategy-revitalize-the-defense-industrial-base-the-21st-century.

3 John Tirpak, "LaPlante on Why Weapon Production Constitutes Deterrence," *Air & Space Forces Magazine*, October 27, 2022, https://www.airandspaceforces.com/laplante-on-why-weapon-production-constitutes-deterrence/.

4 Paul Iddon, "Expansive Military Operations Are Depleting Israel's Munition Stocks," *Forbes*, January 8, 2025, https://www.forbes.com/sites/pauliddon/2025/01/08/expansive-military-operations-are-depleting-israels-munition-stocks/; and Shelby Holliday, Anat Peled and Drew Fitzgerald, "Israel's 12-Day War Revealed Alarming Gap in America's Missile Stockpile," *Wall Street Journal*, July 24, 2025, https://www.wsj.com/world/israel-iran-us-missile-stockpile-08a65396.

5 Mark F. Cancian, Matthew Cancian, and Eric Heginbotham, *The First Battle of the Next War: Wargaming a Chinese Invasion of Taiwan* (Washington, DC: CSIS, January 2023), https://www.csis.org/analysis/first-battle-next-war-wargaming-chinese-invasion-taiwan.

6 Mark F. Cancian, "Rebuilding U.S. Inventories: Six Critical Systems," CSIS, *Commentary*, January 9, 2023, https://www.csis.org/analysis/rebuilding-us-inventories-six-critical-systems.

7 Laura Alviz, "Europe Is Short of Gunpowder and TNT When It Needs Them Most," *Japan Times*, March 22, 2025, https://www.japantimes.co.jp/business/2025/03/22/eu-ukraine-low-munitions-stockpile/.

8 Julian Cooper, "Military Production in Russia Before and After the Start of the War With Ukraine: To What Extent has it Increased and how has This Been Achieved?," *The RUSI Journal* 169, no. 4 (2024), 10–29, https://doi.org/10.1080/03071847.2024.2392990.

9 Cynthia R. Cook, *Reviving the Arsenal of Democracy: Steps for Surging Defense Industrial Capacity* (Washington, DC: CSIS, March 2023), https://www.csis.org/analysis/reviving-arsenal-democracy-steps-surging-defense-industrial-capacity.

10 Government Accountability Office, *Defense Industrial Base: Actions Needed to Address Risks Posed by Dependence on Foreign Suppliers*, GAO-25-107283 (Washington, DC: Government Accountability Office, July 2025), https://www.gao.gov/products/gao-25-107283.

11 Cortney Weinbaum et al., *Assessing Systemic Strengths and Vulnerabilities of China's Defense Industrial Base* (Santa Monica, CA: RAND Corporation, February 2022), https://www.rand.org/pubs/research_briefs/RBA930-1.html.

12 Seth G. Jones and Alexander Palmer, *Rebuilding the Arsenal of Democracy: The U.S. and Chinese Defense Industrial Bases in an Era of Great Power Competition* (Washington, DC: CSIS, March 2024), https://www.csis.org/analysis/china-outpacing-us-defense-industrial-base.

13 Ted Harshberger et al., *A Proactive, Network-Based Approach to Defense Supply Chain Capacity* (Santa Monica, CA: RAND Corporation, January 2025), https://www.rand.org/pubs/perspectives/PEA2899-1.html.

14 John T. Correll, "Lifeline in Danger," *Air & Space Forces Magazine*, November 1988, https://www.airandspaceforces.com/PDF/MagazineArchive/Documents/1988/November%201988/1188danger.pdf.

15 U.S. Department of Defense, *Quadrennial Defense Review Report* (Washington, DC: U.S. Department of Defense, February 2010), https://history.defense.gov/Portals/70/Documents/quadrennial/QDR2010.pdf.

16 "Presidential Executive Order on Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States," White House Archives, 2017, https://trumpwhitehouse.archives.gov/presidential-actions/presidential-executive-order-assessing-strengthening-manufacturing-defense-industrial-base-supply-chain-resiliency-united-states/; and Office of the Under Secretary of Defense for Acquisition and Sustainment, *Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States* (Washington, DC: U.S. Department of Defense, September 2018), https://media.defense.gov/2018/Oct/05/2002048904/-1/-1/1/ASSESSING-AND-STRENGTHENING-THE-MANUFACTURING-AND-DEFENSE-INDUSTRIAL-BASE-AND-SUPPLY-CHAIN-RESILIENCY.PDF.

17 Office of the Under Secretary of Defense for Acquisition and Sustainment, *Securing Defense-Critical Supply Chains* (Washington, DC: U.S. Department of Defense, February 2022), https://media.defense.gov/2022/Feb/24/2002944158/-1/-1/1/DOD-EO-14017-REPORT-SECURING-DEFENSE-CRITICAL-SUPPLY-CHAINS.PDF.

18 Department of Defense, National Defense Industrial Strategy (Washington, DC: U.S. Department of Defense, updated March 2025), https://www.businessdefense.gov/docs/ndis/2023-NDIS.pdf. The strategy was originally released November 16, 2023, and then updated to comply with March 2025 executive orders.

19 Hannah Aries, Bastian Giegerich, and Tim Lawrenson, "The Guns of Europe: Defence-Industrial Challenges in a Time of War," *Survival* 65, no. 3 (June–July 2023), https://www.iiss.org/online-analysis/survival-online/2023/06/the-guns-of-europe-defence-industrial-challenges-in-a-time-of-war/.

20 Clara Falkenek, "Who's at 2 percent? Look how NATO allies have increased their defense spending since Russia's invasion of Ukraine," Atlantic Council, July 8, 2020, https://www.atlanticcouncil.org/blogs/econographics/whos-at-2-percent-look-how-nato-allies-have-increased-their-defense-spending-since-russias-invasion-of-ukraine/.

21 Sebastian Clapp, "European Defence Industrial Strategy," European Parliamentary Research Service, September 2024, https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/762402/EPRS_BRI(2024)762402_EN.pdf.

22 Cynthia R. Cook et al., *Enhancing Defense Industrial Cooperation between Australia and the United States* (Washington, DC: CSIS, March 2025), https://www.csis.org/analysis/enhancing-defense-industrial-cooperation-between-australia-and-united-states; and Cynthia R. Cook and Kester Abbott, "Partnering for forward deterrence in the Indo-Pacific: Overcoming barriers to US-Australia cooperation on Australia's GWEO Enterprise," University of Sydney United States Study Center, July 2025, https://www.ussc.edu.au/partnering-for-forward-deterrence-in-the-indo-pacific-overcoming-barriers-to-us-australia-cooperation-on-australia-s-gweo-enterprise.

23 Australian Department of Defence, *Defence Industry Development Strategy* (Canberra: Asutralian Department of Defence, February 2024), https://www.defence.gov.au/about/strategic-planning/defence-industry-development-strategy.

24 Gregg Rubinstein, "Japan's New Defense Buildup Plan and Its Defense Industrial Base," CSIS, *Commentary*, January 26, 2023, https://www.csis.org/analysis/japans-new-defense-buildup-plan-and-its-defense-industrial-base.

25 Gordon Arthur, "How South Korea's Defense Industry Transformed Itself into a Global Player," Breaking Defense, November 6, 2023, https://breakingdefense.com/2023/11/how-south-koreas-defense-industry-transformed-itself-into-a-global-player/.

26 "Poland signs $6.5 billion deal to purchase a second batch of K2 tanks," *Korea JoongAng Daily*, August 2, 2025, https://koreajoongangdaily.joins.com/news/2025-08-02/national/defense/Poland-signs-65-billion-deal-to-purchase-second-batch-of-K2-tanks/2367180.

27 Matthew P. Funaiole, Brian Hart, and Aidan Powers-Riggs, *Ship Wars: Confronting China's Dual-Use Shipbuilding Empire* (Washington, DC: CSIS, March 2025), https://www.csis.org/analysis/ship-wars-confronting-chinas-dual-use-shipbuilding-empire.

28 Seth G. Jones, "China Is Ready for War," *Foreign Affairs*, October 2, 2024, https://www.foreignaffairs.com/china/china-ready-war-america-is-not-seth-jones.

29 Theodore Bunzel and Elina Ribakova, "The Russian Economy Remains Putin's Greatest Weakness," *Foreign Affairs*, December 9, 2024, https://www.foreignaffairs.com/russia/russian-economy-remains-putins-greatest-weakness#author-info; and Richard Connolly, "Russia's Wartime Economy Isn't as Weak as It Looks," Royal United Services Institute, January 22, 2025, https://www.rusi.org/explore-our-research/publications/commentary/russias-wartime-economy-isnt-weak-it-looks.

30 Cynthia R. Cook, "Friends over Factories," *Foreign Affairs*, March 27, 2023, https://www.foreignaffairs.com/united-states/friends-over-factories; and "Defense Industrial Base Lessons from Russia-Ukraine," CSIS, *Conflict in Focus*, March 13, 2025, https://www.csis.org/analysis/defense-industrial-base-lessons-russia-ukraine-conflict-focus.

31 Maksym Samoiliuk, "Ukraine War Economy Tracker," Centre for Economic Strategy, https://ces.org.ua/en/tracker-economy-during-the-war/.

32 "Fact Sheet on U.S. Security Assistance to Ukraine," U.S. Department of Defense, January 8, 2025, https://media.defense.gov/2025/Jan/09/2003626080/-1/-1/1/UKRAINE-FACT-SHEET-JAN-9-2025.PDF; U.S. Department of State, "U.S. Security Cooperation with Ukraine: Fact Sheet," press release, March 12, 2025, https://www.state.gov/bureau-of-political-military-affairs/releases/2025/01/u-s-security-cooperation-with-ukraine; and Marc Santora and Eric Schmitt, "As F-16s Arrive, Ukraine Still Faces Steep Challenges in the Skies," *New York Times*, July 28, 224, https://www.nytimes.com/2024/07/28/world/europe/ukraine-russia-f-16s.html.

33 Lolita Baldor, "China, North Korea and Russia Military Cooperation Raises Threats in the Pacific, US Official Warns," AP News, April 10, 2025, https://apnews.com/article/pacific-russia-china-north-korea-weapons-ukraine-8ad7156898f1391557d5e53d5d09a02c.

34 Omar Al-Ghusbi and Conrad Rousseau, "Airborne Axis: Inside the Deal That Brought Iranian Drone Production to Russia," C4ADS, May 29, 2025, https://c4ads.org/reports/airborne-axis/.

35 C. Todd Lopez, "Iran Gives Russia Short-Range Missiles, While U.S., Partners Expect to Keep Bolstering Ukrainian Air Defense," U.S. Department of Defense, September 10, 2024, https://www.defense.gov/News/News-Stories/Article/Article/3901774/iran-gives-russia-short-range-missiles-while-us-partners-expect-to-keep-bolster/.

36 "Unlawful Military Cooperation including Arms Transfers between North Korea and Russia," Multilateral Sanctions Monitoring Team, May 29, 2025, https://msmt.info/Publications/detail/MSMT%20Report/4195.

37 Max Bergmann et al., *Collaboration for a Price: Russian Military-Technical Cooperation with China, Iran, and North Korea* (Washington, DC: CSIS, May 2024), https://www.csis.org/analysis/collaboration-price-russian-military-technical-cooperation-china-iran-and-north-korea.

38 Ibid.

39 Isabelle Khurshudyan, Mary Ilyushina, and Kostiantyn Khudov, "Russia and Ukraine are fighting the first full-scale drone war," *Washington Post*, December 2, 2022, https://www.washingtonpost.com/world/2022/12/02/drones-russia-ukraine-air-war/.

40 Lauren Kahn, "How Ukraine Is Remaking War," *Foreign Affairs*, August 29, 2022, https://www.foreignaffairs.com/ukraine/how-ukraine-remaking-war.

41 Kateryna Bondar, "How Ukraine Rebuilt Its Military Acquisition System Around Commercial Technology," CSIS, January 13, 2025, https://www.csis.org/analysis/how-ukraine-rebuilt-its-military-acquisition-system-around-commercial-technology.

42 Vitaliy Goncharuk, "Ukraine Isn't the Model for Winning the Innovation War," War on the Rocks, August 12, 2025, https://warontherocks.com/2025/08/ukraine-isnt-the-model-for-winning-the-innovation-war/.

43 Jorge Rivero, "Innovating under Fire: Lessons from Ukraine's Frontline Drone Workshops," Modern War Institute, March 25, 2025, https://mwi.westpoint.edu/innovating-under-fire-lessons-from-ukraines-frontline-drone-workshops/; and Jack Watling and Nick Reynolds, *Tactical Developments During the Third Year of the Russo-Ukrainian War* (London, UK: Royal United Services Institute, February 2025), tactical-developments-third-year-russo-ukrainian-war-february-2205.pdf

44 William Shelton, Cynthia R. Cook, and Charlie Barton, *A Clean Sheet Approach to Space Acquisition in Light of the New Space Force* (Santa Monica, CA: RAND Corporation, August 2021), https://www.rand.org/pubs/research_reports/RRA541-1.html.

45 Ibid.

46 Ibid.

47 Philip E. Ross, "Budget Drones in Ukraine Are Redefining Warfare," IEEE Spectrum, May 17, 2023, https://spectrum.ieee.org/drone-warfare-ukraine.

48 Tayfun Ozberk, "Analysis: Chain of Negligence Caused the Loss of the Moskva Cruiser," Naval News, April 17, 2022, https://www.navalnews.com/naval-news/2022/04/analysis-chain-of-negligence-caused-the-loss-of-the-moskva-cruiser/.

49 Cancian, Cancian, and Heginbotham, *The First Battle of the Next War*.

50 Shelton, Cook, and Barton, *A Clean Sheet Approach to Space Acquisition*.

51 Gregory Sanders and Audrey Aldisert, "Burden Sharing via Modular Open Systems Approaches: A Collaborative Path to Affordable Mass," CSIS, *Commentary*, December 10, 2024, https://www.csis.org/analysis/burden-sharing-modular-open-systems-approaches-collaborative-path-affordable-mass.

POWER PROJECTION AND THE LOGISTICS OF MODERN WAR

1 Ronald Ti and Christopher Kinsey, "Lessons from the Russo-Ukrainian conflict: the primacy of logistics over strategy," *Defence Studies* 23, no. 3 (2023), https://doi.org/10.1080/14702436.2023.2238613.

2 Department of Defense, *Joint Concept for Logistics* (Washington, DC: Department of Defense, August 2010), 8, https://www.jcs.mil/portals/36/Documents/102710173839_Joint_Concept_for_Logistics_v1_FINAL_with_CJCS_Sig.pdf.

3 Ibid.

4 Ibid.

5 There are a number of useful review articles focused on the Russian experience. See Paul Schwartz et al., Russian Military Logistics in the Ukraine War: Recent Reforms and Wartime Operations (Arlington, VA: CNA, September 2023), https://www.cna.org/reports/2023/10/Russian-Military-Logistics-in-the-Ukraine-War.pdf; and Marta Kepe, Logistics and Sustainment in the Russian Armed Forces (Santa Monica, CA: RAND, November 2023), https://www.rand.org/pubs/research_reports/RRA2523-1.html.

6 Bonnie Berkowitz and Artur Galocha, "Why the Russian military is bogged down by logistics in Ukraine," *Washington Post*, March 30, 2022, https://www.washingtonpost.com/world/2022/03/30/russia-military-logistics-supply-chain/.

7 Ibid.

8 Marta Kepe, *Logistics and Sustainment in the Russian Armed Forces* (Santa Monica, CA: RAND Corporation, November 15, 2023), https://www.rand.org/pubs/research_reports/RRA2523-1.html.

9 Angelica Evans et al., "Russian Offensive Campaign Assessment," Institute for the Study of War, June 24, 2025, https://www.understandingwar.org/backgrounder/russian-offensive-campaign-assessment-june-24-2025.

10 Simone McCarthy, "NATO allies call China a 'decisive enabler' of Russia in Ukraine war as bloc eyes Asia security threats," CNN, July 11, 2024, https://www.cnn.com/2024/07/11/china/nato-china-russia-ukraine-intl-hnk/index.html.

11 Kateryna Stepanenko et al., "Russian Force Generation and Technological Adaptations Update," Institute for the Study of War, July 25, 2025, https://understandingwar.org/backgrounder/russian-force-generation-and-technological-adaptations-update-july-25-2025.

12 Anna Harvey et al., Russian Offensive Campaign Assessment," Institute for the Study of War, August 19, 2025, https://www.understandingwar.org/backgrounder/russian-offensive-campaign-assessment-august-19-2025.

13 Rachel S. Cohen, "What the Wars in Gaza and Ukraine Are Teaching the US About Logistics," *Air & Space Forces Magazine*, September 21, 2024, https://www.airandspaceforces.com/wars-gaza-ukraine-us-lessons-logistics/.

14 Peeter Helme, "Ukraine's drones make Russia's rear go up in flames," Euromaidan Press, August 19, 2025, https://euromaidanpress.com/2025/08/19/ukraine-hits-russian-supply-depots-deep-in-occupied-luhansk/.

15 Elizabeth Hoffman et al., "How Supporting Ukraine Is Revitalizing the U.S. Defense Industrial Base," CSIS, *Commentary*, April 18, 2024, https://www.csis.org/analysis/how-supporting-ukraine-revitalizing-us-defense-industrial-base.

16 Department of Defense Office of the Inspector General, *Audit of DoD Maintenance of Military Equipment Provided in Support of Ukraine*, Report No. DODIG-2025-002 (Washington, DC: Department of Defense, October 2024), https://www.dodig.mil/reports.html/Article/3932056/audit-of-dod-maintenance-of-military-equipment-provided-in-support-of-ukraine-r/.

17 Manuela Tudosia, "Lessons Learned from Ukraine: Logistics," European Security & Defence, June 23, 2023, https://euro-sd.com/2023/06/articles/31845/lessons-learned-from-ukraine-logistics/.

18 Charles Hamilton, "The Logistics of Victory: Ukraine's Sustainment Challenge," RealClearDefense, March 17, 2025, https://www.realcleardefense.com/articles/2025/03/17/the_logistics_of_victory_ukraines_sustainment_challenge_1097974.html.

19 Ibid.

20 Aaron Epstein et al., "Putting Medical Boots on the Ground: Lessons from the War in Ukraine and Applications for Future Conflict with Near-Peer Adversaries," *Journal of the American College of Surgeons* 237, no. 2 (April 2023), https://pmc.ncbi.nlm.nih.gov/articles/PMC10344429/.

21 Siobhán O'Grady and Serhii Korolchuk, "Borscht from the sky: Ukraine uses drones to resupply trench-bound troops," *Washington Post*, September 1, 2025, https://www.washingtonpost.com/world/2025/09/01/ukraine-drones-resupply-trench/.

22 Larry Hanauer and Michael P. Connell, *Political Priorities, Poor Intelligence Tradecraft, and the Suppression of Dissenting Views: Why Israel Failed to Warn of Hamas's October 7 Attack* (Alexandria VA: Institute for Defense Analyses, September 2024), https://www.ida.org/-/media/8e5040cc7ee5457dba26c8127b47c8e0.ashx.

23 Adam Samson and Neri Zilber, "Turkey moves to restrict key exports to Israel," *Financial Times*, April 9, 2024, https://www.ft.com/content/73edc1c9-a6a9-4337-b719-78506e9d1456.

24 Cohen, "What the Wars in Gaza and Ukraine Are Teaching the US."

25 Ibid.

26 Mark F. Cancian, "Can the United States Equip Israel While Simultaneously Equipping Ukraine and Taiwan?," CSIS, *Critical Questions*, October 12, 2023, https://www.csis.org/analysis/can-united-states-equip-israel-while-simultaneously-equipping-ukraine-and-taiwan.

27 David Averre, "Israel's Iron Dome system is running out of ammunition and a joint Hezbollah/Iran missile strike could overwhelm defences - as US warns it can't keep supplying IDF AND Ukraine," *Daily Mail*, October 15, 2024, https://www.dailymail.co.uk/news/article-13961393/israel-iron-dome-hezbollah-iran-missile-strike-tehran-air-defence.html.

28 Ibid.; and Harrison Morgan, "A Year Since October 7: Three Key Lessons from the War in Gaza," Modern War Institute, October 7, 2024, https://mwi.westpoint.edu/a-year-since-october-7-three-key-lessons-from-the-war-in-gaza.

29 Larry Jackson, Geraldo Ferrer, and Harrison Schramm, "The Dawn of Offensive Supply Chains," RealClearDefense, October 14, 2024, https://www.realcleardefense.com/articles/2024/10/14/the_dawn_of_offensive_supply_chains_1064896.html; and Ari Hawkins and Joseph Gedeon, "Middle East pager attacks ignite fear of supply chain warfare," *Politico*, September 19, 2024, https://www.politico.com/news/2024/09/19/pager-attacks-supply-chain-warfare-00180136.

30 "Why is Xi Jinping building secret commodity stockpiles?," *The Economist*, July 23, 2024, https://www.economist.com/finance-and-economics/2024/07/23/why-is-xi-jinping-building-secret-commodity-stockpiles.

31 Matthew P. Funaiole, Brian Hart, Jaehyun Han, and Jennifer Jun, "China Accelerates Construction of 'Ro-Ro' Vessels, with Potential Military Implications," CSIS, *China Power*, October 11, 2023, https://chinapower.csis.org/analysis/china-construct-ro-ro-vessels-military-implications/.

32 Matthew P. Funaiole, Brian Hart, and Aidan Powers-Riggs, "China Dominates the Shipbuilding Industry," CSIS, *CSIS Charts*, March 25, 2025, https://www.csis.org/analysis/china-dominates-shipbuilding-industry; and Chad Peltier, Tate Nurkin, and Sean O'Connor, *China's Logistics Capabilities for Expeditionary Operations* (Washington, DC: U.S.-China Economic and Security Review Commission, March 2020), https://www.uscc.gov/research/chinas-logistics-capabilities-expeditionary-operations.

33 "2024 Regional Sustainment Framework," U.S. Department of Defense, https://www.acq.osd.mil/asds/docs/RSF-9MAY24.pdf; "Fact Sheet: Partnership for Indo-Pacific Industrial Resilience," U.S. Department of Defense, June 1, 2025, https://media.defense.gov/2025/Jun/02/2003730341/-1/-1/1/FACT-SHEET-PARTNERSHIP-FOR-INDO-PACIFIC-INDUSTRIAL-RESILIENCE.PDF; and U.S. Department of Defense, "Under Secretary of

Defense for Acquisition and Sustainment Travel to Japan," Press release, June 5, 2024, https://www.defense.gov/News/Releases/Release/Article/3797650/under-secretary-of-defense-for-acquisition-and-sustainment-travel-to-japan/.

34 Alexandra G. Neenan and Luke A. Nicastro, *The Defense Production Act of 1950: History, Authorities, and Considerations for Congress*, CRS Report No. R43767 (Washington, DC: Congressional Research Service, October 2023), https://www.congress.gov/crs-product/R43767.

THE NEXT OFFSET: WINNING THE FIGHT BEFORE IT STARTS

1 Carl von Clausewitz, *On War* (New York: Penguin, 1968), 101.

2 Michael C. Horowitz, "Battles of Precise Mass: Technology is Remaking War—and America Must Adapt," *Foreign Affairs*, October 22, 2024, https://www.foreignaffairs.com/world/battles-precise-mass-technology-war-horowitz.

3 On offset strategies, see, for example, Robert Martinage, *Toward a New Offset Strategy: Exploiting U.S. Long-Term Advantages to Restore U.S. Global Power Projection Capability* (Washington, DC: Center for Strategic and Budgetary Assessment, 2014), https://csbaonline.org/uploads/documents/Offset-Strategy-Web.pdf.

4 Quoted in Dima Adamsky, *The Culture of Military Innovation: The Impact of Cultural Factors on the Revolution in Military Affairs in Russia, the US, and Israel* (Stanford, CA: Stanford University Press, 2010), 2.

5 James S. Lay, *A Report to the National Security Council* (Washington, DC: National Security Council, NSC 162/2, October 1953), 2, https://irp.fas.org/offdocs/nsc-hst/nsc-162-2.pdf.

6 Ibid., 5.

7 John Foster Dulles, "Policy for Security and Peace," *Foreign Affairs*, April 1, 1954, https://www.foreignaffairs.com/articles/united-states/1954-04-01/policy-security-and-peace.

8 Quoted in Richard M. Leighton, *Strategy, Money, and the New Look, 1953-1956*, History of the Office of the Secretary of Defense, Vol. III (Washington, DC: Historical Office, Office of the Secretary of Defense, 2001), 373, https://history.defense.gov/Portals/70/Documents/secretaryofdefense/OSDSeries_Vol3.pdf.

9 See, for example, ibid., 432–434.

10 Robert J. Watson, *Into the Missile Age, 1956-1960*, History of the Office of the Secretary of Defense, Vol. IV (Washington, DC: Historical Office, Office of the Secretary of Defense, 1997), 35, https://history.defense.gov/Portals/70/Documents/secretaryofdefense/OSDSeries_Vol4.pdf.

11 See, for example, Donn M. Starry, "Extending the Battlefield," in Jack D. Kem, *Deep Operations: Theoretical Approaches to Fighting Deep* (Fort Leavenworth, KS: Army University Press, 2021), 107-128, https://www.armyupress.army.mil/Portals/7/combat-studies-institute/images/LSCO%20DeepOps%20book%20interactive%20with%20cover%20spread%2012Nov21.pdf; and Douglas W. Skinner, *Airland Battle Doctrine* (Alexandria, VA: Center for Naval Analyses, September 1988), https://apps.dtic.mil/sti/tr/pdf/ADA202888.pdf.

12 Department of the Army, *Field Manual 100-5 Operations* (Washington, DC: Headquarters, Department of the Army, 1986), https://cgsc.contentdm.oclc.org/digital/collection/p4013coll9/id/893/.

13 Richard H. Van Atta, Seymour J. Deitchman, and Sidney G. Reed, *DARPA Technical Accomplishments, Vol. III* (Arlington, VA: Defense Advanced Research Projects Agency, July 1991), https://apps.dtic.mil/sti/tr/pdf/ADA241680.pdf; and Benjamin M. Jensen, *Forging the Sword: Doctrinal Change in the U.S. Army* (Stanford, CA: Stanford University Press, 2016).

14 For an overview of the second offset, see Edward C. Keefer, *Harold Brown: Offsetting the Soviet Military Challenge, 1977–1981* (Washington, DC: Historical Office, Office of

the Secretary of Defense, 2017), 575–600, https://history.defense.gov/Portals/70/Documents/secretaryofdefense/OSDSeries_Vol9.pdf.

15 Quoted in ibid., 588.

16 William Perry, *My Journey at the Nuclear Brink* (Stanford, CA: Stanford University Press, 2015), 38–39.

17 Edward C. Keefer, *Caspar Weinberger and the U.S. Military Build-up 1981–1985* (Washington, DC: Historical Office, Office of the Secretary of Defense, 2023), 623–624, https://history.defense.gov/Portals/70/Documents/secretaryofdefense/OSDSeries_Vol10.pdf?ver=NHuRp2OYKrNpaUsCQBMq0A%3D%3D.

18 Quoted in Gordon S. Barrass, *The Great Cold War: A Journey Through the Hall of Mirrors* (Stanford, CA: Stanford University Press, 2009), 274.

19 Robert Work, "Remarks by Deputy Secretary Work on Third Offset Strategy," (speech, Brussels, Belgium, April 28, 2016), https://www.defense.gov/News/Speeches/Speech/Article/753482/remarks-by-deputy-secretary-work-on-third-offset-strategy/.

20 Data from "SIPRI Military Expenditure Database," Stockholm International Peace Research Institute, https://www.sipri.org/databases/milex.

21 "强化政治自觉, 下决心根治'和平病'" [Strengthen Political Awareness and Resolve to Eradicate 'Peace Disease'], 中国军网 [China Military Network], July 2, 2018; 倪文鑫 [Ni Wenxin], "实战化训练必须聚焦明天的 战场—军区空军实战化训练对联合训练的启示" [Training Made Realistic to Actual War Must Focus on Tomorrow's Battlefield: What Military Region Air Force's Training Made Realistic to Actual War Can Tell Us About Joint Training], 人民前线 [People's Front], October 25, 2013; 陈永义 [Chen Yongyi] and 刘媛媛 [Liu Yuanyuan], "和平病' 亦须心药医" [Peace Disease Also Requires Careful Medicine], 解放军报 [People's Liberation Army Daily], July 16, 2019.

22 The U.S. Department of Defense has developed some multidomain efforts and related concepts, such as Assault Breaker II, which is designed to provide rapid, multidomain offensive capabilities to destroy advancing enemy forces before they can consolidate their gains; the Joint Warfighting Concept 3.0, the U.S. military's doctrine for joint warfighting, with a focus on information advantage, command and control, joint fires, contested logistics, expanded maneuver, and a proactive stance in a competitive environment; Hellscape, U.S. Indo-Pacific Command's integration of unmanned ships, aircraft, and submarines working in tandem to engage thousands of targets across the Pacific; and the China operational plan (OPLAN). In addition, former U.S. Secretary of the Air Force Frank Kendall had several operational imperatives: resilient and effective space architectures; Advanced Battle Management System (ABMS) / Air Force Joint All-Domain Command and Control; next generation air dominance (NGAD); moving target engagement at scale; optimized resilience basing, sustainment, and communication in a contested environment; B-21 long rang strike family of systems; and readiness to transition to a wartime posture.

23 Chieh Chung, "PLA Logistics and Mobilization Capacity in a Taiwan Invasion," in Joel Wuthnow et al., eds., *Crossing the Strait: China's Military Prepares for War with Taiwan* (Washington, DC: National Defense University Press, 2022), 261, https://ndupress.ndu.edu/Portals/68/Documents/Books/crossing-the-strait/crossing-the-strait.pdf; Chung Chieh and Andrew N.D. Yang, "Crossing the Strait: Recent Trends in PLA 'Strategic Delivery' Capabilities," in Joel Wuthnow et al., eds. *The PLA Beyond Borders: Chinese Military Operations in Regional and Global Context* (Washington, DC: National Defense University Press, 2021), 54, https://digitalcommons.ndu.edu/books-and-book-chapters/1/.

24 See, for example, Ivan Kanapathy, "Countering China's Use of Force," in Matt Pottinger, ed., *The Boiling Moat: Urgent Steps to Defend Taiwan* (Stanford, CA: Hoover Institution Press, 2024), 93.

25 Joshua Arostegui, "PLA Army and Marine Corps Amphibious Brigades in a Post-Reform Military," in Wuthnow, et al., eds., *Crossing the Strait*, 173.

26 Phillip C. Saunders and Joel Wuthnow, "Crossing the Strait: PLA Modernization and

Taiwan," in Wuthnow, *Crossing the Strait*, 8.

27 Chung, "PLA Logistics and Mobilization Capacity in a Taiwan Invasion," 270.

28 David A. Ochmanek, *Determining the Military Capabilities Most Needed to Counter China and Russia: A Strategy-Driven Approach* (Santa Monica, CA: RAND, June 2022), https://www.rand.org/content/dam/rand/pubs/perspectives/PEA1900/PEA1984-1/RAND_PEA1984-1.pdf.

29 Ochmanek, *Determining the Military Capabilities Most Needed to Counter China and Russia*.

30 Josh Rogin, "The U.S. Military Plans a 'Hellscape' to Deter China from Attacking Taiwan," *Washington Post*, June 10, 2024, https://www.washingtonpost.com/opinions/2024/06/10/taiwan-china-hellscape-military-plan/.

31 Admiral Samuel Paparo, "Posture of United States Indo-Pacific Command," Testimony before the Committee on Armed Services, U.S. Senate, April 10, 2025, https://www.armed-services.senate.gov/imo/media/doc/4102025fulltranscript.pdf.

32 Mark F. Cancian, Matthew Cancian, and Eric Heginbotham, *The First Battle of the Next War: Wargaming a Chinese Invasion of Taiwan* (Washington, DC: CSIS, January 2023), https://www.csis.org/analysis/first-battle-next-war-wargaming-chinese-invasion-taiwan.

33 Ibid.

34 Ronald O'Rourke, *Navy Virginia-Class Submarine Program and AUKUS Submarine (Pillar 1) Project: Background and Issues for Congress*, CRS Report No. RL32418 (Washington, DC: Congressional Research Service, March 2025), https://www.congress.gov/crs-product/RL32418.

35 See, for example, John A. Tirpak, "Navy Shoots Four LRASMs in 'Graduation Exercise,' as Air Force Ramps Up Multiyear Buy," *Air and Space Forces Magazine*, April 3, 2024, https://www.airandspaceforces.com/navy-shoots-four-lrasm-air-force-multiyear-buy/.

36 John A. Tirpak, "Lockheed Get $122 Million for Gear to Accelerate JASSM and LRASM Production," *Air and Space Forces Magazine*, March 17, 2025, https://www.airandspaceforces.com/lockheed-gear-jassm-and-lrasm-production/.

37 Mark A. Milley and Eric Schmidt, "America Isn't Ready for the Wars of the Future," *Foreign Affairs*, August 5, 2024, https://www.foreignaffairs.com/united-states/ai-america-ready-wars-future-ukraine-israel-mark-milley-eric-schmidt.

38 Elon Musk, @elonmusk, X post November 25, 2024, 7:32 AM, https://x.com/elonmusk/status/1861070432377737269?lang=en.

39 Sharon Weinberger and Heather Somerville, "Tech Bros Are Betting They Can Help Win a War with China," *Wall Street Journal*, August 9, 2024, https://www.wsj.com/tech/anduril-drones-palmer-luckey-china-ukraine-china-951494ec.

40 Michael C. Horowitz, *The Diffusion of Military Power: Causes and Consequences for International Politics* (Princeton, NJ: Princeton University Press, 2010), 2.

41 Stephen Peter Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca, NY: Cornell University Press, 1991), 109–129.

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