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The First Battle of the Next War

Wargaming a Chinese Invasion of Taiwan

AUTHORS

Mark F. Cancian
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Eric Heginbotham

A Report of the CSIS International Security Program

CSIS | CENTER FOR STRATEGIC &
INTERNATIONAL STUDIES



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Note on Technical Data

This report contains extensive discussion of the wargame that constituted the foundation for this research project. Nevertheless, length limitations prevented discussion of all the many technical details behind the wargame. Readers interested in these details can contact the project's principal investigators.

Appendix A details the wargame scenarios.

Appendix B contains a lexicon of relevant wargaming terms.

Appendix C contains a list of acronyms and abbreviations used in this report.

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Executive Summary

What would happen if China attempted an amphibious invasion of Taiwan? CSIS developed a wargame for a Chinese amphibious invasion of Taiwan and ran it 24 times. In most scenarios, the United States/Taiwan/Japan defeated a conventional amphibious invasion by China and maintained an autonomous Taiwan. However, this defense came at high cost. The United States and its allies lost dozens of ships, hundreds of aircraft, and tens of thousands of servicemembers. Taiwan saw its economy devastated. Further, the high losses damaged the U.S. global position for many years. China also lost heavily, and failure to occupy Taiwan might destabilize Chinese Communist Party rule. Victory is therefore not enough. The United States needs to strengthen deterrence immediately.

The Challenge

China's leaders have become increasingly strident about unifying Taiwan with the People's Republic of China (PRC).¹ Senior U.S. officials and civilian experts alike have expressed concern about Chinese intentions and the possibility of conflict. Although Chinese plans are unclear, a military invasion is not out of the question and would constitute China's most dangerous solution to its "Taiwan problem"; it has therefore justly become a focus of U.S. national security discourse.

Because "a Taiwan contingency is the pacing scenario" for the U.S. military, it is critical to have a

¹ The project uses "China" to refer to the People's Republic of China, recognizing that many on Taiwan consider themselves Chinese also.

shared, rigorous, and transparent understanding of the operational dynamics of such an invasion.² Just as such an understanding was developed concerning the Cold War's Fulda Gap, so too must analysts consider the Taiwan invasion scenario. This understanding is important because U.S. policy would be radically different if the defense were hopeless than if successful defense were achievable. If Taiwan can defend itself from China without U.S. assistance, then there is no reason to tailor U.S. strategy to such a contingency. At the other extreme, if no amount of U.S. assistance can save Taiwan from a Chinese invasion, then the United States should not mount a quixotic effort to defend the island. However, if U.S. intervention can thwart an invasion under certain conditions and by relying on certain key capabilities, then U.S. policy should be shaped accordingly. In this way, China would also be more likely to be deterred from an invasion in the first place. However, such shaping of U.S. strategy requires policymakers to have a shared understanding of the problem.

Yet, there is no rigorous, open-source analysis of the operational dynamics and outcomes of an invasion despite its critical nature. Previous unclassified analyses either focus on one aspect of an invasion, are not rigorously structured, or do not focus on military operations. Classified wargames are not transparent to the public. Without a suitable analysis, public debate will remain unanchored.

Therefore, this CSIS project designed a wargame using historical data and operations research to model a Chinese amphibious invasion of Taiwan in 2026. Some rules were designed using analogies with past military operations; for example, the Chinese amphibious lift was based on analysis of Normandy, Okinawa, and the Falklands. Other rules were based on theoretical weapons performance data, such as determining the number of ballistic missiles required to cover an airport. Most rules combined these two methods. In this way, the results of combat in the wargame were determined by analytically based rules instead of by personal judgment. The same set of rules applied to the first iteration and to the last iteration, ensuring consistency.

Based on interviews and a literature review, the project posited a "base scenario" that incorporated the most likely values for key assumptions. The project team ran that base scenario three times. A variety of excursion cases then explored the effects of varying assumptions.³ The impact of these varying assumptions on the likely outcome is depicted in a Taiwan Invasion Scorecard (see Figure 8). In all, 24 iterations of the game mapped the contours of the conflict and produced a coherent and rigorously derived picture of a major threat facing the United States.

The Results

The invasion always starts the same way: an opening bombardment destroys most of Taiwan's navy and air force in the first hours of hostilities. Augmented by a powerful rocket force, the Chinese navy encircles Taiwan and interdicts any attempts to get ships and aircraft to the besieged island. Tens of thousands of Chinese soldiers cross the strait in a mix of military amphibious craft and civilian roll-on, roll-off ships, while air assault and airborne troops land behind the beachheads.

2 Ely Ratner, testimony before the Senate Foreign Relations Committee, "The Future of U.S. Policy on Taiwan," 117th Cong., 1st sess., 2021, <https://www.foreign.senate.gov/hearings/the-future-of-us-policy-on-taiwan120821>.

3 Excursion cases include assumptions that are plausible although not considered the most likely.

However, in the most likely “base scenario,” the Chinese invasion quickly founders. Despite massive Chinese bombardment, Taiwanese ground forces stream to the beachhead, where the invaders struggle to build up supplies and move inland. Meanwhile U.S. submarines, bombers, and fighter/attack aircraft, often reinforced by Japan Self-Defense Forces, rapidly cripple the Chinese amphibious fleet. China’s strikes on Japanese bases and U.S. surface ships cannot change the result: Taiwan remains autonomous.

There is one major assumption here: Taiwan must resist and not capitulate. If Taiwan surrenders before U.S. forces can be brought to bear, the rest is futile.

This defense comes at a high cost. The United States and Japan lose dozens of ships, hundreds of aircraft, and thousands of servicemembers. Such losses would damage the U.S. global position for many years. While Taiwan’s military is unbroken, it is severely degraded and left to defend a damaged economy on an island without electricity and basic services. China also suffers heavily. Its navy is in shambles, the core of its amphibious forces is broken, and tens of thousands of soldiers are prisoners of war.

Conditions for Success

Analysis of the 24 game iterations showed four necessary conditions to defeat a Chinese invasion.

1. Taiwanese forces must hold the line.

Recommendation: Strengthen Taiwanese ground forces. Because some Chinese forces will always land on the island, Taiwanese ground forces must be able to contain any beachhead and then counterattack forcefully as Chinese logistics weaken. However, the Taiwanese ground forces have severe weaknesses. Therefore, Taiwan must fill its ranks and conduct rigorous, combined arms training. Ground forces must become the center of Taiwan’s defense effort.

2. There is no “Ukraine model” for Taiwan.

Recommendation: In peacetime, the United States and Taiwan must work together to provide Taiwan with the weapons it needs; in wartime, if the United States decides to defend Taiwan, U.S. forces must quickly engage in direct combat. In the Ukraine war, the United States and the North Atlantic Treaty Organization (NATO) have not sent troops directly into combat but have sent massive amounts of equipment and supplies to Ukraine. Russia has been unable to interdict this overland flow. However, the “Ukraine model” cannot be replicated in Taiwan because China can isolate the island for weeks or even months. Taiwan must start the war with everything it needs. Further, delays and half measures by the United States would make the defense harder, increase U.S. casualties, allow China to create a stronger lodgment, and raise the risk of escalation.

3. The United States must be able to use its bases in Japan for combat operations.

Recommendation: Deepen diplomatic and military ties with Japan. While other allies (e.g., Australia and South Korea) are important in the broader competition with China and may play some role in the defense of Taiwan, Japan is the linchpin. Without the use of U.S. bases in Japan, U.S. fighter/attack aircraft cannot effectively participate in the war.

4. **The United States must be able to strike the Chinese fleet rapidly and en masse from outside the Chinese defensive zone.**

Recommendation: Increase the arsenal of long-range anti-ship cruise missiles. Bombers capable of launching standoff, anti-ship ordnance offer the fastest way to defeat the invasion with the least amount of U.S. losses. Procuring such missiles and upgrading existing missiles with this anti-ship capability needs to be the top procurement priority.

Avoiding a Pyrrhic Victory

Victory is not everything. The United States might win a pyrrhic victory, suffering more in the long run than the “defeated” Chinese. Furthermore, the perception of high costs might undermine deterrence: if China believes that the United States would be unwilling to bear the high costs of defending Taiwan, then China might risk an invasion. The United States should therefore institute policies and programs to make winning less costly in the event of conflict. Such measures would include:

POLITICS AND STRATEGY

- **Clarify war plan assumptions.** There is a seeming gap between war plans, which assume prewar deployments to Taiwan and neutral countries, and political realities.
- **Do not plan on striking the mainland.** The National Command Authority might withhold permission because of the grave risks of escalation with a nuclear power.
- **Recognize the need to continue operations in the face of heavy casualties.** In three weeks, the United States will suffer about half as many casualties as it did in 20 years of war in Iraq and Afghanistan.
- **Move Taiwanese air and naval forces toward asymmetry.** Despite rhetoric about adopting a “porcupine strategy,” Taiwan still spends most of its defense budget on expensive ships and aircraft that China will quickly destroy.

DOCTRINE AND POSTURE

- **Fortify and expand air bases in Japan and Guam.** Dispersion and hardening dilute the effects of missile attacks.
- **Revise U.S. Air Force doctrine and restructure procurement to increase aircraft survivability on the ground.** Ninety percent of aircraft losses occurred on the ground.
- **Do not plan on overflying the Chinese mainland.** Chinese air defense is too strong, the targets take a long time to produce operational results, and the air missions around Taiwan take priority.
- **Recognize the limitations of Marine Littoral Regiments and Army Multi-Domain Task Forces and cap their numbers.** These units are designed to counter China and do provide some value, but political and operational difficulties put limits on their utility.
- **Avoid crisis deployments that create vulnerabilities.** Military doctrine calls for forward deployments to enhance deterrence during a crisis, but these forces make tempting targets.

WEAPONS AND PLATFORMS

- **Shift to smaller, more survivable ships and develop rescue mechanisms to deal with crippled ships and multiple sinkings.** Surface ships are extremely vulnerable, with the United States

typically losing two carriers and 10 to 20 large surface combatants in game iterations.

- **Prioritize submarines and other undersea platforms.** Submarines were able to enter the Chinese defensive zone and wreak havoc with the Chinese fleet, but numbers were inadequate.
- **Continue development and fielding of hypersonic weapons but recognize that they are niche weapons.** Their high cost limits inventories, so they lack the volume needed to counter the immense numbers of Chinese air and naval platforms.
- **Prioritize sustainment of the bomber fleet over fighters.** The range, missile standoff distance, and high carrying capacity of bombers presented the People's Liberation Army with daunting challenges.
- **Produce more, cheaper fighters and balance the acquisition of stealth aircraft with production of non-stealth aircraft.** With so many aircraft lost early in the conflict, the Air Force risks running out of fighter/attack aircraft and becoming a secondary player in the conflict unless it has a large enough force to sustain the losses.

Finally, the project and its recommendations need some caveats. Modeling an invasion does not imply that it is inevitable or even probable. The Chinese leadership might adopt a strategy of diplomatic isolation, gray zone pressure, or economic coercion against Taiwan; even if China opts for military force, this might take the form of a blockade rather than an outright invasion. However, the risk of invasion is real enough and potentially so destructive that analysis is worthwhile.

The project does not take a position on whether the benefits of defending Taiwan outweigh the prospective costs, or how to weigh those costs and benefits. Instead, the purpose is to enhance the public debate and thus allow the nation to make better-informed decisions on this critical national security challenge.

Why This Project?

The Need for Transparent Analysis of a Taiwan Contingency

What was once unthinkable—direct conflict between the United States and China—has now become a commonplace discussion in the national security community. The rise of China as an economic and military power, Beijing’s coercive policies directed against Taiwan and other U.S. regional partners in Asia, and growing U.S. bipartisan support for balancing Chinese economic and military power have created an intensifying competition. A direct clash would constitute the first between nuclear powers and also the first in which both sides possessed the full spectrum of modern military capabilities, such as stealth aircraft, long-range precision munitions, and space surveillance.

Despite the high stakes involved, there is little publicly available material on how such a conflict might play out. Much is classified and unavailable to the public. Unclassified material is either incomplete or too narrow for policymaking. By investigating many scenarios with a wargame based on analysis and running the wargame 24 times, this project fills a critical gap and furthers the public discussion of three key questions: Would a Chinese invasion of Taiwan succeed in 2026? What variables most affect that outcome? What would be the cost to both sides?

China’s Economic and Military Rise

International relations scholars have long highlighted the dangerous dynamics between a rising power and an existing hegemon. In 1958, Abramo Organski first developed the notion that war becomes more likely as the capabilities of weaker, dissatisfied states approach those of the established, advantaged

states.⁴ This theory provides the basis for a natural cycle of the rise and fall of hegemonic powers as unsatisfied and rising challengers defeat them.⁵ Graham Allison's 2018 book about the "Thucydides trap" popularized this notion.⁶ The concern is that this theory applies to today, where a rising China challenges the hegemonic status that the United States has enjoyed since the end of the Cold War.

The perception that China and the United States are strategic competitors, once debated, has gained widespread currency in both Washington and Beijing. In the United States, the sentiment has become bipartisan as hope has faded that China will become "a responsible member of the international community." China's attitude is hardening also. The two highest-grossing movies in Chinese history both featured the Chinese military taking on and defeating Americans (Wolf Warrior II and The Battle of Lake Changjin).

This view has been building over time. Andrew Marshall, the legendary head of the Office of Net Assessment, began warning about China in the late 1980s.⁷ Under President Barack Obama, the Pentagon launched the Third Offset Strategy to counter China's growing capabilities, and in 2016, Secretary of Defense Ashton Carter observed a "return to great power competition" in Asia. The Trump administration's National Defense Strategy continued this view: "China is a strategic competitor using predatory economics to intimidate its neighbors while militarizing features in the South China Sea."⁸ Most recently, the Biden administration's National Security Strategy identifies China as the primary global competitor to the United States: "The PRC is the only competitor with both the intent to reshape the international order and, increasingly, the economic, diplomatic, military, and technological power to do it. Beijing has ambitions to create an enhanced sphere of influence in the Indo-Pacific and to become the world's leading power."⁹

China has embarked on a concerted, long-term military modernization program. From its inception until the late 1990s, China's People's Liberation Army (PLA) was mainly land-focused, filled with masses of poorly trained conscripts, and unable to exert influence at a distance from its borders. Its poor performance in the 1979 border war with Vietnam underscored its weakness, as did the 1996 transit of the Taiwan Strait by U.S. naval forces. This has changed. As an annual assessment by the Department of Defense (DOD) notes: "The PRC has marshaled the resources, technology, and political will over the

4 A.F.K. Organski, *World Politics*, 1st ed. (New York: Alfred A. Knopf, 1958).

5 George Modelski, *Long Cycles in World Politics* (London: Palgrave Macmillan, 1987).

6 Graham T. Allison, *Destined for War: Can America and China Escape Thucydides' Trap?* (Boston: Mariner Books, 2018). For a shorter discussion by Graham Allison about the Thucydides trap, see Graham Allison, "The Thucydides Trap: Are the U.S. and China Headed for War?," *The Atlantic*, September 24, 2015, <http://www.theatlantic.com/international/archive/2015/09/united-states-china-war-thucydides-trap/406756/>.

7 Former members of Marshall's staff Andrew Krepinevich and Barry Watt describe Marshall's early and growing interest in China in Andrew Krepinevich and Barry Watts, *The Last Warrior* (New York: Basic Books, 2015).

8 Department of Defense, *Summary of the 2018 National Defense Strategy: Sharpening the American Military's Competitive Edge* (Washington, DC: January 2018), 1, 2, <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>.

9 The White House, *National Security Strategy* (Washington, DC: October 2022), 23, <https://www.whitehouse.gov/wp-content/uploads/2022/10/Biden-Harris-Administrations-National-Security-Strategy-10.2022.pdf>.

past two decades to strengthen and modernize the PLA in nearly every respect.”¹⁰ These capabilities have focused on air, naval, and missile systems that can target China’s periphery in a so-called anti-access/area denial (A2/AD) strategy.¹¹

China’s A2/AD capabilities are now formidable. China’s sizable and sophisticated force of ballistic and cruise missiles challenges the U.S. ability to operate from its few air bases in the Western Pacific, and China’s development of anti-ship ballistic missiles threatens to destroy U.S. surface ships. China began launching series production of fourth-generation fighter aircraft in the 2000s and now has more than 1,000 such aircraft in service. Series production of large modern warships (e.g., destroyers and frigates) did not begin until the mid-2010s, but progress since then has been even more striking. Between 2014 and mid-2020, China launched 25 Luyang III (Type 052Ds) destroyers and 8 Renhai cruisers.¹² It is currently building its third aircraft carrier, which, at 80,000 tons, will be much larger than its first two.¹³

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The U.S.-China Economic and Security Review Commission’s 2021 annual report to Congress found that decades of improvements by China’s armed forces “have fundamentally transformed the strategic environment,” weakening military deterrence across the Taiwan Strait and diminishing the position of the United States. The commission concluded, “Today, the [PLA] either has or is close to achieving an initial capability to invade Taiwan—one that remains under development but that China’s leaders may employ at high risk—while deterring, delaying, or defeating U.S. military intervention.”¹⁴

Despite impressive gains, China’s air and naval capabilities still lag behind aggregate U.S. capabilities in

10 Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2020* (Washington, DC: Department of Defense, 2020), i–ii, <https://media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF>.

11 CSBA developed the concept of A2/AD strategies. Andrew Krepinevich, Barry Watts, and Robert Work, *Meeting the Anti-Access and Area-Denial Challenge* (Washington, DC: Center for Strategic and Budgetary Assessments (CSBA), May 2003), <https://csbaonline.org/research/publications/a2ad-anti-access-area-denial>.

12 “Chapter Six: Asia,” in International Institute for Security Studies, *The Military Balance*, 121, no. 1 (London: 2021): 232, doi:10.1080/04597222.2021.1868795.

13 The Office of Naval Intelligence estimates that by 2030, China will have 65 large surface combatants. “China: Naval Construction Trends vis-à-vis U.S. Navy Shipbuilding Plans, 2020-2030,” Office of Naval Intelligence, February 6, 2020, <https://irp.fas.org/agency/oni/plan-trends.pdf>.

14 U.S.-China Economic and Security Review Commission, *2021 Report to Congress* (Washington, DC: November 2021), <https://www.uscc.gov/annual-report/2021-annual-report-congress>.

quality and breadth of capability. The fifth-generation aircraft of the PLA Air Force (PLAAF) suffer from the lack of a suitable domestically produced engine and have, therefore, only been produced in limited numbers. The PLA Navy (PLAN) lacks an adequate fighter for its carriers, and its submarine quieting technology remains immature. Despite recent growth, the sustainability and support capabilities of air-to-air refueling aircraft and amphibious warfare ships are limited. Perhaps most importantly, the PLA's "software" (e.g., training, joint operations, and other human elements) is only beginning to adapt to the requirements of modern high-intensity warfare.¹⁵ PLA leaders are aware of and addressing all the organization's weaknesses, and China watchers expect improvement in virtually all areas over time. Indeed, President Xi Jinping called for improving military readiness in his speech to the National Congress of the Chinese Communist Party in October 2022.¹⁶

However, wars are not decided solely by aggregate or abstract capabilities. Geography generally favors China in the relevant scenarios. Taiwan's coast is about 160 km (100 miles) from the Chinese mainland but more than 8,000 km from Honolulu and 11,000 km from San Diego. Flowing forces into the immediate theater would take far longer for the United States than for China. China also enjoys continental scale and strategic depth across which it can deploy or protect aircraft as battlefield needs dictate. The United States would be limited to a handful of air bases in the Western Pacific.

On the other hand, the United States benefits from maritime strategic depth, with the ability to operate from the more open spaces of the Western Pacific. Chinese naval forces would be more susceptible to detection in the confined seas adjacent to its territory. Perhaps most important, conducting an opposed amphibious assault is a hazardous and unforgiving undertaking under even the best of circumstances.

Taiwan Is the Most Dangerous U.S.-China Flashpoint

Taiwan is widely regarded as the most dangerous potential flashpoint for conflict between the United States and China. In 1949, the nationalist government of China (under the Kuomintang party, or KMT) established an autonomous government on the island after being pushed off the mainland. The Chinese Communist Party (CCP) thus regards Taiwan as a breakaway province with no legitimate claim to autonomy or independence.

Recognizing Beijing as the sole legitimate government of China and severing diplomatic relations with Taipei is a precondition for any country to establish diplomatic relations with China. As leaders and officials in Beijing are fond of repeating, China has never foresworn the use of force against Taiwan. To make the point, China's 2005 Anti-Secession Law outlines the circumstances under which China

15 The transition to theater commands and other reforms adopted in 2015 were designed to improve jointness, but the emphasis on joint operations is quite new and plagued by unresolved issues and cultural barriers. For an assessment of Chinese views of this and other problems in the balance of military capabilities, see Eric Heginbotham, "Chinese Views of the Military Balance in the Western Pacific," China Maritime Studies Institute, China Maritime Report No. 14, June 2021, <https://digital-commons.usnwc.edu/cgi/viewcontent.cgi?article=1013&context=cmsi-maritime-reports>. See also: Michael S. Chase et al., *China's Incomplete Military Transformation: Assessing the Weaknesses of the People's Liberation Army* (Santa Monica, CA: RAND Corporation, 2015), https://www.rand.org/content/dam/rand/pubs/research_reports/RR800/RR893/RAND_RR893.pdf.

16 "Full Text of Xi Jinping's Speech at China's Party Congress," Bloomberg, October 18, 2022, <https://www.bloomberg.com/news/articles/2022-10-18/full-text-of-xi-jinping-s-speech-at-china-20th-party-congress-2022>.

might employ force. A recent white paper by the Chinese Taiwan Affairs Office of the State Council laid out the policy: “We are one China, and Taiwan is part of China. . . . We will work with the greatest sincerity and exert our utmost efforts to achieve peaceful reunification. But we will not renounce the use of force, and we reserve the option of taking all necessary measures.”¹⁷

Xi Jinping’s report to the 20th Party Congress reiterated this policy: “Taiwan is China’s Taiwan. Resolving the Taiwan question is a matter that must be resolved by the Chinese. We will continue to strive for peaceful reunification with the greatest sincerity and the utmost effort, but we will never promise to renounce the use of force, and we reserve the option of taking all measures necessary.”¹⁸

Underlining this increasingly assertive attitude has been a practice of provocative military exercises. China increasingly flies masses of aircraft into the Taiwanese air defense identification zone.¹⁹

While Chinese leaders have said they will not allow reunification to be postponed indefinitely, it is unclear what that means in practice. Much clearer is China’s commitment to demonstrating resolve when unwelcome events appear to move Taiwan further from unification—as China did with missile tests off Taiwan after President Lee Teng-hui visited the United States in June 1995 and recently with the military demonstrations during House Speaker Nancy Pelosi’s visit to Taiwan in the summer of 2022. The linkage of both events to the United States indicates the degree of U.S. involvement.

Taiwan is China’s Taiwan. Resolving the Taiwan question is a matter that must be resolved by the Chinese. . . . we reserve the option of taking all measures necessary.

—Xi Jinping

17 “China releases white paper on Taiwan question, reunification in new era,” Xinhuanet, August 10, 2022, https://english.www.gov.cn/archive/whitepaper/202208/10/content_WS62f34f46c6d02e533532f0ac.html.

18 For recent information related to China’s position on Taiwan, see “(CCP) Congress Full text of resolution on Party Constitution amendment,” Xinhua, October 22, 2022, <https://english.news.cn/20221022/fea670f419d7426ab564a795d5737b52/c.html>; and Xi Jinping, *Report to the 20th National Congress of the Communist Party of China* (Beijing: Ministry of Foreign Affairs of the People’s Republic of China, October 2022), https://www.fmprc.gov.cn/eng/zxxx_662805/202210/t20221025_10791908.html. For a recent assessment of Xi Jinping’s policy toward China, as well as Taiwanese and U.S. responses, see Richard Bush, *Difficult Choices: Taiwan’s Quest for Security and the Good Life* (Washington, DC: Brookings Institute, 2021).

19 For discussion on one such incident in 2021, see Chao Deng and Joyu Wang, “China Flies a Dozen Bombers Near Taiwan, Prompting Protest From Taipei,” *Wall Street Journal*, October 5, 2021, <https://www.wsj.com/articles/china-flies-a-dozen-bombers-near-taiwan-prompting-protest-from-taipei-11633365182>; Colm Quinn, “Why Is China Sending So Many Warplanes Near Taiwan?,” *Foreign Policy*, October 5, 2021, <https://foreignpolicy.com/2021/10/05/china-planes-taiwan-adiz-air-zone/>; and Bonny Lin et al., “Tracking the Fourth Taiwan Strait Crisis,” CSIS, October 13, 2022, <https://chinapower.csis.org/tracking-the-fourth-taiwan-strait-crisis/>.

The United States has maintained a policy of strategic ambiguity to discourage China from attacking Taiwan while also discouraging Taipei from taking actions that might incentivize such an attack.²⁰ This is also called dual deterrence, as it aims to deter China from invading Taiwan and deter Taiwan from declaring independence. In accordance with the Three Communiqués with China, in 1972, 1979, and 1982, and the U.S. “One China” policy, the United States maintains formal diplomatic relations with Beijing, not Taipei. Nevertheless, it nurtures historically deep cultural and economic ties with Taipei. Under the Taiwan Relations Act of 1979, the United States provides weapons that Taiwan needs to defend itself, although the United States has no formal obligation to defend Taiwan directly. A variety of additional agreements, laws, and documents link the countries.²¹

The historical relationship with Taiwan (now formally limited to economic and cultural engagement) creates a perception of obligation among many, a perception enhanced by Taiwan’s transition to vibrant democracy during the 1990s. Recently, President Joe Biden has sent clear deterrence signals to China without formally changing policy. When asked whether the United States was “willing to get involved militarily to defend Taiwan if it comes to that,” President Biden replied, “Yes, that’s the commitment we made.”²² President Biden has made such statements repeatedly.

Some members of Congress, wanting to strengthen U.S. support of Taiwan, have proposed the Taiwan Policy Act, which would provide direct military aid and enhance Taiwan’s diplomatic status. Although the act did not pass, it did show strong congressional support for Taiwan.²³ As evidence of a closer military relationship, reports have emerged that the United States has military planning cells on Taiwan. Although these appear to be limited, they constitute a direct military relationship that has not existed since 1973.²⁴

Balancing these leanings are official statements that U.S. policy has not changed. Indeed, the National Security Strategy reiterated the “One China” policy, as did a State Department statement.²⁵ Further,

20 On the logic and continuity of strategic ambiguity, see Timothy W. Crawford, *Pivotal Deterrence: Third Party Statecraft and the Pursuit of Peace* (Ithaca, NY: Cornell University Press, 2003); and Hoo Tiang Boon and Hannah Elyse Sworn, “Strategic Ambiguity and the Trumpian Approach to China-Taiwan Relations,” *International Affairs* 96, no. 6 (June 2020), doi:10.1093/ia/iiaa160.

21 These include the Six Assurances made to Taiwan in the wake of the Three Communiqués, as well as more recent legislation, such as the Taiwan Travel Act of 2018.

22 Brett Samuels, “Biden: US Would Defend Taiwan Militarily If China Invaded,” *The Hill*, May 23, 2022, <https://thehill.com/homenews/administration/3497693-biden-us-would-defend-taiwan-militarily-if-china-invaded/>.

23 Andrew Desiderio, “U.S.-Taiwan Bill Sails through Senate Panel despite White House Misgivings,” *Politico*, September 14, 2022, <https://www.politico.com/news/2022/09/14/taiwan-bill-clears-senate-panel-00056769>.

24 For a timeline outlining U.S.-Taiwan relations, see “Milestones in Relations between the U.S., China and Taiwan,” *Reuters*, August 2, 2022, <https://www.reuters.com/world/milestones-relations-between-us-china-taiwan-2022-08-02/>; and “Timeline: U.S.-China Relations,” *Council on Foreign Relations*, accessed November 9, 2022, <https://www.cfr.org/timeline/us-china-relations>.

25 “U.S. Relations With Taiwan,” U.S. Department of State, May 28, 2022, <https://www.state.gov/u-s-relations-with-taiwan/>.

there is a range of opinions within the United States on the wisdom of defending Taiwan.²⁶

This project does not take a position about whether the United States would or should become involved militarily in a conflict over Taiwan. It is enough to believe that, under certain conditions, the United States might intervene. An assessment of the outcomes of such an intervention is therefore valuable.

Increasing Worries about an Imminent Chinese Attack

Senior military officials have expressed concerns that China’s military might be preparing a military solution to the “breakaway province” problem—or preparing that capability in case called upon to act. Admiral Philip S. Davidson, commander of Indo-Pacific Command (INDOPACOM) until April 2021, testified that the Chinese threat to invade Taiwan “is manifest . . . in the next six years.”²⁷ Current INDOPACOM commander Admiral John C. Aquilino, when asked for his opinion, stated that “this problem is much closer to us than most think.”²⁸ Other military and civilian officials—for example, Secretary of State Anthony Blinken, Admiral Michael M. Gilday, chief of naval operations, and Admiral Charles Richard, head of Strategic Command—have expressed similar concerns. This is a broad narrative in the national security community.²⁹

Senior military officials have expressed concerns that China’s military might be preparing a military solution to the

- 26 Among those who would oppose direct U.S. intervention are core members of the restraint camp. See, for example, Ted Galen Carpenter, “How Far is the U.S. Willing to Go to Defend Taiwan?,” *Cato Institute, Commentary*, September 22, 2020, <https://www.cato.org/commentary/how-far-us-willing-go-defend-taiwan>. Recently, more mainstream analysts have also joined the discussion. See, for example, Charles L. Glaser, “Washington is Avoiding the Tough Questions on Taiwan and China: The Case for Reconsidering U.S. Commitments in East Asia,” *Foreign Affairs*, April 28, 2021, <https://www.foreignaffairs.com/articles/asia/2021-04-28/washington-avoiding-tough-questions-taiwan-and-china>.
- 27 Mallory Shelbourne, “Davidson: China Could Try to Take Control of Taiwan In ‘Next Six Years,’” *USNI News*, March 9, 2021, <https://news.usni.org/2021/03/09/davidson-china-could-try-to-take-control-of-taiwan-in-next-six-years>.
- 28 David Vergun, “Defense of Taiwan Vital to Regional, National Security, Admiral Says,” *DOD News*, March 23, 2021, <https://www.defense.gov/Explore/News/Article/Article/2547389/defense-of-taiwan-vital-to-regional-national-security-admiral-says/>. These concerns were widely reported at the time, for example, Brad Lebdon, “Chinese Threat to Taiwan Closer Than Most Think,” *CNN*, March 24, 2021, <https://www.cnn.com/2021/03/24/asia/indo-pacific-commander-aquilino-hearing-taiwan-intl-hnk-ml/index.html>.
- 29 Ellen Francis, “China Speeding Up Plans to Seize Taiwan,” *Washington Post*, October 18, 2022, <https://www.washingtonpost.com/world/2022/10/18/china-seize-taiwan-plan-blinken/>; Valerie Insinna, “Navy leader ‘can’t rule out’ Chinese invasion of Taiwan even earlier than 2027,” *Breaking Defense*, October 19, 2022, <https://breakingdefense.com/2022/10/navy-leader-cant-rule-out-chinese-invasion-of-taiwan-even-earlier-than-2027/>; and Oliver Parken and Tyler Rogoway, “Extremely Ominous Warning about China from US Strategic Command Chief,” *The War Zone*, November 6, 2022, <https://www.thedrive.com/the-war-zone/extremely-ominous-warning-about-china-from-us-strategic-command-chief>.

“breakaway province” problem. . . . Others are more cautious . . . The project does not take a position on the likelihood of conflict but recognizes the possibility of conflict.

Civilian writers echo these concerns. Recent articles in the *New York Times*, *Foreign Affairs*, and the defense trade press have highlighted Chinese assertiveness about Taiwan and the risks of a conflict.³⁰

Oriana Skylar Mastro, a Chinese specialist at Stanford University, observed, “In recent months there have been disturbing signs that Beijing is reconsidering its peaceful approach [to Taiwan] and contemplating armed unification. . . . Whereas Chinese leaders used to view a military campaign to take the island as a fantasy, now they consider it a real possibility.”³¹ Lonnie Henley, a retired defense intelligence officer for East Asia at the Defense Intelligence Agency, stated before Congress that, “if the political leadership turned to the [PLA] today and said, can you invade right now, it’s my assessment that the answer would be a firm yes.”³² Robert Blackwill and Philip Zelikow go further: “China is now in a prewar tempo of political and military preparations. We do not mean that we know that China is about to embark on a war. We simply observe that the Chinese government is taking actions that a country would do if it were moving into a prewar mode.”³³ Taiwan itself has entered the debate, with its defense minister saying that China would be able to launch a “full-scale invasion” by 2025.³⁴

Others are more cautious and stress that it is difficult to impute intentions from improving capabilities. General Mark Milley, chairman of the Joint Chiefs of Staff, addressed the statements made by other military leaders: “What Davidson and Aquilino and others have said is that Chinese capability to invade and seize the island of Taiwan is being accelerated to 2027, six years from now. I don’t dismiss that at all.

30 For example, Oriana Skylar Mastro, “The Taiwan Temptation: Why Beijing May Resort to Force,” *Foreign Affairs*, July/August 2021, <https://www.foreignaffairs.com/articles/china/2021-06-03/china-taiwan-war-temptation>; Sarah A. Topol, “Is Taiwan Next?,” *New York Times*, August 4, 2021, <https://www.nytimes.com/2021/08/04/magazine/taiwan-china.html>; Michael Mazza, “Shoot It Straight on Taiwan,” *War on the Rocks*, August 3, 2021, <https://warontherocks.com/2021/08/shoot-it-straight-on-taiwan/>; and Jeff Schogol, “Why the Next War Is Likely to Start in Taiwan,” *Task and Purpose*, August 6, 2021, <https://taskandpurpose.com/news/china-taiwan-next-major-war/>.

31 Mastro, “The Taiwan Temptation.”

32 Lonnie Henley, Hearing before the U.S. China Economic and Security Review Commission on “Deterring the People’s Republic of China Aggression toward Taiwan,” February 18, 2021, <https://www.uscc.gov/hearings/deterring-prc-aggression-toward-taiwan>.

33 Robert Blackwill and Philip Zelikow, *The United States, China, and Taiwan: A Strategy to Prevent War* (New York: Council on Foreign Relations, February 2021), 31, <https://www.cfr.org/report/united-states-china-and-taiwan-strategy-prevent-war>.

34 “Defense Minister Says China Could Launch ‘full-Scale Invasion’ of Taiwan by 2025,” *Taiwan News*, October 6, 2021, <https://www.taiwannews.com.tw/en/news/4307745>.

. . . but I don't see it happening right out of the blue."³⁵ Christopher Johnson, a China scholar at CSIS, was more emphatic, saying that at the 2022 party congress Xi "held fast to the judgment that stability and economic growth continued to be dominant global trends" and that portrayals of Xi as "itching for war" were "overhyped."³⁶ Lonnie Henley qualified his own congressional testimony, writing separately:

I do not think they [the Chinese] will attack Taiwan as long as they believe unification without war remains a viable course of action. They will attack, however, despite the enormous cost and despite any doubts about their own military capabilities, if they judge that peaceful unification is no longer possible, that military force is the only remaining option. That in turn is driven by their assessment of political developments in Taipei and Washington.³⁷

Timothy Heath similarly argues that "There is no evidence that the [Chinese] government is seriously contemplating abandoning its peaceful unification strategy."³⁸

The project does not take a position on the likelihood of conflict but recognizes the possibility of conflict. A CSIS study on surprise in war concluded that "wars happen" despite the dangers, uncertainty, and potential economic ruin.³⁹ Nations miscalculate the military balance, get swept along in a crisis, feel that the balance of power is moving against them, or make national security choices based on domestic politics. As Colin Kahl, DOD undersecretary for policy, said: "I don't think in the next couple of years that they're likely to invade Taiwan, but you never know."⁴⁰ Although there is an ongoing debate about both Chinese capabilities and intentions, China's determination to develop military options for use against Taiwan is widely accepted.⁴¹ A war over Taiwan is not certain, but it is not unimaginable either; for that reason, wargaming such a conflict is important for developing U.S. policy.

35 Joseph Bosco, "Milley adds confusion to America's ambiguity on defending Taiwan," *The Hill*, June 29, 2021, <https://thehill.com/opinion/international/560623-milley-adds-confusion-to-americas-ambiguity-on-defending-taiwan?rl=1>; and Sam LeGrone, "Milley: China Wants Capability to Take Taiwan by 2027, Sees No Near-term Intent to Invade," *USNI News*, June 23, 2021, <https://news.usni.org/2021/06/23/milley-china-wants-capability-to-take-taiwan-by-2027-sees-no-near-term-intent-to-invade>. These concerns were widely reported at the time, for example, Lebdon, "Chinese Threat to Taiwan Closer Than Most Think."

36 Christopher Johnson, "Why China Will Play It Safe: XI Would Prefer Détente – Not War – with America," *Foreign Affairs*, November 14, 2022, <https://www.foreignaffairs.com/china/why-china-will-play-it-safe>.

37 Email exchange between the authors and Lonnie Henley, November 22, 2022.

38 Timothy R. Heath, "Is China Planning to Attack Taiwan? A Careful Consideration of Available Evidence Says No," *War on the Rocks*, December 14, 2022, <https://warontherocks.com/2022/12/is-china-planning-to-attack-taiwan-a-careful-consideration-of-available-evidence-says-no/>.

39 Mark Cancian, *Coping with Surprise in Great Power Conflicts* (Washington, DC: CSIS, 2018), 7, <https://www.csis.org/analysis/coping-surprise-great-power-conflicts>.

40 "The 2022 National Defense Strategy: A Conversation with Colin Kahl," (public event, Brookings Institution, November 4, 2022), <https://www.brookings.edu/events/the-2022-national-defense-strategy-a-conversation-with-colin-kahl/>.

41 For further examples of the debate over future conflict, see Rachel Eslien Odell and Eric Heginbotham, Bonny Lin and David Sacks, Kharis Templeman, and Oriana Skylar Mastro, "Strait of Emergency? Debating Beijing's Threat to Taiwan," *Foreign Affairs*, September/October 2021, <https://www.foreignaffairs.com/articles/china/2021-08-09/strait-emergency>; and Bonny Lin and Joel Wuthnow, "The Weakness Behind China's Strong Façade," *Foreign Affairs*, November 10, 2022, <https://www.foreignaffairs.com/china/weakness-behind-china-strong-facade>.

Parallels and Differences with the War in Ukraine

Russia's invasion of Ukraine has sparked a renewed interest in international conflict. The focus for the last generation has been on gray zone conflict and insurgency. The possibility of one country invading another to acquire territory seemed antiquated. Russia's attack on Ukraine has reminded the world that cross-border invasions are possible. Speculation about a Chinese invasion of Taiwan was inevitable.⁴²

A war over Taiwan is not certain, but it is not unimaginable either; for that reason, wargaming such a conflict is important for developing U.S. policy.

There are clear parallels between the Russian invasion of Ukraine and a possible Chinese attack on Taiwan. Russia and China believe that the target is not a sovereign state but a part of their country and should be reunited. Both are authoritarian (though of very different forms), and the target is democratic. In both cases, the United States and many global partners would support the potential victim.

There are also significant differences, including two that pertain directly to military deterrence. First, the United States has a longer and deeper history with Taiwan. It seems more committed to Taiwan's defense than to that of Ukraine and, as discussed earlier, more likely to intervene directly. Second, the challenge to the Chinese military is much greater. It is harder to cross 160 km of water than to cross a land border, as Russia has done. Moreover, once a landing has begun, there is no going back.

Views about how China sees the war in Ukraine have been highly speculative since China's decisionmaking process is so opaque. Early on, the concern was that Russia's success in Ukraine would embolden China. More recently, Russia's military failure and the strong diplomatic reaction may discourage China. Regardless, the invasion has reminded everyone that irredentist policies are dangerous, that U.S. deterrence might fail, and that countries might do what they say they reserve the right to do.⁴³

42 For an example of such speculation, see Amy Qin and Amy Chang Chien, "As China Rattles Sabers, Taiwan Asks: Are We Ready for War?," *New York Times*, June 13, 2022, <https://www.nytimes.com/2022/06/13/world/asia/china-taiwan-ukraine-military.html>.

43 "'The Big One Is Coming' and the U.S. Military Isn't Ready," *Wall Street Journal*, November 4, 2022, <https://www.wsj.com/articles/the-big-one-is-coming-china-russia-charles-richard-u-s-military-11667597291>. For an example of how the invasion of Ukraine might embolden China, see "Japan Calls for Tough Response on Ukraine, Saying China Is Watching," *Wall Street Journal*, February 15, 2022, <https://www.wsj.com/articles/japan-calls-for-tough-response-on-ukraine-saying-china-is-watching-11644923764>. For an example of how it might restrain China, see Grant Newsham, "Ukraine Invasion: Time for Beijing to Rethink Taiwan," *Japan Forward*, March 3, 2022, <https://japan-forward.com/ukraine-invasion-time-for-beijing-to-rethink-taiwan/>. For a discussion on limitations of drawing parallels between Ukraine and Taiwan, see "China Is Not Russia; Taiwan Is Not Ukraine," *The Diplomat*, July 25, 2022, <https://thediplomat.com/2022/07/china-is-not-russia-taiwan-is-not-ukraine/>.

Limitations of Currently Available Models, Assessments, and Wargames

Although there is a building sense of crisis about the Taiwan Strait, the ability of Chinese forces to achieve operational objectives has not been adequately studied in the public domain. Previous analyses largely include unclassified models focusing on one aspect of an invasion, seminar-type games that educate players but do not provide an adequate analytic foundation for policy recommendations, political-military games that primarily investigate diplomatic and political issues, or classified wargames whose assumptions and even results are not transparent to the public. All of these analytical efforts have value, but none can answer the central question of this project: can China conquer Taiwan in a military invasion?

Views about how China sees the war in Ukraine have been highly speculative since China’s decisionmaking process is so opaque. . . . Regardless, the invasion has reminded everyone that irredentist policies are dangerous, that U.S. deterrence might fail, and that countries might do what they say they reserve the right to do.

Existing Unclassified Analyses and Assessments

Scholars of military affairs and China have conducted several analyses and assessments that have contributed to understanding the military balance. These efforts have been invaluable resources for developing the project’s wargame. However, they do not purport to convert the data or insights into a wargame that would provide operational insights in a dynamic environment.

- Michael O’Hanlon of the Brookings Institution and a long-time military analyst produced an assessment of China’s prospects for invasion in 2000. The assessment was detailed and analytical, concluding that an invasion was not possible at that time. However, as detailed above, much has changed in recent decades.⁴⁴
- Ian Easton’s 2019 book on the subject, *The Chinese Invasion Threat*, contains detailed information about geography and orders of battle but does not convert those into a model or wargame.⁴⁵
- Michael A. Glosny (2004), Bradley Martin et al. (2022), and O’Hanlon (2022) looked at a Chinese

44 Michael O’Hanlon, “Why China Cannot Conquer Taiwan,” *International Security* 25, no. 2 (2000): 51–86, <https://www.jstor.org/stable/2626753>.

45 Ian Easton, *The Chinese Invasion Threat: Taiwan’s Defense and American Strategy in Asia* (Eastbridge Books, 2019).

blockade of Taiwan rather than an amphibious invasion.⁴⁶

- Stephen Biddle and Ivan Oelrich (2016) argue that surface ships will not be able to survive within 400 to 600 km of hostile coasts due to advances in A2/AD, but they do not go on to model an invasion of Taiwan.⁴⁷
- The U.S.-China Military Scorecard (2015), published by RAND, assessed many elements of a potential invasion over time and in depth, though without aggregating them into a unified analysis. One of its conclusions was the need for a wargame: “Perhaps the most direct follow-on to this study would be the creation of a unified model to assess the interrelationships between the different scorecards.”⁴⁸

WARGAMES

Several organizations have conducted wargames that examine a possible U.S.-China conflict over Taiwan. However, their focus has been on escalation dynamics and politics rather than analysis of military operational outcomes.

In May 2022, the Center for a New American Security (CNAS) worked with NBC’s Meet the Press to broadcast a wargame on a notational 2027 Chinese invasion of Taiwan and, in June, published a corresponding report, *Dangerous Straits*.⁴⁹ These provided compelling and insightful examinations of the political and military issues related to such a conflict, especially prewar deterrence, alliance management, nuclear signaling, political messaging, and escalation management. However, these games were not focused on operational outcomes. Furthermore, the structure of the CNAS game restricted the exercise to a single iteration with a single set of assumptions and a single set of players.

CNAS conducted another game, described in a report, entitled *The Poison Frog Strategy*, developed from an earlier game exploring a Chinese seizure of Pratas Island/Dongsha Atoll and its international fallout.⁵⁰ A game sponsored by Germany’s Körber Foundation, in cooperation with the United Kingdom’s Chatham House, examined the potential European response to a Chinese invasion of

46 Michael A. Glosny, “Strangulation from the Sea? A PRC Submarine Blockade of Taiwan,” *International Security* 28, no. 4 (April 2004): 125–60, doi:10.1162/0162288041588269; Bradley Martin et al., *Implications of a Coercive Quarantine of Taiwan by the People’s Republic of China* (Santa Monica, CA: RAND Corporation, May 2022), https://www.rand.org/pubs/research_reports/RR1279-1.html; and Michael E. O’Hanlon, *Can China Take Taiwan? Why No One Really Knows* (Washington, DC: Brookings, August 2022), <https://www.brookings.edu/research/can-china-take-taiwan-why-no-one-really-knows/>.

47 Discussion of Taiwan is in particular on pages 13–14. Stephen Biddle and Ivan Oelrich, “Future Warfare in the Western Pacific: Chinese Antiaccess/Area Denial, U.S. AirSea Battle, and Command of the Commons in East Asia,” *International Security* 41 (July 1, 2016): 7–48, particularly 13–14, doi:10.1162/ISEC_a_00249.

48 Eric Heginbotham et al., *The U.S.-China Military Scorecard: Forces, Geography, and the Evolving Balance of Power, 1996–2017* (Santa Monica, CA: RAND Corporation, 2015), 354, https://www.rand.org/pubs/research_reports/RR392.html.

49 Stacie Pettyjohn, Becca Wasser, and Chris Doherty, *Dangerous Straits: Wargaming a Future Conflict over Taiwan* (Washington, DC: Center for a New American Security, June 2022), <https://www.cnas.org/publications/reports/dangerous-straits-wargaming-a-future-conflict-over-taiwan>; and “Wargames: The Battle for Taiwan,” YouTube video, posted by NBC News, May 13, 2022, 26:54, <https://www.youtube.com/watch?v=qYfvm-JLhPQ>.

50 Chris Dougherty, Jennie Mutuschak, and Ripley Hunter, *The Poison Frog Strategy* (Washington, DC: Center For New American Security, October 2021), <https://www.cnas.org/publications/reports/the-poison-frog-strategy>.

Taiwan. The two games—CNAS and Körber—were similar in that they were single-instance seminar games that focused heavily on political issues.

Reuters published an investigative report that was termed a wargame. The report presented several policy and governmental scenarios to describe possible escalatory paths for China and Taiwan.⁵¹ While this report was not a game in the customary sense, it did present several plausible scenarios based on expert opinions and illustrated its findings with excellent graphics. The report was also a good example of how broadly the term “wargame” is used.

All of these games provided useful policy insights. However, wargames specifically about military operational outcomes are needed as a complement. Unfortunately, all such wargames hitherto have been in the classified realm.

Lack of Transparency from Classified Wargames

The DOD has done much internal wargaming on a U.S.-China conflict, but the results are classified, with only a few details leaking out. These details hint at heavy casualties and unfavorable outcomes.⁵²

For example, in a widely cited commentary, David Ochmanek, a senior RAND analyst, noted, “In our games, when we fight Russia and China, [the United States] gets its ass handed to it.”⁵³ Michele Flournoy, former undersecretary of defense for policy, similarly stated, “The Pentagon’s own war games reportedly show that current force plans would leave the military unable to deter and defeat Chinese aggression in the future.”⁵⁴ Another report noted that a “secret wargame” showed that the United States could prevail in the conflict with China, but at the risk of causing nuclear escalation.⁵⁵

51 David Legue and Maryanne Murray, “T-Day: The Battle for Taiwan,” Reuters, November 5, 2021, <https://www.reuters.com/investigates/special-report/taiwan-china-wargames/>. This work also cited *The Poison Frog Strategy*.

52 Tara Copp, “‘It Failed Miserably’: After Wargaming Loss, Joint Chiefs Are Overhauling How the US Military Will Fight,” *Defense One*, July 26, 2021, <https://www.defenseone.com/policy/2021/07/it-failed-miserably-after-wargaming-loss-joint-chiefs-are-overhauling-how-us-military-will-fight/184050/>; Brett Tingley, “Joint Chiefs Seek A New Warfighting Paradigm After Devastating Losses In Classified Wargames,” *The Drive*, July 27, 2021, <https://www.thedrive.com/the-war-zone/41712/joint-chiefs-seek-a-new-warfighting-paradigm-after-devastating-losses-in-classified-wargames>; and John Vandiver, “US Military Vulnerabilities Exposed During Classified Wargame, Top General Says,” *Stars and Stripes*, July 27, 2021, <https://www.stripes.com/theaters/us/2021-07-27/US-China-military-war-game-hyten-2326077.html>.

53 Sydney J. Freedberg. “US ‘Gets Its Ass Handed to It’ In Wargames: Here’s A \$24 Billion Fix,” *Breaking Defense*, March 7, 2019, <https://breakingdefense.com/2019/03/us-gets-its-ass-handed-to-it-in-wargames-heres-a-24-billion-fix/>.

54 Michele Flournoy, “America’s Military Risks Losing Its Edge,” *Foreign Affairs*, April 20, 2021, <https://www.foreignaffairs.com/articles/united-states/2021-04-20/flournoy-americas-military-risks-losing-its-edge>.

55 Lauren Thompson, “Why the Air Force’s Plan for Fighting China Could Make Nuclear War More Likely,” *Forbes*, June 15, 2021, <https://www.forbes.com/sites/lorenthompson/2021/06/15/why-the-air-forces-plan-for-fighting-china-could-make-nuclear-war-more-likely>. Other commentaries have touched on the same issue, for example, Edward Geist, “Defeat Is Possible,” *War on the Rocks*, June 17, 2021, <https://warontherocks.com/2021/06/defeat-is-possible/>. The 2018 National Defense Strategy Commission raised similar concerns. Unclear is whether these commentaries are providing additional information about wargames or pointing back to the handful of reports that have filtered out.

Regarding another wargame, General John E. Hyten, then-vice chairman of the Joint Chiefs of Staff, said, “[The U.S. warfighting concept] failed miserably. An aggressive China team that had been studying the United States for the last 20 years just ran rings around us.” This happened, at least in part, because “the blue team lost access to its networks almost immediately.”⁵⁶ Unclear was what sort of cyberattack caused this loss of capability or what the China team did to “run circles” around the U.S. team.

In March 2021, Lieutenant General S. Clinton Hinote, the deputy chief of staff, strategy, integration, and requirements, headquarters, said that for over a decade, U.S. Air Force wargames had indicated that the Chinese were investing in military capabilities that would make the Air Force’s preferred model of expeditionary warfare “increasingly difficult.”⁵⁷ “The trend in our wargames was not just that we were losing, but we were losing faster,” he said. He told reporters, “The definitive answer if the U.S. military doesn’t change course is that we’re going to lose fast. In that case, an American president would likely be presented with almost a *fait accompli*.”⁵⁸

As these examples indicate, these hints from the classified world do not specify the parameters of the games, including basic information such as when the war occurs, or the conditions and assumptions incorporated into the game. Many DOD wargames are set far in the future—not infrequently 20 years in the future—to grapple with future acquisition questions that often play out over decades. References to losses or challenges may not refer to operational outcomes, such as which side achieved its objectives.

This is not surprising since those wargames are classified, and the restrictions are intended to keep sensitive data from potential adversaries. However, restrictions on describing game parameters make it impossible for outsiders to judge why the outcomes occurred, whether the game assumptions were reasonable, and whether alternative assumptions might produce different outcomes. Further, many of the reported results appear self-serving, as they support programs favored by the wargaming agency. Classified wargames also often focus on challenging cases, even if those cases are not particularly likely, to test the limits of the U.S. military.

Without transparency and independent assessment of the assumptions, it is impossible to judge a game’s credibility.

The Need for a Wargame Examining Operational Outcomes

This project fills a void in the literature by providing an unclassified analysis of operational outcomes if China attempted to invade Taiwan. This is important for three reasons.

56 Copp, “‘It Failed Miserably’: After Wargaming Loss, Joint Chiefs Are Overhauling How the US Military Will Fight.”

57 James Kitfield, “‘We’re Going to Lose Fast’: U.S. Air Force Held a Wargame That Started with a Chinese Biological Attack,” Yahoo News, March 10, 2021, <https://news.yahoo.com/were-going-to-lose-fast-us-air-force-held-a-war-game-that-started-with-a-chinese-biological-attack-170003936.html>. See also, John A. Tirpak, “Wargame Ends Better with ‘Trans – Domain ‘Moves Plugged in, Hinote Says,” *Air and Space Forces Magazine*, September 28, 2022, <https://www.airandspaceforces.com/wargame-ends-better-with-trans-domain-moves-plugged-in-hinote-says>.

58 Kitfield, “‘We’re Going to Lose Fast’: U.S. Air Force Held a Wargame That Started with a Chinese Biological Attack.”

First, there is disagreement about whether a defense of Taiwan could be successful. Any policy discussion must begin with baseline assumptions and resulting outcomes against which to measure change. The nature of the policy discussion depends heavily on the baseline. If China can take Taiwan in a day, that produces a different discussion than if Taiwan can hold out for weeks while the United States and its partners deploy forces.

Second, by examining a wide variety of scenarios, the project can provide insights into the most important conditions for success.

Finally, the project provides the necessary descriptions and data for the broader national security community to discuss these critical issues of war and peace, deterrence, and national commitment. The Pentagon's classified wargames do not help this broader discussion. Decisions relating to the defense of Taiwan are not just technical but involve judgments about values, priorities, and trade-offs. This project facilitates that discussion.

This project fills a void in the literature by providing an unclassified analysis of operational outcomes if China attempted to invade Taiwan.

What the Project Does Not Do

Because the project assesses the prospects of a Chinese military invasion of Taiwan, it does not investigate other strategies that might be attractive. For example, China might blockade Taiwan and try to achieve its goals without an amphibious assault and all the attendant risks.⁵⁹ Similarly, the United States might avoid a direct military confrontation but instead blockade China, intending the long-term pain to force the Chinese government to relinquish its gains. In some instances, the players might want to use nuclear weapons.

China might bombard Taiwan for an extended period before launching an attack. This would allow China to isolate Taiwan, grind down Taiwan's air and naval forces, and assemble a fleet of merchant ships to act as decoys and "missile sponges" in an attack. The historical analogy would be German air attacks on Great Britain in the summer of 1940. Even though the ocean barrier was narrow, Germany

59 For an argument in favor of blockade as China's preferred strategy, see, for example, Charles Hutzler, "China Drills around Taiwan Give Hints about Its Strategy," *Wall Street Journal*, August 4, 2022, <https://www.wsj.com/articles/chinas-drills-around-taiwan-give-hint-about-its-strategy-11659633265>.

recognized that risks were great if opposing air and naval assets still operated.⁶⁰

Each alternative approach has strengths and weaknesses. All entail less military risk and might be more attractive to a cautious Chinese leadership. The project does not take a position on what action is most likely. Indeed, there is no certainty that China will undertake any military action at all. However, invasion is the most dangerous threat to Taiwan and is thus the first course of action that needs to be analyzed, hence the relevance and importance of the current project.

The teams play as military command authorities rather than civilian commanders in chief. Thus, there is no political and nuclear decisionmaking within each game iteration by the teams. However, varying the structure of scenarios allows analysis of some alternative approaches in these areas. (The variables are discussed in detail in Chapter 5). For example, in some scenarios, concerns about nuclear escalation led to rules of engagement prohibiting the United States from attacking the Chinese mainland.

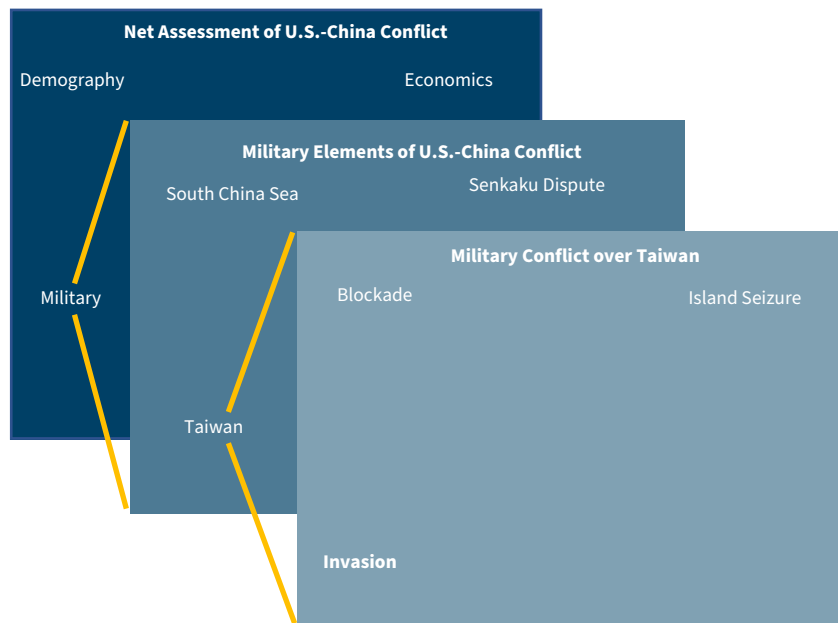
Finally, the project does not make recommendations about U.S. Taiwan policy. This project assessed the potential costs of maintaining Taiwan's autonomy but does not examine the benefits. Many commentators note the moral value of preserving a democracy of 23 million people and that a China-controlled Taiwan would complicate the defense of regional allies, including Japan and South Korea. An evaluation of U.S. policy requires an assessment of benefits and costs that is beyond the scope of this project.

60 In the Chinese literature on military campaigns, joint firepower strike campaigns (联合火力打击战役) can be employed independently or as part of landing, blockade, or other type of campaign. The goal is to strike key points (e.g., adversary air bases or C2) in order to isolate the battle area. See, for example, Ian Easton, "China's Top Five War Plans," Project 2049 Institute, January 2019, https://project2049.net/wp-content/uploads/2019/01/Chinas-Top-Five-War-Plans_Ian_Easton_Project2049.pdf; and Roger Cliff et al., *Shaking the Heavens and Splitting the Earth: Chinese Air Force Employment Concepts in the 21st Century* (Santa Monica, CA: RAND Corporation, 2011), <https://www.rand.org/pubs/monographs/MG915.html>.

The graphic below shows how the current analysis fits into a broader assessment of U.S.-Chinese relations. It is an important element but only one aspect of such an assessment.

The project does not make recommendations about U.S. Taiwan policy. . . . [Such an] evaluation of U.S. policy requires an assessment of benefits and costs that is beyond the scope of this project.

Figure 1: How an Assessment of a Possible Invasion Fits into a Broader Net Assessment of U.S.-Chinese Competition



Source: CSIS.

Wargaming as a Method

The project sought to produce a wargame that was transparent and analytically sound, such that decisionmakers and the public could use it to make decisions about policy. This chapter discusses the design decisions intended to produce such a game. A list of relevant terms and their definitions is in Appendix B, which details relevant wargaming lexicon.

When analyzing military affairs, there has been a historical tension between quantitative modeling and qualitative judgments. Wargaming offers one tool to combine these two approaches. For a wargame aimed at analysis (instead of participant education or other purposes), quantitative models provide the best tools to base adjudications on because of their transparency and rigor. The decisionmaking of players adds human judgment to the interaction of these quantitative models, allowing for plausible sequences of events to be explored. To aggregate models and human decisionmaking in a structured way that addresses uncertain assumptions, analytic wargames should be varied and iterated. The results of a series of wargames thus constructed offer insights into the distribution of outcomes for a future conflict and how key variables impact this distribution. While it is not predictive, it provides data on plausible outcomes and facilitates informed analysis.

Quantitative Models vs. Qualitative Judgments

The first decision in beginning an assessment of a hypothetical future conflict is whether to use quantitative models, qualitative judgments, or some combination of the two. To assess the complex set of operations that would constitute an invasion of Taiwan, wargaming offers a good mix of rigor and transparency.

Any attempt to analyze the future relies on judgments about uncertainty. This is especially true for warfare, which is chaotic and contingent on chance. For example, although there have been amphibious landings before, they are too few to generate quantitative models allowing for statistical confidence. Even issues of weapon performance, which should be the most amenable to analysis based on testing and modeling, require some judgment because such testing is conducted under peacetime conditions; there is, for example, no real-world data on the performance of a Chinese YJ-12 anti-ship cruise missile against an Arleigh Burke-class destroyer. This uncertainty is only magnified when trying to appraise key factors such as the relative morale and training of forces. Every analysis of future war must therefore approach the problem with humility.

Uncertainty aside, there are more basic analytic faults or pitfalls to be avoided. First are physically impossible faults: a prediction about a U.S.-China war that has 30 Ford-class carriers in the 2026 U.S. order of battle (OOB) is not factual. Second are faults that are physically possible but that overlook operational history, such as by having all 11 Ford-class carriers show up in a U.S.-China war without factoring some of them being in deep maintenance. While it is physically possible for the United States to have all 11 Ford-class carriers ready, such an analysis is less plausible than an analysis that accounts for historical factors, such as maintenance cycles and operational readiness. Most reasonable analytic disagreements occur in this space. Third is inflexibility about variation in assumptions: for example, ignoring the amount of warning available to the United States would miss important variation in how many carriers show up, where, and when. Any analysis based on one model or wargame would have difficulty addressing this problem. Fourth, analysis might restrict variables to quantifiable factors without exploring human decisionmaking: a model that has all carriers charge into the fight without concern for losses or changing tactics would ignore the human decisionmaking critical in warfare. Finally, analysis that is not transparent is impossible to dissect and debate. When considering methods of analysis and comparing them, all these factors must be considered.

One of the most basic ways in which future conflicts are analyzed involves unstructured or loosely structured judgments. Unstructured judgments usually refer to sources about the relative strength of the concerned militaries and postulate a course of events, possibly based on analogy to an episode from military history. Loosely structured judgments may follow from simple quantitative comparisons (e.g., the total size of the contending militaries or the number of combat aircraft) that lack a structured assessment of how forces might interact dynamically over relevant time and space. While such judgments are easy to make, they allow little basis for discussion and lack replicability. When one person's judgment conflicts with another's, there is little ground for resolution. This leads to the requirement for methods of structured judgment.

Methods of structured judgment, such as net assessment or the mission planning process, are helpful because they ensure that critical variables are not overlooked, and they allow for debate and scrutiny. For mission planning, junior officers in the U.S. Army and Marine Corps are taught the METT-TC mnemonic (Mission, Enemy, Terrain, Troops, Time, Civilians) to avoid forgetting critical factors. There are many similar and more complicated planning processes across the services that all aim to structure judgment about a military situation. Net assessment, although usually used for strategic and longer-term evaluations, represents another methodology that is less rigid than military mission planning but still structured. For example, Eliot Cohen describes net assessment as “the appraisal of military

balances” that operates through examining five critical questions.⁶¹ Cohen contrasts net assessment with quantitatively oriented methods of analysis.

Military forces can also be analyzed with quantitative models. A model is “a mathematical or otherwise logically rigorous representation of a system or a system’s behavior.”⁶² While even loosely structured judgments may use numbers to support their argument, modeling adds rigor and transparency to these numbers and their interactions. Former secretary of defense Robert McNamara formalized the use of systems analysis in the DOD, principally to better inform the acquisitions process.⁶³ During the Cold War, unified models (e.g., TACWAR and CEM) were developed to assess entire theater campaigns.⁶⁴ These employed representations of ground attrition and movement, supplemented by simple calculations about the support provided by airpower.⁶⁵ Some current campaign models (for example, JICM and STORM) incorporate sophisticated interactions and can employ imposing wills. However, all their results are classified and only run once, thus rendering them unsuitable for public discussion and sensitivity analysis.

While modeling of future conflicts can be done under the umbrella of systems analysis, in the scholarly community it is usually conducted in the framework of campaign analysis. Campaign analysis is “a method that involves the use of a model and techniques for managing uncertainty to answer questions about military operations.”⁶⁶ While campaign analysis has been practiced by many scholars over the last several decades, it has recently been formalized by Rachel Tecott and Andrew Halterman.⁶⁷ The essence of campaign analysis is specifying a scenario, building a model based on

61 Eliot Cohen, “Net Assessment: An American Approach,” Jaffee Center for Strategic Studies, April 1990, 4, 10, <https://www.inss.org.il/publication/net-assessment-an-american-approach/>.

62 Paul K. Davis and Donald Blumenthal, *The Base of Sand Problem: A White Paper on the State of Military Combat Modeling* (Arlington, VA: Defense Advanced Research Projects Agency, 1991), 1, <https://apps.dtic.mil/sti/citations/ADA255880>.

63 Stephen Rosen, “Systems Analysis and the Quest for Rational Defense,” *Public Interest* no. 76 (Summer 1984): 3, <https://www.proquest.com/scholarly-journals/systems-analysis-quest-rational-defense/docview/59916060/se-2>.

64 TACWAR and CEM (Concepts Evaluation Model) were both theater-level combat simulation models developed originally in the 1970s and used into the 1990s. TACWAR was developed by the Institute for Defense Analyses, and CEM was developed by the Center for Army Analysis. These were two-sided models that used the Lanchester’s laws to calculate attrition.

65 See, for example, Barry Posen, “Measuring the European Conventional Balance: Coping with Complexity in Threat Assessment,” *International Security* 9, no. 3 (Winter 1984/85), 47–88, doi:10.2307/2538587; and Joshua M. Epstein, *Strategy and Force Planning: The Case of the Persian Gulf* (Washington, DC: Brookings Institution, 1987).

66 Rachel Tecott and Andrew Halterman, “The Case for Campaign Analysis: A Method for Studying Military Operations,” *International Security* 45, no. 4 (Spring 2021), 9, doi:10.1162/isec_a_00408.

67 John J. Mearsheimer, “Why the Soviets Can’t Win Quickly in Central Europe,” *International Security* 7, no. 1 (1982): 3–39, doi:10.2307/2538686; Joshua M. Epstein, *Measuring Military Power: The Soviet Air Threat to Europe* (Princeton, NJ: Princeton University Press, 1984); Barry R. Posen, “Measuring the European Conventional Balance: Coping with Complexity in Threat Assessment,” *International Security* 9, no. 3 (1984): 47–88, doi:10.2307/2538587; Joshua M. Epstein, “Dynamic Analysis and the Conventional Balance in Europe,” *International Security* 12, no. 4 (1988): 154–165, doi:10.2307/2538999; and Barry R. Posen, “Is NATO Decisively Outnumbered?,” *International Security* 12, no. 4 (1988): 186–202, doi:10.2307/2539002.

historical data, running that model, and analyzing the model for sensitivity to variation. Campaign analysis is particularly suited to studying questions of sufficiency, such as the adequacy of certain force postures to succeed in a particular military operation.⁶⁸

More broadly, this difficulty contributed to debate between Cohen, who supported a broader framework of net assessment to address these and other uncertainties, and John Mearsheimer and Barry Posen, who supported using campaign analysis to evaluate specific operations analysis.⁶⁹ Ideally, conflict analysis would combine the rigor and transparency of campaign analysis with human decisionmaking. One way to do this is with wargaming.

Different Wargames for Different Purposes

While wargaming has a long history, its relationship to analysis and military decisionmaking is still unsettled. Wargames are increasingly used as pedagogic and research tools at universities, think tanks, and government agencies to examine security questions from crisis stability to regional conflicts.⁷⁰

Despite calls to increase the use of wargaming in policy analysis, it is often unclear what such usage should look like and how it best aids the national security debate.⁷¹

The current debate on the utility of wargames centers around their purpose. Experimental wargames aim to better understand human decisionmaking in a specific context. Educational wargames aim to foster decisionmaking simulations for military and political elites. Finally, analytic wargaming aims to analyze a military problem to better inform policy. Each of these represents a path that this project might have followed.

Experimental wargaming aims to aid political scientists in the study of decisionmaking processes, particularly in international relations. Political science's emphasis on experimentation and the desire to understand the micro-level processes of international wargames have led to the exploration of

68 Charles L. Glaser and Chaim Kaufmann, "What Is the Offense-Defense Balance and Can We Measure It?" *International Security* 22, no. 4 (1998): 75, doi:10.2307/2539240.

69 For the debate, see Eliot A. Cohen, "Toward Better Net Assessment: Rethinking the European Conventional Balance," *International Security* 13, no. 1 (1988): 50–89, doi:10.2307/2538896; and the response by Mearsheimer, Posen, and Cohen, John J. Mearsheimer, Barry R. Posen, and Eliot A. Cohen, "Reassessing Net Assessment," *International Security* 13, no. 4 (1989): 128–79, <https://www.jstor.org/stable/2538782>.

70 A host of new wargaming organizations have been established at universities, including: Georgetown University Wargaming Society (established 2020); MIT Wargaming Working Group (established at the MIT Center for International Studies, 2019); King's College Wargaming Network (established within the School of Security Studies, 2018); and the SAIS Wargaming Club.

71 War on the Rocks. "Revitalizing Wargaming Is Necessary to Be Prepared for Future Wars," December 8, 2015. <https://warontherocks.com/2015/12/revitalizing-wargaming-is-necessary-to-be-prepared-for-future-wars/>; Reddie, Andrew W., Bethany L. Goldblum, Kiran Lakkaraju, Jason Reinhardt, Michael Nacht, and Laura Epifanovskaya. "Next-Generation Wargames." *Science* 362, no. 6421 (December 21, 2018): 1362–64. <https://doi.org/10.1126/science.aav2135>; Hirst, Aggie. "States of Play: Evaluating the Renaissance in US Military Wargaming." *Critical Military Studies* 0, no. 0 (January 9, 2020): 1–21. <https://doi.org/10.1080/23337486.2019.1707497>.

experimental wargaming.⁷² For example, Erik Lin-Greenberg conducted a series of wargames while varying whether a drone or a manned aircraft were shot down and, if a manned aircraft were shot down, what happened to the pilot.⁷³ By manipulating a key variable and recording the discussions that ensued, the experimental wargame shed light on the ways that losses of drones might affect escalation risk differently than the losses of manned aircraft.

Educational wargaming aims to prepare leaders for decisionmaking in war. In the words of Peter Perla, “The choice of the best weapons and the men who will skillfully employ them is a major concern for the military and the nation. Wargames and wargaming are important tools for helping to sort through such choices.”⁷⁴ In another formulation, Perla and McGrady write that wargaming’s strength is “its ability to enable individual participants to transform themselves by making them more open to internalizing their experiences in a game.”⁷⁵ Francis J. McHugh argued for a subdivision between wargames that provide military commanders with decisionmaking experience and those that provide decisionmaking information.⁷⁶ For example, playing a game about Napoleonic warfare might give contemporary military commanders decisionmaking experience, without giving them decisionmaking information about the war that they might have to fight in the future. Educational wargaming might therefore be subdivided into “experiential,” focusing on providing decisionmaking experience, and “current operations-oriented” games that focus on decisionmaking information.⁷⁷ Regardless, educational wargames broadly favor the development of players over the use of wargames as analytic tools.

Finally, analytic wargames exist to provide data about a specific problem that can be analyzed. Jon Compton has been the main proponent of this approach, calling for wargamers to take analytical ownership of national security problems.⁷⁸ To do this, he argues for an analytic architecture that builds models based on evidence, which then feed into a wargame design that is vetted by subject matter experts; this game is then played iteratively by a small group of people to facilitate analysis.⁷⁹ The use of quantitative models (in the sense of those used in campaign analysis) in wargames has not been a

72 The best definition and discussion of methodology for experimental wargaming appears in Erik Lin-Greenberg, Reid B.C. Pauly, and Jacquelyn G. Schneider, “Wargaming for International Relations Research,” *European Journal of International Relations* 28, no. 1 (March 1, 2022): 83–109, doi:10.1177/135406612111064090.

73 Erik Lin-Greenberg, “Wargame of Drones: Remotely Piloted Aircraft and Crisis Escalation,” *Journal of Conflict Resolution* 66, no. 10 (June 2022), doi:10.1177/00220027221106960.

74 Peter Perla, *Peter Perla’s The Art of Wargaming: A Guide for Professionals and Hobbyists*, Ed. John Curry (lulu.com Second Edition, 2012), 21.

75 Peter P. Perla, and ED McGrady, “Why Wargaming Works,” *Naval War College Review* 64, no. 3 (2011): 112.

76 Francis J. McHugh, *U.S. Navy Fundamentals of Wargaming* (New York: Skyhorse, 2013).

77 This distinction is also made in the U.S. Naval War College’s Wargaming Handbook. See: Shawn Burns ed., *Wargamers’ Handbook: A Guide for Professional Wargamers* (Newport, RI: United States Naval War College Wargaming Department, 2022), 4, <https://apps.dtic.mil/sti/pdfs/AD1001766.pdf>.

78 Jon Compton, “The Obstacles on the Road to Better Analytical Wargaming,” *War on the Rocks*, October 9, 2019, <https://warontherocks.com/2019/10/the-obstacles-on-the-road-to-better-analytical-wargaming/>.

79 “What Is Analytical Wargaming with Jon Compton,” YouTube video, posted by Georgetown University Wargaming Society, September 25, 2020, 1:36:11, <https://www.youtube.com/watch?v=M-sENrcBPJY>.

feature of many DOD wargames, causing some debate within the DOD wargaming community.⁸⁰

The crux of contemporary debate on wargaming centers on whether educational wargames are more helpful than analytic wargames for the national security enterprise. While both sides decry wargames that are a “bunch of guys sitting around a table,” they disagree on how to move forward.⁸¹ Perla advanced the idea of a “cycle of research” that integrates wargaming, analysis, and military exercises to illuminate the decisions, data, and actions relevant to contemporary warfighting.⁸² That is, wargames raise questions which are then to be explored through military exercises and mathematical analysis. Perla and co-authors reiterated the belief that wargaming could not take analytical ownership of a problem but that it should be mutually constitutive with exercises and analysis in informing policymakers, who would themselves own the problem.⁸³ In line with Perla, McGrady argues that wargames function best as a storytelling device and not as a method of analysis.⁸⁴ In riposte, Compton has written a fictional juxtaposition of his method with seminar-style educational wargaming.⁸⁵

In the view of this report’s authors, different wargame purposes are not better or worse than others; the problem arises when a wargame is designed for one purpose but employed for another. When a wargame is designed to educate participants but is used as a basis of analysis, it results in wasted effort and faulty conclusions. The debate is not entirely a matter of misperception; some wargamers believe that wargames cannot serve certain purposes. Despite these disagreements, all agree that aligning the structure of a wargame to the purpose of a project is a key step in any wargaming effort.

Principles of Analytic Wargaming

The purpose of this project—to analyze the dynamics of a conventional invasion of Taiwan by China—led CSIS’s efforts to follow Compton’s analytical wargaming approach. The project does not purport to predict the future with certainty. However, the large number of game iterations, the variation of scenarios, and the adjudication based on evidence-based rules mean that policymakers and the public can reasonably use the range of outputs for making judgments about warfighting dynamics and policy choices.

80 For example, see Peter Pellegrino explaining that he uses models to refer to how he gets players to interact with the wargame, rather than a quantitative representation of reality. “Pellegrino: Modeling and Games,” YouTube video, posted by PAXsims, September 11, 2020, 2:03:50, <https://www.youtube.com/watch?v=vNYPH0HBh3U>. This is not to say that his approach is not correct or helpful, but as discussed below, it does not suit the purpose of this project.

81 Peter Perla, “Now Hear This - Improving Wargaming Is Worthwhile—and Smart,” U.S. Naval Institute, January 1, 2016, <https://www.usni.org/magazines/proceedings/2016/january/now-hear-improving-wargaming-worthwhile-and-smart>.

82 Perla, Peter Perla’s *The Art of Wargaming*, 252

83 Peter Perla et al., “Rolling the Iron Dice: From Analytical Wargaming to the Cycle of Research,” War on the Rocks, October 21, 2019, <https://warontherocks.com/2019/10/rolling-the-iron-dice-from-analytical-wargaming-to-the-cycle-of-research/>.

84 Ed McGrady, “Getting the Story Right about Wargaming,” War on the Rocks, November 8, 2019, <https://warontherocks.com/2019/11/getting-the-story-right-about-wargaming/>.

85 Jon Compton, “A Tale of Two Wargames: An Entirely Fictitious Tale of Wargaming Woe and Tragedy,” War on the Rocks, September 22, 2022, <https://warontherocks.com/2022/09/a-tale-of-two-wargames-an-entirely-fictitious-tale-of-wargaming-woe-and-tragedy/>.

Integrating methods of campaign analysis with Compton's suggestions for analytic wargaming, this wargame:

- Used a variety of methods to create evidence-based models that determined adjudication;
- Integrated several models across domains to examine a campaign;
- Conducted many iterations with varied strategies by both sides;
- Varied key assumptions to examine their impacts on the outcome;
- Used players to account for human decisionmaking, explore many plausible pathways, and to inject variation into scenario outcomes; and
- Nested the wargame in broader analysis.

Using the Method of History and the Method of P_k s to Create Evidence-based Rules

The most important factor in making an analytic wargame generate plausible outcomes is for the rules to be based on empirical data. The rules of educational wargames do not have to conform to reality in order to teach students about strategy. However, rules are how analytic wargames model reality. As mentioned above, it is impossible for the rules to be entirely certain because of the paucity of real-life cases of twenty-first century warfare. However, wargames based on rigorous modeling that recognizes physical constraints and operational realities will generate analytically valid insights.

There are two broad approaches to creating models: the method of history and the method of P_k s. This project used both.

The method of history models the results of future military operations by making analogies with past military operations at the appropriate level of analysis. For example, this may include using the sorties per day of aircraft from Desert Storm to project the sortie rate per day of aircraft in a future conflict or allowing players to move land forces based on historical advance rates. This approach is popular both in campaign analysis and in commercial wargaming. Dunnigan, in a foreword to Perla, argues: "Basically, you obtain good games by paying attention to past experience (history) and letting the chips fall where they may."⁸⁶ However, history is not self-explanatory, and analogies can be misleading. A key question is one posed by Barry Posen: "What is this a case of?" For example, modeling the rate of advance for an infantry unit in urban terrain during heavy combat on a historical breakthrough operation by a mechanized force across plains would be inappropriate.

The P_k s method models the results of future military operations by assigning probabilities and values to the weapons systems and aggregating these capabilities up to the appropriate level. " P_k s" means the probability of kill, a common measure of theoretical weapon efficacy. Every military operation is the result of an infinite number of micro-level interactions, such as the detection of enemies, the employment of weapons, and the result of a hit. While every interaction cannot be modeled, the method of P_k s tries to model the likely effects of major weapons and their effects. This is more suited for air, naval, and missile combat than for ground combat. Data about the probabilities of detection, weapon hits, and weapons effects can be

86 James F. Dunnigan, in foreword to Perla, *Peter Perla's The Art of Wargaming*, 9.

taken from historical data or weapons testing data. In the absence of better evidence, values can be taken from subject matter experts. These probabilities can be calculated separately or aggregated into a cumulative “probability of kill,” or P_k . With these values in hand, researchers model individual interactions, then aggregate the results of these interactions to the appropriate level for the analysis (e.g., individual dogfights, meetings between two aircraft flights, or even squadron-on-squadron engagements). Games conducted during the interwar period at the Naval War College addressed this problem by modeling “hit probabilities,” derived from real-world tests with bomber aircraft and warship guns, and then embedding those models into the larger operational wargames.⁸⁷

The method of history and the method of P_k s both have strengths and weaknesses. The method of history does a good job of ensuring that models account for operational realities: allowing a tank battalion to advance according to the maximum speed of a tank, for example, ignores the operational reality that it is much harder to organize and direct an armored force. The method of history deals with problems of aggregation and unknown factors by getting plausible values at the appropriate level of analysis. In contrast, the method of P_k s struggles to deal with these operational factors and cannot account for unquantifiable factors such as morale and friction. However, the method of history is not as good at accounting for changes in weaponry and technology or situations that lack good analogies; in contrast, the method of P_k s excels here. For example, there is no historical precedent for mass precision-guided tactical ballistic missile attacks against defended targets that would allow the method of history to work. The method of P_k s can be used to extrapolate upward from historical cases of single ballistic missile launches and from testing data on interceptors. The mixed virtues and vices of these methods means that researchers must be aware of and use each as appropriate.⁸⁸

Anti-ship Missile Interception

How frequently do anti-ship cruise missiles hit their targets? This project combines the methods of history and P_k s to generate rules that are rigorous and evidence based.

First, based on missile attacks in Desert Storm, the project team estimates that 15 percent of missiles either fail to launch or otherwise malfunction.⁸⁹

The project team assumes that defenders will have sufficient warning to launch interceptors. The curvature of the earth restricts a radar on a 15-meter mast from seeing a missile skimming 5 meters above the sea until the missile is 20 kilometers from the ship. Depending on the tactical situation, the defending ships might also have airborne early warning (AEW) or organic helicopters to aid in initial detection. This project judges that this initial detection is sufficient to alert the crew, but that the defenders only have one

87 Norman Friedman, *Winning a Future War: Wargaming and Victory in the Pacific War* (Washington, DC: Department of the Navy, 2019).

88 An excellent example of this is Brian McCue, *U Boats in the Bay of Biscay: An Essay in Operations Analysis* (Bloomington, IL: Xlibris Publishing, 2008). While he does not use these terms, McCue constructs two models of U-Boat search using what this project calls the method of history and the method of P_k s, explains their functions, and compares the results.

89 A GAO report (GAO/NSIAD-97-134, 140) states that 282 of 307 attempted Tomahawk launches achieved flight. A separate report states that 35 of 39 (90 percent) of CALCMs achieved flight and proceeded to their targets (GAO/NSIAD-95-116, 24).

engagement opportunity against a supersonic cruise missile traveling at approximately 2,400 km/hr.⁹⁰ They would launch two interceptors in a salvo against each incoming missile.⁹¹

The project team further estimates that each interceptor launched by the defender has a 70 percent chance of hitting an incoming anti-ship cruise missile.⁹² While this number is supported in a variety of sources, it does strike the authors as optimistic. One excursion case explores what would happen if missile interception were not as effective. With two interceptors launched at each supersonic anti-ship cruise missile, there is therefore a 91 percent chance that at least one interceptor will work.⁹³

Next, the project estimates that 10 percent of anti-ship missiles will experience terminal guidance failures. This 10 percent miss rate is taken from the historical record showing that 8.7 percent of anti-ship cruise missiles have missed undefended civilian targets.⁹⁴

Finally, terminal interception and electronic warfare will have a combined 70 percent effectiveness, based on historic attacks against military ships without interceptors.⁹⁵

The project aggregates these probabilities into a table for game play. This combines the 15 percent failure to

90 This is also true against ballistic missiles. Against subsonic cruise missiles, the project assesses that defenders would have enough time for two engagement opportunities, allowing for a ‘Shoot-Look-Shoot-Shoot’ doctrine.

91 The project created a “fat-tailed” distribution where there is a 5 percent chance of catastrophic failure leading to no detection of incoming missiles. Smith gives a 10 percent chance for detection of incoming cruise missiles in time for interception. See Roy M. Smith, “Using Kill-Chain Analysis to Develop Surface Ship CONOPS to Defend against Anti-Ship Cruise Missiles,” Naval Postgraduate School, 2010, <https://apps.dtic.mil/sti/pdfs/ADA524758.pdf>.

92 See 82 percent effectiveness for AEGIS, “Ballistic Missile Defense Intercept Flight Test Record,” Missile Defense Agency, 2020, <https://www.defense.gov/Portals/1/Interactive/2018/11-2019-Missile-Defense-Review/ballistic-missile-defense-intercept-flight-test-record-UPDATED.pdf>; an estimate of .7 in a RAND report, Walter L. Perry et al., *Measures of Effectiveness for the Information-Age Navy: The Effects of Network-Centric Operations on Combat Outcomes* (Washington, DC: April 2002), 34, https://www.rand.org/pubs/monograph_reports/MR1449.html; a wide range of .5-1.0 provided by JHUAPL, William G. Bath, “Overview of Platforms and Combat Systems,” *Johns Hopkins APL Technical Digest* 35, no. 2 (2020), 9, <https://www.jhuapl.edu/Content/techdigest/pdf/V35-N02/35-02-Bath.pdf>; a Naval Postgraduate School thesis, Smith, “Using Kill-Chain Analysis to Develop Surface Ship CONOPS to Defend against Anti-Ship Cruise Missiles”; and a .75 estimate in a Canadian analysis, Dale E. Blodgett et al., “A Tabu Search Heuristic for Resource Management in Naval Warfare,” *Journal of Heuristics* 9, no. 2 (March 2003): 158, doi:10.1023/A:1022525529778.

93 The calculation does not distinguish between Standard-Missile 2, Enhanced Sea Sparrow Missile, and Rolling Airframe Missile.

94 John C. Schulte, “An Analysis of the Historical Effectiveness of Anti-Ship Cruise Missiles in Littoral Warfare,” Naval Postgraduate School, September 1994, x, <https://calhoun.nps.edu/handle/10945/27962>.

95 While modern navies rely on interceptors to defend themselves, the record of successful combat use seems minimal. An anti-ship missile targeting the USS Missouri was intercepted by a British destroyer, but only after the missile had been defeated by chaff: JWH1975, “Missile Attack on Battleship USS Missouri,” *Wwiiafterwwii*, July 21, 2019, <https://wwiiafterwwii.wordpress.com/2019/07/21/missile-attack-on-battleship-uss-missouri/>. The only successful interception of anti-ship cruise missiles with missiles seems to have been the USS Mason. See: Sam LaGrone, “USS Mason Fired 3 Missiles to Defend from Yemen Cruise Missiles Attack,” *USNI News*, October 11, 2016, <https://news.usni.org/2016/10/11/uss-mason-fired-3-missiles-to-defend-from-yemen-cruise-missiles-attack>.

launch, 91 percent chance of success with interceptors, 70 percent effectiveness of terminal defense and electronic warfare, and 10 percent miss rate. The team further adds on two “fat-tails”: a 5 percent chance that the attacker has made a catastrophic error (e.g., gross target location error) and a 5 percent chance that the defender has made a catastrophic error (e.g., no AEW is overhead, or the crew does not react in time). This generates the table below. For each salvo of 25 incoming supersonic cruise missiles, a 20-sided dice is rolled against the table to determine the number of “leakers,” or missiles that hit ships.

Table 1: Interception of Supersonic Anti-ship Cruise Missiles

Probability	30%	35%	15%	10%	5%
Die Rolls (d20)	1-6	7-13	14-17	18-19	20
# of Hits on Task Force	0	1	2	3	Destroyed

In a simple demonstration, 24 Chinese H-6 bombers launch a total of 96 YJ-12 supersonic anti-ship cruise missiles (grouped into four missile “salvos” of 25 missiles each) at a U.S. surface action group of two Arleigh Burke-class destroyers and a Ticonderoga-class cruiser.⁹⁶ Rolling four 20-sided dice (one for each salvo) shows: 13, 3, 15, and 2. Referencing the table, three missiles leak through and hit U.S. ships. The project team assigns the hits randomly, this time getting that one missile hits each ship. This U.S. surface action group is now combat ineffective with all its ships either sunk or not mission capable. This serves as a good illustration how, even using optimistic assumptions, it is very hard to defend surface ships.

Whether the method of P_k s or history is used, these models can provide a grounding for plausible rules about combat. For example, a model of the result of two squadrons of aircraft can be used to generate a table of possible outcomes for such a combat in the game. A table of probable outcomes is preferable to a deterministic result because of the fat-tailed nature of combat results throughout history. Throughout this paper are examples of models and how they determined rules in the wargame. Most models for campaign analysis need only be aggregated (or disaggregated) to a level appropriate for a wargame. In that form, the wargame can serve to interact these models in an appropriate way for analysis.

MODEL INTERACTIONS

The transparency of modeling enables observers to review and vet models but requires a certain degree of simplification.⁹⁷ This is easier to achieve when modeling a single domain (e.g., a ground campaign or air campaign) or when the variety of engagement types is limited (e.g., a submarine campaign involving passage through an acoustic barrier followed by ship hunting). As the variety of engagement types increases, the complexity of models may increase geometrically, and the difficulty of clear exposition and vetting will grow proportionately. This is true even when strategy, or the allocation of assets to particular

96 While an H-6K/J has six hardpoints, two of these would likely be used for electronic countermeasure pods. See: H I Sutton, “China’s New Aircraft Carrier Killer Is World’s Largest Air-Launched Missile,” Naval News, November 1, 2020, <https://www.navalnews.com/naval-news/2020/11/chinas-new-aircraft-carrier-killer-is-worlds-largest-air-launched-missile/>.

97 As models become more complicated, they require more investment by readers to understand, making them less transparent.

tasks, is held constant throughout the model “run.”

Not only does the number of sub-routines increase when modeling a menu of operations within a single campaign, but decision rules also increase. When modeling a single type of interaction, there may be no need for the model to reallocate resources to new tasks. When modeling an air superiority campaign, for example, combat aircraft will remain allocated to the air superiority task (e.g., through offensive counter-air) for the duration of the model “run.” In cases where two tasks might be possible, a model can apply simple algorithms. So, in the preceding example, a model might assume that when a greater than 2:1 superiority is achieved in the number of aircraft “on station” in the air superiority fight, any additional aircraft will be dedicated to another task, such as ground support. However, such algorithms can quickly add complexity when they become numerous, which may ultimately undermine transparency.⁹⁸

Given these issues, most campaign analyses have addressed the critical portions of larger campaigns. While it is possible to model operations down to the size of boots worn by each soldier, such a level of complication would be unlikely to shed light on the course of the wider campaign. However, precision is not the same as accuracy.⁹⁹ The modeler relies on their judgment and the literature to identify which areas demand precision, and which can be treated abstractly. With these areas identified, they can be modeled in turn. RAND’s U.S.-China Military Scorecard, for example, contains chapters that address 10 critical aspects of the larger U.S. China competition, but it does not attempt to knit them together into an overarching whole. In the academic domain, too, there have been several attempts to model individual aspects of conflict in Asia but no attempts to model an entire conflict, despite the fact that China is the so-called “pacing threat” for the United States. Wargaming can help with this holistic modeling.

Of course, wargames do not inherently require different models. A basic wargame might have players control only one type of force, such as aircraft. All aircraft need not be similar, but they need to operate within the framework of the same model, which would specify an attrition rate that occurs when different types of aircraft meet.

However, such a basic wargame is appropriate only if the chosen pieces are the only significant parts of a conflict. Surface-to-air missiles (SAMs) are a critical element of contemporary air combat; a wargame or model of air combat that failed to account for SAMs would be incomplete. The same is true of major surface combatants, which largely function as floating SAMs. But if surface combatants are included, then the major ways in which they can be attrited must also be included: other surface ships, submarines, and anti-ship missiles. This produces a complex system wherein dozens of models must interact.

Analytic wargaming allows models to interact in an intelligent way. The models-based rules create grounds for adjudicating the results of various interactions, from what happens when an aircraft squadron flies into an SAM to the likelihood that a submarine sinks a surface ship. The specific events that generate scenarios for adjudication come from intelligent decisionmaking from human players. An attempt to simulate an entire war as an ensemble of models would likely see extreme results from actions that humans would recognize as blunders. For example, one could model aircraft attacking ships with the longest-range munition they have, while ships defend themselves with their longest-

98 Discussed by Tecott and Halterman, “The Case for Campaign Analysis.”

99 Peter P. Perla, “Peter Perla on Prediction,” (presentation, Connections 2017, Quantico, VA, 2017), <https://slideplayer.com/slide/14003660/>.

range munition. At some point, the aircraft run out of their longest-range missiles, while a significant inventory of the ship's longest-range missiles remains. The merciless logic of the model drives the aircraft into the ships to be completely annihilated; an intelligent player on a wargame would redirect the aircraft to a different target. A wargame allows for some check on these interactions. Furthermore, analytic wargaming allows for flexibility with an inherently modular approach to modeling conflict. Depending on the operations research that shapes the game rules, more models can be created for elements that the literature finds to be important.

The results of these interactions between models provide data for analysts to form qualitative judgments. For example, the air-to-air fight impacts anti-submarine warfare (ASW) by determining what level of risk maritime patrol aircraft (MPA) face in various geographic areas. If the air-to-air fight is going poorly for one side, their ASW efforts might suffer accordingly because of less MPA coverage. The quantitative results provide the basis for qualitative judgments about the effects of one domain on another. By providing a way for rigorous and transparent models to interact in an intelligent way, wargames provide a valuable aid to analysis.

Iteration to Examine a Variety of Strategies

Despite often being overlooked in modeling, no discussion of combat outcomes can ignore the strategies of the respective commanders. For example, in 1939–40, the French outnumbered the Germans in troops and equipment, including tanks. However, the best Anglo-French formations moved north as Germany struck through the Ardennes to the south. The result was an encirclement of the French army and ultimately French defeat. Generalship matters. Months after the fall of France, Germany's own plans fell short during the Battle of Britain. Although the Luftwaffe outnumbered the Royal Air Force, Luftwaffe leaders failed to appreciate the significance of British radar stations and aerial command and control. As a result, they were unable to translate their superiority in matériel into air superiority.

Nor are recent examples lacking. In the ongoing war between Russia and Ukraine, Russia enjoyed many initial advantages, including larger and more modernized forces. Nevertheless, Russia's initial plan for the invasion, to include the occupation of Kiev, greatly exceeded the capacity of its forces.

While developing a comprehensive set of possible results is impossible, focusing on the most likely and plausible interactions can produce an analytically sound and useful set of outcomes. With so many models interacting, there is no way to exhaustively explore all the possible decision points short of a massive computing effort. Even chess has a lower bound of 10¹²⁰ possible games, despite only having 32 pieces and 64 legal positions.¹⁰⁰ The ability to exhaustively analyze a series of models by exploring all possible decisions to see the distribution of possible outcomes likely lies in the distant future. Similarly, there are promising efforts to train computers to play games through millions of iterations, such as AlphaStar.¹⁰¹ While more plausible in the near term, these efforts still require large teams of expert programmers. Short of a focused government effort, this is not feasible for research.

However, iteration allows some of the most plausible lines of play to be explored. The project

100 Claude E. Shannon, "Programming a Computer for Playing Chess," *Philosophical Magazine* 41, no. 314 (1950).

101 "AlphaStar: Mastering the Real-Time Strategy Game StarCraft II," DeepMind, January 24, 2019, <https://www.deepmind.com/blog/alphastar-mastering-the-real-time-strategy-game-starcraft-ii>.

generated these plausible lines of play by having many different players participate in game iterations. To continue with the example of chess, there may be 10120 possible games, but most of those follow nonsensical decisions, such as allowing a queen to be taken by a pawn. Moreover, while there are many possible openings, almost all competitive openings follow the movement of the d- or e-pawn and efforts to control the center. The goal of iterative wargaming should not be seen as an effort to exhaustively explore all possible outcomes but rather as a way to assess the major lines of play that result from intelligent decisionmaking.

Varying strategies over multiple iterations of a wargame generates data on the likely interactions between plausible strategies. One wargame may not be illustrative of the overall contours of the problem due to an a priori reasonable strategy being chosen that turns out to be suboptimal. For example, in one iteration of this project's wargame, the Chinese invasion fleet was destroyed in one turn after the Chinese player chose a strategy of defending their coastline while simultaneously invading Taiwan. If that was the first and only wargame that was played, a highly erroneous conclusion would be reached. Repeated play of the scenario using different Chinese strategies showed that the Chinese invasion fleet being destroyed on the first turn is an outlier. Many other strategies that China could choose would lead to outcomes much more favorable to China. This case illustrated the importance of iteration to try multiple strategies, lest the insights from a single scenario are misguidedly based on a particular strategy.

Another benefit of having outside players participate is that they will try novel strategies that did not occur to the principal investigators. It is easy for the wargame creators to try a few strategies and then settle into a local optimum that they believe represents best play of the scenario. Outside players inject mutation into the play of the game with their own ideas about how to play. Like genetic mutation, most of these new ideas are maladaptive. However, some are successful and represent advances on best play. Some required additional research and the design of new scenarios to test (in a way suggested by J. Peter Scoblic and Philip E. Tetlock).¹⁰² This process of mutation, iteration, and refinement helps to explore the seams of the possible and plausible outcomes of the wargame.

Variation of Key Assumptions to Explore Uncertainty

Analyses of the future must explore how sensitive results are to variations in assumptions. For example, wars begin in different ways. While most wars are preceded by a state of crisis, if a defender is surprised and has not mobilized their forces, this will have a dramatic effect on the subsequent campaign.¹⁰³ Political factors are often unclear before the clash of forces and could lead in multiple directions, such as whether the British would intervene when the Germans invaded Belgium in World War I. Weapon systems might perform far differently in combat than expected, such as the Mark 14 torpedo in World War II. An analysis that does not explore key uncertainties risks building a detailed argument on a foundation of sand.¹⁰⁴

102 J. Peter Scoblic and Philip E. Tetlock, "A Better Crystal Ball," *Foreign Affairs*, October 30, 2022, <https://www.foreignaffairs.com/articles/united-states/2020-10-13/better-crystal-ball>.

103 Cancian, *Coping with Surprise in Great Power Conflicts*.

104 For a detailed treatment of this issue, see: Paul K. Davis and Don Blumenthal., *The Base of Sand Problem: A White Paper on the State of Military Combat Modeling* (Santa Monica, CA: RAND Corporation, 1991), <https://www.rand.org/pubs/notes/N3148.html>.

Iterating wargames in different scenarios with different assumptions for key variables allows for sensitivity analysis. A variable is a condition likely to have an impact on the analysis about which the analysis must make an informed assumption. In the same way that campaign analysis begins by specifying a scenario, this study refers to each bundle of assumptions for each variable as a scenario. For example, an invasion of Taiwan where China achieves operational surprise is one scenario; an invasion wherein operational surprise is not achieved is another. A new scenario is created when any assumption about a variable is changed: operational surprise with missile defense working is a different scenario than operational surprise without missile defense working.

The selection of variables should reflect the purpose of the game. For example, in the services' "Futures Wargame," designed to test alternative force structures against one another, two iterations of the same scenario, one incorporating force structure from the so-called DOD program of record and one reflecting an alternative set of forces, were selected by experts and officers over a period of months.¹⁰⁵ Thus, in the "Futures Wargame," all elements of the game that are not related to order of battle should, to the extent possible, be kept equal.¹⁰⁶ However, analytic wargames exploring other research questions require varying other assumptions between scenarios.

By running several iterations of the wargame with one scenario, then changing the scenario, it is possible to draw inferences about the importance and impacts of each variable change. The project team does not claim that this leads to a causally identified finding, which is the goal of experimental wargamers. However, it is possible to observe the impact of changing the assumptions about certain variables: for example, if Japan allows U.S. basing, then the outcome is likely to be more favorable for the United States than if basing is denied. More importantly, it allows for researchers to develop better judgments about the relative importance of these uncertainties: is Japanese basing more or less impactful on the outcome than Philippine basing? (Yes, as discussed in Chapter 8.)

By running several iterations of the wargame with one scenario, then changing the scenario, it is possible to draw inferences about the importance and impacts of each variable change.

105 See, for example, "Air Force Plans Wargames, Tech Experiments to Flesh Out Arctic Strategy," *Breaking Defense*, July 27, 2021, <https://breakingdefense.com/2021/07/air-force-plans-wargames-tech-experiments-to-flesh-out-arctic-strategy/>; and C. Todd Lopez, "Futures Wargame Exercise Prepares Army for 2030," *Military News*, September 27, 2013, https://www.militarynews.com/peninsula-warrior/news/around_the_army/futures-wargame-exercise-prepares-army-for-2030/article_abb46b8f-0f72-58f1-a789-4da26323404b.html.

106 In wargaming, one set of factors that is impossible to hold equal is related to players. One may select like-types of players (e.g., mid-grade officers of a certain background) but may not be able to involve the same players in each game. And if the same set of players is recruited to play a second game, learning from the preceding experience will represent another factor or variable that may influence outcomes.

It is impossible to model all potential values of all variations. With 25 variables eventually identified by the project team that could take on binary values, that leads to 225 possible combinations, or approximately 33.5 million scenarios. Obviously, this is beyond the capability of human analysis.

The selection of variables can be informed by previous literature or from insights generated during play. The question of which variables to include is the same problem that confronts efforts to make historical analogies. While no historical case is ever 100 percent analogous to another, it is possible to make inferences as long as they are similar enough in the most relevant variables.¹⁰⁷ The variables of study must therefore both be uncertain and likely to have a high impact on the outcome. For example, in this project it became clear that the effectiveness of the Joint Air-to-Surface Standoff Missile (JASSM) against moving ships was a critical factor in the outcome of the game after playing several iterations. A close review of the literature showed that this effectiveness was unclear. The project team therefore decided that the effectiveness of the JASSM was an important variable to test.

Additional variables came from players who participated in game iterations. They surfaced some of former secretary of defense Donald Rumsfeld's "unknown unknowns," factors that the game designers had not anticipated.¹⁰⁸ Wargaming can help explore these "unknown unknowns" by facilitating brainstorming about key variables among players who then help to shape future scenarios by including important variables that the researchers did not think of themselves.¹⁰⁹

Human Participants Make Intelligent Decisions, Generate Mutation, and Shape Assumptions

The primary benefit of having human participants is to focus on the most plausible lines of play. As discussed above, the number of models, variables, and decisions in play make it impossible even for the most powerful computers to examine all possible lines of play for a game. Players of a game must choose the most promising courses of action. They can choose these lines based on knowledge of the actual countries' doctrines, historically similar campaigns, and their own strategic intuition.

One approach is to have a core group of players who have been involved in the game design. First, they are most familiar with the weapons systems and capabilities that go into the wargame, helping them to avoid blunders. The actual participants in a real-life conflict would be similarly familiar with their capabilities, so this allows for more plausible play. Second, the core group of players will know what

107 John Stuart Mill, *A System of Logic, Ratiocinative and Inductive: Being a Connected View of the Principles of Evidence and the Methods of Scientific Investigation* (London: Longmans, Green, and Company, 1882).

108 Rumsfeld's distinction between "known knowns," "known unknowns," and "unknown unknowns" has its roots in systems analysis, despite having been harshly criticized at the time. For a full discussion, see Donald Rumsfeld, *Known and Unknown: A Memoir* (New York: Sentinel, 2012). For a discussion of this typology, see U.S. Congress, House, "NASA Program Management and Procurement Procedures and Practices," Hearings before the Subcommittee on Space Science and Applications of the Committee on Science and Technology, 97th Cong., 1st sess., June 24, 25, 1981, https://www.google.com/books/edition/NASA_Program_Management_and_Procurement/dRMrAAAAMAAJ?hl=en&gbpv=1..

109 "Using Wargames to Battle Uncertainty by Peter Scoblic," YouTube video, posted by Georgetown University Wargaming Society, May 30, 2021, 1:05:47, <https://www.youtube.com/watch?v=95NsBUkf6DI>.

broad courses of action have been used before and how they interact. This allows iterations to focus on lines of play that have been found to be more promising, rather than redoing earlier attempts at lines that have been found lacking. Finally, a core group of players can cycle through iterations much quicker than outside players.

However, outside participants are helpful in two ways. First, as discussed above, new players can inject mutation into strategies used by the core team. After several iterations, it is common for the core team to settle into a local optimum of strategies that they believe is best for both sides. New players can try new strategies that the core team finds unintuitive, shaking the game from its local optimum toward a global optimum. To integrate their intent with the game mechanics, the project provided each team with an “operations officer” from the staff. Second, outside participants can bring their knowledge into the game to refine the models underlying the rules. This is particularly the case when the number of outside participants in each game iteration is low (two to four). That allows each player to give in-depth feedback on any subject in which they have expertise. Several participants with experience in Pacific operations pointed out that current policy is to keep a continuous submarine presence in the Philippine Sea. The project, therefore, adjusted its order of battle to reflect this insight. This feedback means that there are slight changes that occur to the rules throughout the life of the project; however, this is compensated for by the increased fidelity of the project’s models.

Nesting Wargame Results into Analysis

The numbers of missiles fired and aircraft destroyed in any iteration are descriptive data, not analytic outcomes. The results of any of these runs are contingent on a multitude of factors beyond the underlying models, including the makeup of players and previous decisions in that game. For example, take two iterations whose scenarios were the same except for the assumption about Taiwanese ground force competence. The players in one iteration decided to use their missile inventory as quickly as possible, but the players in the other iteration decided to conserve their inventory. This difference had nothing to do with the changing assumption about the variable of Taiwanese ground force competence: the difference was produced solely by differences in the participants, or it could even have been the same participants wanting to try something different. It would be a mistake to conclude that the variable of Taiwanese ground force competence has a significant effect on the rate of missile expenditures. Thus, the quantitative data out of each iteration should not be seen as statistically significant projections about the future but as illustrative of the corpus of wargames that a project creates.

Analytic wargames produce qualitative insights among the investigators, which must then be situated in an analytic framework. This framework should focus on not only the ebb and flow of events generally but also a description of how differing assumptions about variables impact the likely outcome of a conflict. Two factors make variables relatively more or less important: their impact on the outcome and the degree of confidence in their values. The analysis thus comments on the general impact of variables rather than the specific outcomes of games. To paraphrase President Dwight D. Eisenhower, “Wargames are worthless, but wargaming is indispensable”—the specific outcome of each iteration is not predictive of the future, but the process of wargaming is indispensable to analyzing the conflict.

However, analytic wargames must be careful not to make assertions outside of their scopes or to confuse the insights of the wargame with the insights of their modelling. A wargame about the outcome of an invasion of Taiwan cannot claim to grant insights about the operational impacts that Chinese control over Taiwan would have on the defense of Japan; such speculation is outside of the scope of analysis. Separately, an insight such as that China likely has enough ballistic missiles to cover the tarmac of all the military airfields in Japan does not come from the wargame: it comes from the modeling and the assumptions that went into the modelling. While the analytic insights of wargames are valuable, they must be appropriately scoped.

Building the Taiwan Operational Wargame

With the methodological principles developed in Chapter 2 in mind, the project set out to develop a wargame to answer the questions: Would a Chinese invasion of Taiwan succeed in 2026? What variables most affect that outcome? What would be the cost to both sides?

The first decision was whether to adapt an existing system for this project. As mentioned earlier, CNAS and the Körber Foundation have run similar wargames. Both games featured adversarial play between two teams of experts in conflicts with China. However, their focus on escalation dynamics and political decisionmaking made them unsuited for adaptation to this project’s methodology, which deals with political decisionmaking by varying scenarios across iterations. The different purposes of the projects meant that this study could not adapt their systems.

Several commercial wargames are more operationally focused and have either a Taiwan invasion at the center of the game (*Next War: Taiwan*) or a Taiwan scenario as part of a larger conflict (*Breaking the Chains*). Although designed primarily for entertainment, these games are often the product of deep research and thoughtful mechanics. As a result, they have been used in professional military education (PME).¹¹⁰

Nevertheless, several elements inherent to commercial games rendered them unsuitable for this project. First, commercial games, as a rule, balance playability and analytic rigor. This means that an important part of commercial wargame design is ensuring that both sides of the game have a path to victory, even if the balance of forces means that one side realistically does not have a way to win if both players are equally

110 Sebastian J. Bae and Ian T. Brown, “Promise Unfulfilled: A Brief History of Educational Wargaming in the Marine Corps,” *Journal of Advanced Military Studies* 12, no. 2 (September 2021): 45–80, doi:10.21140/mcuj.20211202002.

skilled (and lucky). The purpose of this project was to test outcomes of a notational invasion of Taiwan by China using the project team's best estimate of forces available, national policies, equipment capabilities, and combat results. That may or may not produce a balanced result (in fact, it did not). For players, it can be deeply unsatisfactory to participate in a game if the prospects for victory are remote. However, that might be the correct analytic outcome.

Further, commercial wargames do not reveal the assumptions and calculations for their force lay down and combat interactions. Although these are often sophisticated, the lack of transparency makes relying on them problematic. Is a particular outcome the result of analysis or a desire to balance play? Are calculations based on historical data, test data, or the developer's judgment? At the same time, the project team's review of the available commercial games suggested that important elements, especially air combat and attacks on air bases, were not represented rigorously. *Next War: Taiwan* focuses primarily on the ground campaign on the island, and *Breaking the Chains* focuses primarily on naval combat, generally between relatively small forces. Because of these issues, the project team needed a game where it understood and could stand behind every one of the game elements and assumptions.

Similar difficulties exist with adapting semi-official wargames, such as *Assassin's Mace*, an operational-level wargame designed to simulate future war in the Western Pacific between 2025 and 2050.¹¹¹ It uses the sophisticated Operational Wargame System developed by Tim Barrick and Mark Gelston. An invasion of Taiwan is one of the several scenarios available. The game integrates multiple warfare domains, including those outside of traditional military operations such as cyber and satellite intelligence, surveillance, and reconnaissance (ISR). *Assassin's Mace* is intended to provide PME to field-grade officers and, to this end, requires a significant amount of professional knowledge in participants. Given the audience and purpose, this game is granular in design. It is very well designed for its purpose, and it has entered wide use in U.S. War Colleges as a tool for teaching joint operations.

However, like commercial board games, *Assassin's Mace* was unsuited to this project's purposes because of discrepancies between its rules and the project team's modelling. For example, within the *Assassin's Mace* game rules, the F-35 and J-20 both attack at 12 and defend at 7, meaning that both aircraft roll a 12-sided die to attack and must score a 7 or greater to destroy the other. This means that there is a 50 percent chance that an attack will destroy the other, or a 50 percent attrition rate. Given that the historical attrition rate per sortie in most conflicts is less than 1 percent, and only 2 percent for the particularly intense Battle of Britain, the project team would use a lower attrition rate. This is not to disparage the Operational Wargame System but to demonstrate how its rules produce different operational outcomes than the project team's research would suggest. However, given the official nature of the Operational Wargame System, it might be reasonable to wonder if it (or any government wargame) is inherently superior to civilian wargames due to the possession of non-public information.

The Question of Classified Data

This project used only unclassified data so that its results can inform public debate. Some observers, particularly within the government, might argue that accurate modeling is impossible without access

111 "Wargame Design: The Marine Corps' Operational Wargame System w/ Tim Barrick," YouTube video, posted by Georgetown University Wargaming Society, July 21, 2021, 1:59:06, <https://www.youtube.com/watch?v=3A7JZ4MjIMM>.

to classified data. However, classified data is not necessary for the construction of a credible wargame. Although classified data might help tweak certain parameters (e.g., missile ranges, intercept probabilities, and submarine detection capabilities), they would not change the fundamental structure of the game or the outcomes. The reasons are threefold.

First, much information that was previously classified is now available from open sources. For example, *The Military Balance* by the International Institute for Strategic Studies (IISS) provides detailed equipment numbers, while Jane's databases provide detailed information about equipment capabilities.

Google Earth provides information about facilities that required U-2 flights during the Cold War. The team used Google Earth to determine the number and location of Chinese underground airfields, the size of parking ramps, and other parameters of air bases. Although classified imagery might refine this information, unclassified information is more detailed and accurate than ever before.¹¹²

Second, classified data is not necessarily correct data. It is vulnerable to a lack of probing and testing because of restricted access. Indeed, bureaucratic and political forces may require government actors to accept weapons testing data that does not account for the friction that can greatly diminish weapons effectiveness in the real world. For example, classified Air Force testing projected a 92 percent hit rate for the AIM-9J missile before its fielding in Vietnam; analysis after the war found that its actual hit rate was 13 percent.¹¹³ A similar result was obtained in the infamous U.S. torpedo scandal of World War II.¹¹⁴ These mistakes were possible because projections of future conflicts require making assumptions about events that have never happened and classification prevented the usual vetting of these projections. No squadron of F-35s has ever engaged a squadron of J-20s; predicting the result of such an engagement relies on assumptions, regardless of classification level. Most of the parameters in the project's wargame are based on historical data; classified information might help refine these assumptions but would not replace the importance of historical data.

Third, the appropriate use of historical data can sometimes be more accurate in modeling future conflicts than classified information about specific weapons systems. Before Desert Storm, classified models using accurate weapons performance data predicted 20,000 to 30,000 casualties. However, private commentators predicted fewer casualties, based on data from Israel's Six-Day War.¹¹⁵ Although the classified models had more accurate weapons capability data, they modeled the Iraqis as fighting as competently as the Soviets.¹¹⁶ The open-source models accounted for the poorer operational competence

112 See, for example, International Institute for Security Studies, *The Military Balance 2022* (London: Routledge, 2022), <https://www.taylorfrancis.com/books/9781003294566>; and Alex Pape, *Janes Fighting Ships 2021-2022* (Coulson, Surrey: Jane's Information Group, 2021).

113 John Siemann, *Project Checo: Southeast Asia Report COMBAT SNAP* (Washington, DC: Department of the Air Force, 1974), <https://apps-dtic-mil.libproxy.mit.edu/dtic/tr/fulltext/u2/a486826.pdf>.

114 The failure of the U.S. submarine torpedo is a classic example of testing failures and the slowness of the bureaucracy to recognize and fix the failures. See, for example, Frederick Milford, "US Navy Torpedoes: Part Two: The Great Torpedo Scandal, 1941-1943," *The Submarine Review*, October 1996, <https://www.geocities.ws/pentagon/1592/ustorp2.htm>.

115 Netanel Lorch, "The Arab-Israeli Wars," gov.il, November 23, 2017, <https://www.gov.il/en/Departments/General/the-arab-israeli-wars>.

116 A competence that might now be called into question, given Russia's performance in Ukraine.

of Arab militaries, which more than made up for their deficiencies in classified weapons performance data. Thus, open-source models have value beyond their intrinsic transparency and public accessibility.¹¹⁷

Philosophy of the Base Model

This section lays out the key design choices that the project made and explains the reasons for the choices.

Use rules rather than judgment. As discussed in Chapter 2, models for analytic wargaming must be built in a rigorous manner on the best available open-source information. These models can be based either on the method of history or the method of P_k s (see previous chapter). However, they must create a comprehensive set of rules that minimizes the influence of judgment. Of course, sometimes players will create situations that are plausible but unanticipated. In these cases, some judgment by the umpires is necessary.¹¹⁸

Incorporate only demonstrated capabilities. The game is based on capabilities that the countries involved have demonstrated or have concrete plans to field. Players often had imaginative initiatives for cyber, special operations, and new systems, but the game did not include these unless the relevant country had demonstrated those capabilities. The relatively near time horizon of the game (2026) limits how many new capabilities might be fielded.

There are classified programs that might produce relevant capabilities. Some details about these programs have leaked out and have been incorporated into the game. Most elements would be fielded and operationally significant numbers after 2026, if fielded it all. However, this uncertainty is present in all discussions of national security issues.

Assume China has decided to invade. Because the purpose of the game is to assess the outcome of a Chinese invasion of Taiwan, the game assumes that the CCP has made the decision to launch such an attack. The Chinese government could reach such a decision for a variety of reasons related to domestic politics, faulty intelligence, inaccurate military assessments, and international pressure that would not align with an outsider's military or political assessment. External factors might also drive the decision. For example, Taiwan could move toward a declaration of independence, or the United States might begin permanently stationing troops on the island. The premise that China decides to invade is not a prediction but rather a tool that sets up the research question about whether such an invasion might succeed. However, the scenario is plausible given the concerns about such a Chinese course of action, as described in Chapter 1.

117 High pre-war official estimates were enumerated in Steven V. Roberts, "George Bush, Diplomat: The President Is Hoping That a 'New World Order' Will Contain Hussein," *U.S. News & World Report* 109, no. 10, 1990; and "Potential War Casualties Put at 100,000: Fewer U.S. Troops Would Be Killed or Wounded than Iraq Soldiers, Military Experts Predict," *Los Angeles Times*, September 5, 1990, <https://www.latimes.com/archives/la-xpm-1990-09-05-mn-776-story.html>. For more accurate predictions by outside analysts using unclassified data, see John J. Mearsheimer, "A War the US Can Win - Decisively," *Chicago Tribune*, January 15, 1991, <https://www.chicagotribune.com/news/ct-xpm-1991-01-15-9101040923-story.html>; and Barry Posen, "Political Objectives and Military Options in the Persian Gulf," Defense and Arms Control Studies Working Paper, MIT, Cambridge, MA, November 1990, <https://css.ethz.ch/en/services/digital-library/publications/publication.html/19773>.

118 All the data used by the project and all the models developed were unclassified. However, because one of the authors possesses a security clearance, some models must remain private until a security review verifies that they do not contain classified data.

Use base and excursion scenarios. The project developed a base scenario wherein all variables took their most likely values. Excursion scenarios explored key parameters about which there were plausible alternative assumptions. For example, the base case for Joint Air-to-Surface Standoff Missile-Extended Range (JASSM-ER) employability was that it could target ships at sea. An excursion scenario restricted JASSM-ER employability to stationary land targets. This approach allowed the project to explore the sensitivity of wargame results to changes in assumptions. (The next chapter discusses the base scenario and excursion cases in detail.)

Explore diplomatic and political conditions with excursion scenarios. Because the game play was primarily concerned with operational factors that affect military outcomes, the project accounted for political inputs as variables that were manipulated by control between iterations. It is possible to either model the political behavior of states through expert discussions during game play or to employ stochastic models (e.g., rolling a die to determine if a neutral country joins the conflict). However, such modeling is problematic. More important from the perspective of the project was the need to maintain a degree of control over game inputs so that a range of conditions could be examined. Rather than integrating these factors into the rules, this project explores them with excursion scenarios.

For each of these political factors, the project identifies the most plausible outcomes, binned into a few meaningful categories. For example, consider the Japanese decision to enter the war. Discussions with experts led the project team to believe that the base case was that Japan would most likely enter the war only if Japanese bases or U.S. bases in Japan were attacked. This base case assumption was therefore used for most games. Certain excursion scenarios explored what would happen if Japan joined the United States from the first day of China's invasion or if Japan never joined the war. Although there are in reality an infinite number of permutations on this critical factor, creating a few meaningfully different categories for assumptions and playing iterations with different assumptions allows the project to explore the effects of these highly uncertain yet important factors. Additionally, there are some plausible political decisions—such as the decision to surrender—that are possible but that cannot be usefully wargamed; those lie outside the scope of this project.

Focus on Taiwan. The game focuses on combat around Taiwan and in the Western Pacific region that could affect such combat on the island. It abstracted operations in the South China Sea to maintain focus on Taiwan. These battles would unfold as the East Coast units of the U.S. Navy arrived in the region, having traveled via the Suez Canal. Chinese forces would attempt to block these U.S. forces from approaching Taiwan. Some Chinese forces are not available for the invasion of Taiwan, being stationed in the south to guard against such actions. As U.S. forces arrive, China must withdraw forces from other regions, including those attacking Taiwan, to maintain defense.

The Taiwan Operational Wargame

This section explains specific design parameters.

TIME SCALE

Each turn in the game is 3.5 days—the time increment needed to simulate enough real-world time to produce an estimate of the result of the battle and be playable in a single day. Multi-day games would take too long to run 24 iterations.

Considering that the invasion of Okinawa, a much smaller island than Taiwan, took two months and three weeks, the time scale had to allow exploration of several weeks of combat. This also gave insights into how depleting munition stockpiles affected the conflict: both sides had enough high-end missiles to launch continuously for several days, but what happens when those are gone? The 3.5-day turns allowed the project to get further into the battle than games with smaller time increments, which was critical for the study's purposes.

The time scale required trade-offs to get through weeks of combat in a timely manner. First, it required some amount of aggregation: instead of modeling every aircraft, the game modeled aircraft squadrons. Second, it does not allow for as granular decisionmaking: players have to give general instructions for half of a week and cannot adjust their orders for day two based on the results of day one. Third, it required a specific sequencing in resolution for accuracy: for example, a surface ship traveling 30 knots could cover the entire game board in 3.5 days, but an enemy would almost certainly detect and react to such a charge within that time period. Sequencing combat resolution in a specific way allowed such interactions. However, weighed against the analytic benefits of the longer time scale, these disadvantages were judged to be acceptable.

OPERATIONAL MAP

Figure 2: Taiwan Operational Wargame—Operational Map



Source: CSIS.

Air and naval combat in the Taiwan Operational Wargame (TOW) unfolds on an operational map of the Western Pacific. Hexes on the map are approximately 600 km (roughly 370 miles) from side to side. Each hex is colored according to its distance from Taiwan and numbered.

Each map hex lists the following information:

- The number of aircraft squadrons that can park on military and dual-use airport tarmac;
- The number of aircraft squadrons that can be housed in underground hangars and hardened aircraft shelters (HASs); and
- The number of SAM battalions.

Placed on the map are counters representing the following:

1. Aircraft squadrons (representing 24 tactical aircraft and 12 large aircraft);
2. Ground forces that have been moved between hexes;
3. Surface ship task forces; and
4. Squadrons of four submarines.

Ground-Launched Missiles

China's People's Liberation Army Rocket Force (PLARF) is a formidable force. Thus, each game turn begins with ground-based missile attacks. These missiles primarily target U.S. and Japanese surface ships and air bases. To speed up play, China's war-opening joint fires strike on Taiwan was modeled and pre-adjudicated in every iteration. This strike employs much of China's short-range ballistic

missile inventory and would largely destroy Taiwan's navy and cripple its air force.¹¹⁹

Taiwan's ground-launched anti-ship missiles are also a key element in the fight. Besides indigenous Hsiung Feng II and III missiles, Taiwan is procuring 100 Harpoon launchers and 400 Harpoons. These have the potential to inflict significant attrition on China's amphibious force. Rather than having players specify an attack for these, the project models their likely use and effects on China's fleet in each turn.

Chinese Amphibious Lift

One key output of the operational fight is the number of units that China can place on Taiwan in a 3.5-day turn. Rather than modeling specific waves of landings, the project models lift as the thousands of tons that China can transport across the strait over 3.5 days. Each battalion requires a certain number of tons, depending on whether it is leg infantry, mechanized infantry, armor, artillery, or engineer. Once China moves troops onto Taiwan, it must also keep them supplied, which progressively reduces the number of new formations that can be transported.

There are four ways China moves troops onto Taiwan: amphibious landing, air assault, airborne, and via captured facilities. Amphibious landing over suitable beaches constitutes the primary way that China moves forces in an initial assault. The amount of amphibious lift decreases as major

119 Taiwan's navy consists of outdated ships that would be subjected to a wide array of Chinese coastal defense cruise missiles, Houbei fast-attack boats, and bombing from attack aircraft. The ships possess only rudimentary self-defenses that are unsuitable for the sophistication of Chinese attacks. China's success in destroying these ships would be even greater if China could catch them in port because Taiwan failed to receive or react to warnings of China's impending attack. While some Taiwanese ships would survive this initial strike, they would be unable to operate in the strait or as an effective force. For an overview of Taiwan's navy, see: "Overview of Taiwanese Navy Warships," YouTube video, posted by Eurasia Nabal Insight, August 13, 2022, 20:37, https://www.youtube.com/watch?v=ItW7f3_BVCo. Taiwan has done an admirable job of hardening its air bases. By our measure, they possess around 250 HASs and over 300 million square feet of tarmac space on which to disperse their aircraft. However, China has been building its rocket force in part to counter these defenses. The sheer volume of Chinese missiles means that they could blanket all of Taiwan's air bases with the DF-11 family of close-range ballistic missiles (CRBMs) alone. Any surviving aircraft would struggle to be maintained, fueled, and armed after this initial strike. The only Taiwanese aircraft that would survive would be those based in the Chiashan and Shizishan underground facilities. The project team was internally divided on whether China could destroy these underground facilities but ultimately decided that they were probably survivable. Taiwan could probably store three operational squadrons there (75 functional aircraft plus non-mission-capable aircraft). However, China could still destroy the runways outside of the hangars. For game play, the project team committed enough Chinese CRBMs to suppress these runways for the first two weeks of the conflict. After that point, China must commit bombers and ground-attack aircraft to suppress these runways or the Taiwanese fighters in the underground shelters begin flying. For a detailed discussion of a Chinese knockout strike, see Michael J. Lostumbo et al., *Air Defense Options for Taiwan: An Assessment of Relative Costs and Operational Benefits* (Santa Monica, CA: RAND Corporation, April 2016), 11, https://www.rand.org/pubs/research_reports/RR1051.html.

ships are sunk.¹²⁰ Air assault with helicopters is limited to the extreme west of Taiwan due to range considerations, while airborne landings with paratroopers can occur anywhere on the island. Both methods are slowly attrited by anti-air artillery and man-portable SAMs, but attrition increases greatly if China's air superiority is degraded. Ports and airfields enable the use of more varied ships and aircraft to accelerate the transport of troops ashore. The United States may attack these facilities to deny their use after Chinese capture.

Air and Naval Combat

Players issue orders for their air and naval forces. These orders unfold over the course of the 3.5-day turn. These orders therefore must allow aircraft and ships to execute missions not only once but as frequently as they can over the course of the turn. For example, orders to fly combat air patrol (CAP) result in coverage as frequently as aircraft can sortie, ASW sweeps reflect the coverage of a hex that can be achieved through constant searching over 3.5 days, and so on.¹²¹

AIR FORCES

Aircraft are represented by counters. For fighter/attack aircraft, there are three categories: fourth generation (non-stealthy, no Active Electronically Scanned Array [AESA] radar), 4.5 generation (non-stealthy, AESA radar), and fifth generation (stealthy, AESA radar).¹²² Fighter/attack counters represent standardized squadrons of 24 aircraft. Most of Taiwan's aircraft would be destroyed in the initial bombardment by China, but some would survive in their underground hangars on the eastern side of the island. Bombers are grouped into legacy and stealth bombers, and counters represent a standardized 12-aircraft squadron.

120 While the project team grants China great credit for using specially designed civilian Ro-Ro ships for amphibious assaults, there is skepticism of their ability to use small civilian craft for amphibious assaults. For an account of the ANZAC landing party in the official Australian history, see C.E.W. Bean, "Chapter XII – The Landing at Gaba Tepe," in *Volume I – The Story of ANZAC from the Outbreak of War to the End of the First Phase of the Gallipoli Campaign, May 4, 1915*, 11th ed. (Australian War Memorial, 1939), <https://www.awm.gov.au/collection/C1416845>. The slow rate of offloading meant that Ottoman counterattacks were able to contain the ANZAC forces in the infamous ANZAC cove. On Y Beach, the landing actually failed, and the British were forced to withdraw. On V beach, 2,500 British troops landed from 24 rowboats and the *SS River Clyde* (3,900 gross tons) on a 300-yard beach. They suffered 70 percent casualties, as there were defenders there and the civilian ships were unsuited to disembarking in the face of resistance. See Julian Stafford Corbett and Henry John Newbolt, *Naval Operations* (London, New York: Longmans, Green and Co., 1920), <http://archive.org/details/navaloperations00newbgoog>.

121 The question of terminology arose during game play. The project used "combat air patrol" to refer to air missions that contested the airspace in a particular region, as this term is used in campaign analyses. See Heginbotham et al., *The U.S.-China Military Scorecard*, 73. However, some Air Force participants preferred "air superiority" because that aligned more closely with Air Force doctrine, which linked activities with outcomes.

122 These definitions are the project's own but are generally in accordance with previous definitions, such as found in Jeremiah J. Gertler, *Tactical Aircraft Modernization: Issues for Congress*, CRS Report No. RL33543 (Washington, DC: Congressional Research Service, November 2009), 14, <https://crsreports.congress.gov/product/pdf/RL/RL33543/15>; and Jeffrey Hood, "Defining the 5th Generation Fighter Jet," Joint Base Langley-Eustis, March 14, 2017, <https://www.jble.af.mil/News/Commentaries/Display/Article/1112351/defining-the-5th-generation-fighter-jet/>.

Tankers and airlift are also tracked in squadrons of 12.¹²³ Testing showed that categorizing aircraft by generation greatly facilitated game play at only slight cost in terms of fidelity.¹²⁴

Fighter/attack aircraft and bombers perform four missions in the game. First, they can try to establish air superiority with CAP, patrolling over the battlefield 24/7. Proximity to the battlefield is critical to establishing continuous CAP, as an hour spent flying to and from the battle area is an hour when an aircraft is not on station conducting the mission. Therefore, the distance between a squadron's base and its target hex (usually Taiwan) and the amount of tanking available are key determinants in the time on station for fighter/attack squadrons performing CAP.¹²⁵

Second, aircraft can perform strike missions by attacking air bases, surface ships, ground units, and critical infrastructure. If there is adversary CAP over the target, then escorts are needed to defend the attackers. The choice of munitions for aircraft conducting these missions is critical. In the early stages of the war, sophisticated and long-distance cruise missiles are available, but as these inventories are depleted, aircraft must use shorter-range munitions and accept more risk.

Third, aircraft can perform ground support. This is divided between close air support near the front line of troops and interdiction at a distance from the front line to slow enemy movement. Both missions require flying over enemy ground troops and therefore involve risk from SAMs. They also require longer loiter times over the ground than strike missions, meaning that they can only be conducted when there is friendly air superiority.

Finally, aircraft can rebase to different hexes. All reinforcements arriving in theater must initially rebase. Units in theater can also rebase. Based on peacetime exercise reports, the game assumed that it takes approximately a game turn to set up operations and maintenance facilities at new bases.

NAVAL SURFACE FORCES

Naval surface forces are represented in surface action groups (SAGs), carrier strike groups (CSGs), lightning carrier groups (LCGs), and amphibious groups. The size and composition of these forces vary by nation, as the United States, China, and Japan all have different fleet compositions (as mentioned above, the Taiwanese surface fleet would be largely destroyed in the initial phases of a conflict).

SAGs can launch anti-ship missiles at enemy surface ships, launch cruise missiles at ground targets, or conduct ASW; however, their primary value is in intercepting enemy missiles and aircraft. (China's large surface fleet has several potent SAMs, which pose a threat to U.S. and Japanese aircraft. U.S. and Japanese SAGs can similarly threaten Chinese aircraft while also potentially intercepting some

123 The game standardized squadron size for simplicity. Thus, the squadrons align roughly with Air Force doctrine but not with specific units, which vary greatly in size.

124 As approximately 90 percent of aircraft losses for the United States occur on the ground, attrition from air combat is less frequent than observers might have thought. The results chapter discusses this in detail.

125 This dynamic is developed in Chapter 4 of "Scorecards," in Heginbotham et al., *The U.S.-China Military Scorecard*, 71-93.

of China's tactical ballistic missiles, or TBMs.) However, after their missiles are depleted, ships must return to port and rearm, during which time they are vulnerable. All SAGs can also conduct ASW, which is a particular specialty of the Japan Maritime Self-Defense Forces (JMSDF).

SUBMARINES

Submarines are grouped into squadrons of four submarines. Diesel submarines, due to their shorter endurance compared with nuclear submarines, generally 30 to 45 days, must constantly rotate back to port for refueling and resupplying. Both Chinese and Japanese diesel submarine squadrons on the board therefore represent four submarines actively hunting and four submarines transiting back and forth from the hunting ground.¹²⁶

Submarines can hunt other submarines. The United States and Japan begin with some submarines forming a barrier on the first island chain, intercepting Chinese submarines and inflicting attrition on them. They are aided by U.S. and Japanese MPA. Conversely, China can assign some submarines to intercept U.S. nuclear-powered submarines (SSNs) approaching the Taiwan Strait.

Submarines are potent threats to surface ships and can engage them with torpedoes and anti-ship cruise missiles (ASCMs). The speed of SSNs makes them much more effective at searching the open ocean. U.S. SSNs can hunt Chinese amphibious shipping in the Taiwan Strait (JMSDF submarines would not be able to concurrently hunt in the strait due to battlespace management issues). Their effectiveness there is diminished by Chinese corvettes and MPA actively conducting ASW, as well as a barrier at the entrance/exits to the strait comprised of Chinese submarines and minefields that China plants over the course of the opening weeks. Chinese submarines would not enter the strait itself in order to make it a free fire zone for these ASW forces.

CYBER

The game included cyber at the operational level. Both sides have cyber exploits they can use against the other. These exploits are modeled as system penetrations that passively grant intelligence while they are undetected. However, teams can activate these exploits to conduct cyberattacks, thereby generating one-time effects. Once these active effects are used, the exploit is assumed to be identified and patched. The previously discussed restriction of the game to proven capabilities means that these effects, while potent, are not magic wands. For example, power can be shut down at some ports to degrade Chinese amphibious lift, but there is no ability to destroy all of China's electrical grid.

The game did not include strategic cyber effects that might affect the U.S. homeland or military command and control systems. These effects might have operational impact in the Western Pacific but lie beyond the scope of this project.

126 China has good reason to stagger its submarine deployments given uncertainty about the arrival times of U.S. surface forces from other theaters and Japanese entry in the war. Similarly, Japan cannot surge all its diesel submarines because of uncertainty about when China will begin hostilities. For a discussion of this dynamic, see Heginbotham et al., *The U.S.-China Military Scorecard*, 196.

Ground Combat Map

Figure 3: Ground Combat Map



Source: CSIS.

Ground combat occurs on a different scale than the air and missile combat that dominates the operational map. While missiles fly at the speed of sound over thousands of kilometers, ground combat unfolds at the speed of a tired infantryman crawling forward under enemy fire. Thus, the ground map of Taiwan uses hexes measuring 30 kilometers (19 miles) across and uses the same 3.5-day turns. Within each hex, there is movement of the forward edge of the battle area. Ground forces include leg infantry, mechanized infantry, armor, artillery, engineers, and attack helicopters, each of which have different movement speeds and combat values. These combat values can be enhanced by combat air support provided by friendly aircraft. A key element of ground combat is the interdiction provided by Chinese aircraft, which slows Taiwanese movement.

While missiles fly at the speed of sound over thousands of kilometers, ground combat unfolds at the speed of a tired infantryman crawling forward under enemy fire.

Players alternated between the operational map and the ground map, moving forces and initiating combat on each map during a turn.

Sensitivity Analysis

Each iteration (run of the game) was set in a specific scenario with plausible assumptions about each variable. A scenario refers to the specific combination of assumptions used for one iteration. The scenario where all variables are set to their most plausible values is called the base scenario. As discussed earlier, varying the assumptions from iteration to iteration allowed the investigators to develop judgments about the effects of those variables on the likely outcome. The next chapter explains these most likely base case assumptions and the excursion cases that the project tested.

Assumptions—Base Cases and Excursion Cases

Every wargame requires assumptions about dozens of variables, from the grand strategic and political context, through the strategic military situation, down to minute details about operations and weapons. This chapter describes the assumptions underpinning the wargame’s base scenario and the alternative assumptions (called “excursion cases”) that the project explored.

A “base case” in the project’s terminology is the most likely value of a given variable. “Most likely” does not mean certain but simply more likely than other possibilities. The base scenario is a game iteration wherein all the variables are set to their base case (so that no variables take on a less likely value). The project ran three iterations of this base scenario.

An “excursion case” is a less likely but plausible value of a given variable. Given the limitations of time and resources, the project selected excursion cases based on two criteria: (1) those variables that might have the greatest impact on the outcome of a scenario, and (2) those base case elements that were most uncertain. The project ran a total of 24 game iterations: three base scenarios and 21 scenarios with alternative assumptions.

By playing iterations of the game with excursion cases, the project team was able to assess the sensitivity of the findings to alternative assumptions. An “excursion scenario” is a game iteration that used one or more excursion cases. Some excursion scenarios varied a single assumption. Most varied several assumptions; as noted above, varying assumptions one by one would have required playing over 33.5 million games.

The table below summarizes the major assumptions, their base case, and the excursion cases explored.

Table 2: Major Assumptions in Base Case and Excursion Cases

Assumption	Base Case	Excursion Case
Grand Strategic: Political Decisionmaking		
China		
China invades, decides D-Day		-----
Taiwan		
Taiwanese resistance	Strong	-----
United States		
U.S. entry into war	Automatic	Taiwan stands alone; U.S. bombers delayed to D plus 4 ¹²⁷ ; U.S. combat starts at D plus 14
U.S. troops on Taiwan	None	U.S. MLR pre-deployed
Japan		
Japan basing rights	Granted	Japan neutral
JSDF entry	In response to attack	JSDF engages on D-Day
JSDF operations	All allowed after entry	JSDF remains defensive
Others		
Philippines	Out	Philippines allows basing
Other allies/partners	Australia only	-----
Opportunistic aggression	None	U.S. holdout for simultaneous crisis
Strategic: Order of Battle, Mobilization, and Rules of Engagement		
Order of Battle		
China	Base	Increased Chinese IRBMs; Chinese TBM holdout
Taiwan	Base	Fewer Taiwanese Harpoons
United States	Base	U.S. submarines withheld
Japan	Base	-----
Mobilization		
Chinese mobilization	D minus 30	-----
U.S. mobilization	D minus 14	U.S. mobilizes on D-day; no U.S. “show of force”

127 With the day that China’s invasion begins being “D-Day,” D plus 1 is the day after the invasion, and D minus 1 is the day before the invasion.

Taiwanese reaction	Immediate	Taiwanese forces paralyzed to D plus 4
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Rules of Engagement

Chinese strikes on U.S./Japanese territory	Authorized	-----
U.S. strikes on mainland	Authorized	U.S. strikes on mainland forbidden

Operational and Tactical: Competence, Weapons, and Infrastructure

Competence

PLA amphibious	Same as United States in World War II	Reduced PLA amphibious competence
Taiwan ground	Same as China	Reduced Taiwanese ground force competence
PLAAF	Same as United States	Reduced PLAAF air-to-air competence

Weapons

Maritime strike for JASSM	Works	No maritime strike JASSM
Ship defenses	Works	Ship defenses poor
ASAT and cyber	Moderately effective	-----
Fifth-generation aircraft	U.S. and China equivalent	Superior U.S. fifth-generation fighters

Infrastructure

HASs in Japan	As programmed	Increased HASs in Japan
Use of Japanese civilian airports	Only one regional airport per military base used	United States, Japan can use large Japanese airports

Source: CSIS.

Grand Strategic Assumptions: Political Context and Decision

This section discusses the base case assumptions about the grand strategic context of the conflict, particularly the conditions under which each state decides to join the conflict.

THE PRINCIPAL COMBATANTS: CHINA, TAIWAN, THE UNITED STATES, AND JAPAN

China: As discussed earlier, the project assumes that China has decided to launch an invasion. They have the advantage of deciding when the war starts and use that flexibility to attack preemptively taking advantage of tactical surprise. They will have created uncertainty about the timing of the attack by gradually expanding military exercises in the preceding years, making it difficult for other countries to know that this time is the real attack.

Taiwan: The project assumes that Taiwan resists vigorously. According to the Stockholm International Peace Research Institute, Taiwan's military spending as a percentage of GDP is 4.4 percent, China's is 1.7 percent,

and U.S. spending is 2.3 percent.¹²⁸ Taiwan's relatively high level of peacetime spending represents serious social commitment. Further, Taiwanese officials have repeatedly stated their intention to defend the island.

However, morale is hard to predict. While many countries have fought fiercely despite long odds (e.g., Finland in the Winter War and contemporary Ukraine), others have surrendered soon after invasions (e.g., Thailand and Denmark in World War II). When faced with a Chinese assault, Taiwan might capitulate rather than fight. There have been worrying reports about CCP penetration of the Taiwanese military.¹²⁹ The base case assumes that Taiwan resists to the maximum extent of its capabilities. However, the project recognizes that this is an assumption. As immediate Taiwanese capitulation would mean that there is no war, it is impossible to analytically wargame. Taiwanese morale is therefore outside the scope conditions of the project.

U.S. Entry into the War: The base case assumes immediate U.S. intervention. For reasons discussed at the outset of this report, such intervention seems more likely than not despite the lack of a formal treaty. The United States has deep historical ties to Taiwan, and U.S. policy opposes unilateral changes to the status quo across the Taiwan Strait. The United States defended Kuwait's autonomy in 1991 and defended Ukraine in 2022, albeit with weapons only in Ukraine's case. The United States has never foresworn the possibility of using force to defend Taiwan, and the Taiwan Relations Act stipulates that the United States will "consider any effort to determine the future of Taiwan by other than peaceful means . . . a threat to the peace and security of the Western Pacific area and of grave concern to the United States."¹³⁰ This language has been regularly echoed by administrations from both parties, including the present one, for decades.

Excursion: Taiwan stands alone.

Although the base case assumes immediate U.S. intervention, there may be circumstances under which the United States does not engage.¹³¹ Each time President Biden states that the United States would respond to Chinese attack, other administration stipulate that U.S. policy has not changed.¹³² Moreover, Biden may not be president in 2026. Actual decisions would depend heavily on the personality of the president and on the domestic and international circumstances of the conflict.

128 "SIPRI Military Expenditure Database," Stockholm International Peace Research Institute (SIPRI), n.d., <https://www.sipri.org/databases/milex>. For an explanation of the data, which includes, for the Chinese side, a number of categories not counted in China's official defense budget, see "Sources and Methods," SIPRI, n.d., <https://www.sipri.org/databases/milex/sources-and-methods>.

129 For example, see Huang Chia-lin and Jake Chung, "Colonel Accused of Allying with China," *Taipei Times*, November 23, 2021, <https://www.taipeitimes.com/News/front/archives/2022/11/23/2003789444>.

130 *Taiwan Relations Act*, Public Law, 96-8, April 10, 1979, <https://www.congress.gov/96/statute/STATUTE-93/STATUTE-93-Pg14.pdf>.

131 "What Is America's Policy of 'Strategic Ambiguity' Over Taiwan?," *The Economist*, May 23, 2022, <https://www.economist.com/the-economist-explains/2022/05/23/what-is-americas-policy-of-strategic-ambiguity-over-taiwan>.

132 Amy B. Wang, "Biden Says U.S. Troops Would Defend Taiwan in Event of Attack by China," *Washington Post*, September 19, 2022, <https://www.washingtonpost.com/politics/2022/09/18/biden-taiwan-military-china-attack/>.

Important international circumstances would include whether actions by Taiwan were seen as contributing to crisis (e.g., passing a referendum on formal independence); the reaction of other important actors (not least Japan); and the existence (or absence) of concurrent crises or events. Domestic circumstances in the United States (e.g., war weariness or economic downturn) might also act against U.S. involvement.¹³³

The “Taiwan stands alone” excursion case assumes no direct U.S. intervention. The United States commits no U.S. combat units of any kind to the conflict. Furthermore, without the direct involvement of the United States, Tokyo and other regional governments would view their own intervention as excessively risky and would therefore remain neutral. The United States and possibly other partners might allow weapons and ammunition resupply. However, unlike the situation in Ukraine, the Chinese defensive zone makes this essentially impossible (described below in Chapter 6).

Excursion: The United States delays authorization for combat operations one or two days.

This excursion case assumes the possibility of a minor delay of one or two days before the commencement of U.S. combat operations. Even when attacked, nations sometimes hesitate to respond militarily as they seek to understand what has happened. Sometimes this produces devastating results (for example, Clark Airfield in the Philippines at the beginning of World War II).¹³⁴ Given that the initial Chinese landing force unloads over several days, such a delay would affect the conflict by precluding U.S. bomber strikes (originating from Alaska and Hawaii) on the first turn.

Excursion: The United States delays combat operations for 14 days.

There might be a more substantial, two-week delay. In this excursion case, the U.S. national command authority attempts to preserve Taiwanese autonomy without paying the price of direct conflict by engaging Beijing through diplomacy to halt the invasion. This effort lasts for a week while the invasion unfolds. When diplomacy fails, the United States declares a no-fly zone over Taiwan, which China vigorously opposes. The United States gets drawn into direct conflict when this “low-cost” approach fails.

U.S. Troops on Taiwan: The base case has no substantial U.S. presence on Taiwan when the conflict begins. The United States has not stationed significant forces on Taiwan since the 1970s. A recent increase in 2021 raised the U.S. troop level on the island from 20 to 39; however, this force could do little

133 Daniel W. Drezner, Ronald R. Krebs, and Randall Schweller, “The End of Grand Strategy: America Must Think Small,” *Foreign Affairs*, May/June 2020, <https://www.foreignaffairs.com/articles/world/2020-04-13/end-grand-strategy>.

134 Despite being warned about the imminence of war and then about the attack on Pearl Harbor, the U.S. command in the Philippines allowed aircraft to be caught on the ground, with many destroyed. See Walter D. Edmonds, “What Happened at Clark Field,” *The Atlantic*, July 1, 1951, <https://www.theatlantic.com/magazine/archive/1951/07/what-happened-at-clark-field/639484/>.

beyond liaison.¹³⁵ Although stationing more U.S. troops would be militarily advantageous, it would provide a clear *cassus belli* for China. If the United States deployed troops to Taiwan in response to every Chinese exercise that could be serving as cover for an invasion, then the United States would quickly shut down many roads to peaceful resolution. Even if the United States knew when the invasion was coming and deployed troops to Taiwan only then, China could still seize on that deployment to justify their already planned invasion.

Excursion: U.S. forces deploy to Taiwan before conflict begins.

Although unlikely, it is theoretically possible that the United States would station forces on Taiwan before conflict begins. This could happen in two ways. First, concerns about Taiwanese security might drive the United States to position some forces there in peacetime despite vehement Chinese opposition. Second, Chinese mobilization might generate enough U.S. concern that it is willing to risk provocation by putting U.S. forces on Taiwan. In this excursion case, a Marine Littoral Regiment (MLR) deploys from Okinawa to Taiwan with its load of missiles and one reload, augmenting the shore-based fires of Taiwanese ASCMs.

Japan: Japan can influence the conflict in two major ways: (1) by allowing the United States to operate its forces from bases in Japan, and (2) with the direct intervention of the Japan Self-Defense Forces (JSDF). Japan hosts more U.S. bases and servicemembers than any other state in the world.¹³⁶ The United States operates these bases despite their being on sovereign Japanese territory. The proximity of these bases to Taiwan and the lack of nearby alternatives means that a major part of the U.S. response to a Chinese invasion operates out of Japanese bases.

Although Japan and China are not on friendly diplomatic terms and the United States and Japan are allied, Japanese intervention against China is not assured. The Treaty of Mutual Cooperation and Security between Japan and the United States binds the two countries in a limited defensive alliance. Article V states that, “Each Party recognizes that an armed attack against either Party in the territories under the administration of Japan would be dangerous to its own peace and safety and declares that it would act to meet the common danger in accordance with its constitutional provisions and processes.”¹³⁷ As Japan analyst Jeffrey Hornung observes, none of the critical decisions about Japanese assistance to U.S. operations are “legally automatic. . . . All these decisions are political, resting with the prime minister at any given moment.”¹³⁸ Despite these caveats, recent activities point to mutually coordinated action in the event of a war with China.

135 Erin Hale, “US Nearly Doubled Military Personnel Stationed in Taiwan This Year,” VOA, December 2, 2021, <https://www.voanews.com/a/pentagon-us-nearly-doubled-military-personnel-stationed-in-taiwan-this-year-/6337695.html>.

136 According to the Defense Manpower Data Center (DMDC), Japan hosts 55,000 U.S. military personnel. The next-largest concentration is Germany, with 36,000. “Military and Civilian Personnel by Service/Agency by State/Country,” Defense Manpower Data Center, June 2022, <https://dwp.dmdc.osd.mil/dwp/app/dod-data-reports/workforce-reports>.

137 “Treaty of Mutual Cooperation and Security between Japan and the United States of America,” Ministry of Foreign Affairs of Japan, signed January 19, 1960, <https://www.mofa.go.jp/region/n-america/us/q&a/ref/1.html>.

138 Jeffrey W. Hornung, *Japan’s Potential Contributions in an East China Sea Contingency* (Santa Monica, CA: RAND Corporation, 2020), xvi, https://www.rand.org/pubs/research_reports/RRA314-1.html.

There are recent suggestions that Japan would participate to some degree in the defense of Taiwan. Japan has built a formidable military. Japanese military spending is significantly greater than that of any other Asian state other than China or South Korea. The JSDF began deploying overseas for disaster relief and humanitarian relief early in the Heisei era.¹³⁹ Japan's new Defense White Paper warns that China's growing military muscle, overflights, and naval incursions "have become a matter of grave concern to the region including Japan and the international community."¹⁴⁰ A commission from Japan's ruling Liberal Democratic Party proposed increasing Japan's "counterattack capability."¹⁴¹ The 2015 update to the "Guidelines for Japan-U.S. Defense Cooperation" outlined an expanded set of roles for Japan in the event of "an armed attack against a country other than Japan" that "threatens Japan's survival."¹⁴² However, it would be a mistake to read these movements as definitive proof of wholehearted and immediate Japanese participation in the defense of Taiwan.¹⁴³

Given the U.S.-Japanese treaty and these recent (admittedly non-definitive) political developments in Japan, the base case assumes that Tokyo: (1) allows the United States access to U.S. bases in Japan freely from the outset; (2) directs the JSDF to engage Chinese forces only in response to a Chinese attack on Japanese territory (to include U.S. military bases in Japan); and (3) allows the JSDF, after entering the war, to conduct offensive operations away from Japanese territory.¹⁴⁴

This is also Japan's path of least resistance because it avoids a difficult internal decision and a potential confrontation with the United States. Furthermore, refusing the United States use of the bases would risk undoing the long-standing U.S.-Japanese alliance, which has underpinned Japanese security policy for 70 years.

Excursion: Japan participates from the beginning.

One excursion case assumes that Japanese forces participated actively from the beginning of the conflict. The events leading up to war could involve explicit threats to Japan or some other form of sharply exacerbated tensions between Beijing and Tokyo. Japanese officials have stipulated that preemptive attacks on adversary systems are constitutionally permissible if it

139 "Two Decades of International Cooperation: A Look Back on 20 Years of SDF Activities Abroad," Japan Ministry of Defense, Japan Defense Focus, no. 24, 2011, <https://warp.da.ndl.go.jp/info:ndljp/pid/11591426/www.mod.go.jp/e/jdf/no24/specialfeature01.html>.

140 Ministry of Defense, *Defense of Japan 2021* (Tokyo: 2021), https://www.mod.go.jp/en/publ/w_paper/wp2021/DOJ2021_Digest_EN.pdf.

141 Naoki Matsuyama and Ryo Aibara, "LDP Panel Hands Kishida Proposal for Counterattack Capability," *Asahi Shimbun*, April 28, 2022, <https://www.asahi.com/ajw/articles/14609609>.

142 "The Guidelines for Japan-U.S. Defense Cooperation," Japan Ministry of Foreign Affairs, April 27, 2015, <https://www.mofa.go.jp/files/000078188.pdf>.

143 Adam P. Liff, "The U.S.-Japan Alliance and Taiwan," *Asia Policy* 29, no. 3 (July 2022): 125–60, doi:10.1353/asp.2022.0038.

144 "Furthermore, a PLA attack on, or occupation of, the nearby Senkakus—which Beijing considers part of Taiwan (and thus PRC-claimed territory)—or strikes against U.S. facilities or forces within Japanese territory seem likely to quickly render thorny constitutional questions about collective self-defense moot." *Ibid.*, 156.

appears that preparations are under way for attacks against Japan.¹⁴⁵ A brewing Taiwan war might provide the circumstances that would justify preemptive action.¹⁴⁶

While obtaining the approval to enter the war could be cumbersome, the specific nature of the evidence of a triggering attack is not stipulated by law. It is plausible that a government might, under emergency conditions and with the advantage of a majority in the Diet, obtain such a declaration and begin to operate against Chinese forces. Having obtained a Diet declaration, the JSDF or civilian defense officials would likely be empowered to determine what adversary assets constituted a threat to Japan. This might result in Japan joining the war at the outset alongside the United States.

Excursion: Japan is completely neutral.

On the other hand, Japan might seek to prevent all U.S. military activities from its soil. Although mutual defense treaties give the United States the right to use its bases, the Japanese might balk. There is often a disconnect between peacetime expectations of military access and what is given in a crisis. In a study of historical patterns in the granting or withholding of access during U.S. military operations, Stacie Pettyjohn and Jennifer Kavanagh write, “peacetime and contingency access decisions are driven by fundamentally different dynamics.”¹⁴⁷ And despite strong public support for the U.S.-Japan alliance, public discussions of concrete issues, such as a Taiwan conflict, often lack clear or realistic appraisals of potential consequences—topics that would become acute when facing large-scale violence by China.

Excursion: The JSDF is limited to defensive operations.

Finally, the JSDF might be limited to defensive operations over Japanese territory even after entering the war. In this scenario, legal or political constraints prevent the JSDF from conducting operations away from Japanese territory. The only extraterritorial operation this excursion case allows Japan to conduct is ASW on its eastern approaches.

Other Allies, Partners, and Adversaries

A U.S.-China conflict would not happen in a vacuum. The stakes involved would be so great and the economic disruption so widespread that every country on the planet would react. This section lays out the base case and excursion cases for other countries.

Regional Allies and Partners: A Chinese invasion of Taiwan would put all countries in the region in a dilemma. On the one hand, they are more likely to fear the close power of Beijing than the distant power

145 See, for example, “「敵基地攻撃」65年前から論点、政府「自衛の範囲内」” [‘Base Attacks’ Debated Prior to 1965, Government Rules ‘within Scope of Self-Defense’], *Nikkei Shimbun*, November 25, 2021.

146 James Kraska and Yusuke Saito, “The Law of Military Operations and Self-Defense in the U.S.-Japan Alliance,” *Naval War College Review* 73, no. 3 (Summer 2020), 9, <https://digital-commons.usnwc.edu/nwc-review/vol73/iss3/8/>.

147 Stacie L. Pettyjohn and Jennifer Kavanagh, *Access Granted: Political Challenges to the U.S. Overseas Presence, 1945-2014* (Santa Monica, CA: RAND Corporation, 2016), <https://apps.dtic.mil/sti/pdfs/AD1021746.pdf>.

of Washington.¹⁴⁸ All have reasons to be wary of the strengthening of China’s position that might result from a conquest of Taiwan; furthermore, all have reasons to be friendly to the United States, which would be clamoring for access, basing, and overflight rights.¹⁴⁹ On the other hand are the dangers that would result from participation, either active (e.g., directing forces against China) or passive (e.g., granting the United States basing rights). The safest course of action for most countries would be to remain neutral.

Asian scholars are relatively unified in assessing that most countries would remain neutral. In congressional testimony, Bonny Lin, an Asia scholar at CSIS, argued that “India, the Philippines, Singapore, South Korea, Thailand, and Vietnam . . . may try to stay neutral or provide limited, less conspicuous forms of assistance.”¹⁵⁰ John Culver was more forthright:

I think you’d get a chilling set of answers if you approached authoritative people in our treaty allies—Australia, Japan, Thailand, the Philippines, South Korea and our partners like Singapore and important other countries in the region like Vietnam—and ask them in the event that China attacks Taiwan, will you back our military alliance? Will you assist in preventing Chinese conquest? With maybe one or two exceptions, I think the answer we would get is no.¹⁵¹

A more optimistic assessment by Zack Cooper and Sheena Chestnut Greitens posits some basing access granted by the Philippines, Singapore, South Korea, and Thailand, although this would only happen under “certain circumstances” and “would likely come with severe limitations.”¹⁵²

Based on these analyses, the project decided on the following as the base case for particular countries:

- **India, Singapore, Thailand, and Vietnam:** All would be concerned about Chinese encroachment but also fear Chinese power. They would be sympathetic to the United States and Taiwan but reluctant to expose themselves to Chinese attack. Thus, they would take a passive approach, allowing U.S. overflight and transit but not participating themselves or allowing operations from their territory.
- **South Korea:** South Korea would not only fear Chinese power but would also worry about hostile actions by North Korea, whether driven by the North Korean leadership or incentivized by China to distract the United States and Japan. Indeed, South Korean president Yoon Suk Yeol has said

148 The famous “stopping power of water” was first explicated in: John J. Mearsheimer, *The Tragedy of Great Power Politics* (New York: W. W. Norton & Company, 2001).

149 For a detailed assessment of the relative diplomatic, political, economic, and military influence of China and the United States in each country in the region, see: Bonny Lin et al., *Regional Responses to U.S.-China Competition in the Indo-Pacific: Study Overview and Conclusions* (Santa Monica, CA: RAND Corporation, November 2020), https://www.rand.org/pubs/research_reports/RR4412.html.

150 Bonny Lin, “U.S. Allied and Partner Support for Taiwan: Responses to a Chinese Attack on Taiwan and Potential U.S. Taiwan Policy Changes,” RAND Corporation, February 18, 2021, <https://www.rand.org/pubs/testimonies/CTA1194-1.html>.

151 David Wertime, “Former Intel Officers: U.S. Must Update Its Thinking on Taiwan,” *Politico*, October 8, 2020, <https://politi.co/36LgfuS>.

152 Zack Cooper and Sheena Chestnut Greitens, “Asian Allies and Partners in a Taiwan Contingency: What Should the United States Expect?,” In *Defending Taiwan*, edited by Kori Schake and Allison Schwartz (Washington, DC: American Enterprise Institute, 2022), <https://www.defendingtaiwan.com/wp-content/uploads/2022/06/BK-Defending-Taiwan-online-final.pdf>.

that in the event of a conflict over Taiwan, North Korea would likely stage a provocation that would draw South Korea's focus.¹⁵³ The project assumed that because of the pressing nature of the conflict with China the United States would release two of its four squadrons in South Korea. However, because of the continuing threat from North Korea, the other two squadrons would remain in South Korea for deterrence.

- **Australia:** Because of its close relationship with the United States and the stationing of U.S. forces there in peacetime, Australia would give access, basing, and overflight. Australian forces would participate in the South China Sea fight but be unavailable as a result for operations around Taiwan.
- **The Philippines:** The base case assumes that the Philippines remains neutral. This assumption was driven first by the relative weakness of the Philippine military compared with the Chinese military. For example, whereas China has a large and modern navy, the Philippines has a small coastal navy with only four ships over 1,000 tons. Its air force focuses on counterinsurgency, with only a small number of modern jet aircraft. This imbalance in relative strength was illustrated by the Philippines reaction when a Chinese vessel rammed and sank a Filipino fishing vessel in the vicinity of Recto Bank in the West Philippine Sea. President Rodrigo Duterte refused to take a strong stand against the Chinese incursion, later stating in public "I am powerless there."¹⁵⁴

The assumption of Philippine neutrality was also based on Duterte's general diplomatic shift away from being a close partner of the United States and attempting to balance between U.S. and Chinese interests in the region.¹⁵⁵ This move was driven by both personal animus toward the United States and the promise of Chinese investment into the Philippines.¹⁵⁶ As part of this shift, there was a move away from security cooperation with the United States, with the notice of cancellation of the Visiting Forces Agreement (VFA), which allows the United States to temporarily station forces on Philippine bases.¹⁵⁷

153 Jung H. Pak, *Trying to Loosen the Linchpin: China's Approach to South Korea* (Washington, DC: Brookings Institute, July 2020), <https://www.brookings.edu/research/trying-to-loosen-the-linchpin-chinas-approach-to-south-korea/>.

154 Rambo Telabong, "Chinese Vessel Sinks Philippine Boat in West PH Sea 'Collision'," *The Rappler*, June 12, 2019, <https://www.rappler.com/nation/232892-chinese-vessel-sinks-philipino-boat-collision-west-philippine-sea-june-9-2019/>; Isabel Guarco, "Filipinos Don't Trust Duterte to Handle China," *Foreign Policy*, July 12, 2019, <https://foreignpolicy.com/2019/07/12/filipinos-dont-trust-duterte-to-handle-china/>; and Aie Belagtas See, Basilio Sepe, and Luis Liwanag, "Duterte Says Philippines Powerless over South China Sea Rights," *Benar News*, July 27, 2020, <https://www.benarnews.org/english/news/philippine/annual-address-07272020153033.html>.

155 Thomas Lum, Ben Dolven, and Christina L. Arabia, *The Philippines: Background and U.S. Relations*, CRS Report No. R47055 (Washington, DC: Congressional Research Service, March 2022), 1, <https://sgp.fas.org/crs/row/R47055.pdf>.

156 Michael Sullivan, "Why Philippine President Rodrigo Duterte Distrusts The U.S.," *NPR*, October 11, 2016, <https://www.npr.org/sections/parallels/2016/10/11/497487363/why-philippine-president-rodrigo-duterte-distrusts-the-u-s>.

157 John Shaus, "What Is the Philippines-United States Visiting Forces Agreement, and Why Does It Matter?," *CSIS, Critical Questions*, February 12, 2020, <https://www.csis.org/analysis/what-philippines-united-states-visiting-forces-agreement-and-why-does-it-matter>.

Excursion: The Philippines allows U.S. basing.

An excursion case allows the United States to base aircraft out of Philippine military airports. What seemed like a sharp rupture with the United States during the Duterte era is now less clear. Between the failure of Chinese investment to materialize and Chinese actions in the South China Sea, the Philippines have had a partial reproachment with the United States.¹⁵⁸ The Philippines withdrawal from the VFA was postponed, then replaced by a recommitment to the VFA and other defense pacts.¹⁵⁹ Further, there is no clear assessment of what Ferdinand Marcos Jr.'s position is, despite the overall favorability of the United States in the Philippines.¹⁶⁰ Since being elected, Marcos Jr. has made statements strongly affirming Philippine rights in disputed areas of the South China Sea while simultaneously insisting that Philippine-China relations are “set to shift into higher gear,” indicating a continued desire for closer ties with China.¹⁶¹ With these mixed signals, it is possible that the Philippines would allow U.S. basing and overflight during a war against China.

The North Atlantic Treaty Organization (NATO) and Europe: Europe has been wary about becoming involved in the U.S.-China competition. China's immense economic power and the Europeans' lack of territory in the Pacific drives Europe to maintain good relations with China.¹⁶² None of these countries are so closely involved in Pacific affairs that they regard China as a direct threat that would warrant automatic participation in what could be World War III with potential nuclear consequences.¹⁶³ However, Europe is also wary of Chinese authoritarianism and desires to maintain the liberal international order.¹⁶⁴ The United States has engaged NATO and the European Union in its efforts to contain China and has had some success.¹⁶⁵ Despite these engagements, it is likely that most European countries would limit themselves to economic sanctions on China.

158 Derek Grossman, “Duterte’s Dalliance with China Is Over,” RAND Corporation, November 2, 2021, <https://www.rand.org/blog/2021/11/dutertes-dalliance-with-china-is-over.html>.

159 Ibid.

160 Lum, Dolven, and Arabia, *The Philippines*, 6.

161 Cliff Venzon, “Marcos Says Philippine-China Ties ‘Set to Shift to Higher Gear,’” *Nikkei Asia*, May 18, 2022, <https://asia.nikkei.com/Politics/Philippine-elections/Marcos-says-Philippine-China-ties-set-to-shift-to-higher-gear>; and Raissa Robles, “No Compromise on ‘Sacred’ Sovereignty, Says Philippines’ President-Elect,” *South China Morning Post*, June 1, 2022, <https://www.aacom.tr/en/asia-pacific/no-compromise-on-sacred-sovereignty-says-philippines-president-elect/2598142>.

162 Philippe Le Corre, “Europe’s Tightrope Diplomacy on China,” Carnegie Endowment for International Peace, March 24, 2022, <https://carnegieendowment.org/2021/03/24/europe-s-tightrope-diplomacy-on-china-pub-84159>; and Tom McTague, “The West’s World War II Moment,” *The Atlantic*, April 4, 2022, <https://www.theatlantic.com/international/archive/2022/04/western-response-to-china-russia-invasion/629465/>.

163 The United States would certainly be calling for greater participation from the Europeans and would likely invoke Article V of the NATO treaty in the event of a Chinese strike on Guam.

164 Stewart Lau, “EU Slams China’s ‘Authoritarian Shift’ and Broken Economic Promises,” *Politico*, April 25, 2021, <https://www.politico.eu/article/eu-china-biden-economy-climate-europe/>.

165 For example, NATO has expressed concern about “China’s growing influence and international policies.” “Brussels Summit Communiqué Issued by NATO Heads of State and Government (2021),” NATO, June 14, 2021, https://www.nato.int/cps/en/natohq/news_185000.htm.

The United Kingdom and France might be exceptions since they have sent military forces to the Pacific in the past and possess expeditionary forces.¹⁶⁶ However, those forces are not permanently stationed in the Pacific and would take a long time to arrive. The governments would likely take longer than the United States to decide about intervention, and the forces would not have used the warning time to increase readiness for deployment. When they do get there, the arrival of one or two small aircraft carriers and nuclear attack submarines would be useful but not decisive. The ability of other European countries to provide military aid to the United States in the Pacific is extremely limited even if these countries wanted to help. Therefore, the project assumed that Europe would not be a factor in the initial stages of the conflict that the wargame simulates.

Opportunistic Aggressors: Russia, North Korea, Iran, or others might take advantage of U.S. distraction to launch aggressive action in their own spheres and attempt to settle long-standing territorial claims. Opportunistic aggression would still be risky for the aggressor if its local opponents are powerful. For example, if North Korea stages a provocation, that might bring other combatants into the conflict against China, such as South Korea, NATO, or the Gulf states, if it looked like the military operations were connected.¹⁶⁷ To have an effect during the short timelines of the game, opportunist aggression would require close coordination between China and the other state before the conflict breaks out so that the opportunistic aggression takes place simultaneously or nearly simultaneously with the Chinese attack. These preparations would likely be detected ahead of time.

Further, there is historical experience. During the 2000s, when the United States was deeply involved in conflicts in the Middle East, other nations did not take advantage of U.S. distraction, nor was there opportunistic aggression during the period of the Korean or Vietnam Wars. Thus, the base case assumes that other adversaries would not launch their own military operations and that the United States could focus on the conflict in the Western Pacific.

Excursion: There are simultaneous crises.

On the other hand, China itself might launch the invasion in response to U.S. distraction by a crisis elsewhere or might itself instigate others, particularly North Korea, to take advantage of the situation despite the risks. Therefore, an excursion case considers what might happen if the United States faced simultaneous crises. This excursion case reduces the U.S. order of battle and delays the reinforcement schedule.

166 For more on the United Kingdom and France in the Pacific, see Bruce Vaughn, Derek E. Mix, and Paul Belkin, “The United Kingdom, France and the Indo-Pacific,” Congressional Research Service, August 5, 2021, IF11052, <https://sgp.fas.org/crs/row/IF11052.pdf>; and Ben Berry and Hugo Decis, “Posturing and Presence: The United Kingdom and France in the Indo-Pacific,” IISS, June 11, 2021, <https://www.iiss.org/blogs/military-balance/2021/06/france-uk-indo-pacific>.

167 Josh Smith, “Home to 28,000 US troops, South Korea is unlikely to avoid a Taiwan conflict,” Reuters, September 26, 2022, <https://www.reuters.com/world/asia-pacific/home-28000-us-troops-skorea-unlikely-avoid-taiwan-conflict-2022-09-26/>.

Strategic Assumptions: Orders of Battle, Mobilization, and Rules of Engagement

The next set of assumptions covers the strategic context, namely the force structure, mobilization, and doctrine of combatants.

ORDER OF BATTLE

Orders of battle (OOBs) are “the identification, strength, command structure, and disposition of the personnel, units, and equipment of any military force.”¹⁶⁸ OOBs are critical for designing wargames because they specify what units participate, their location, and their strength. However, OOBs are often not published in detail for security reasons, and the project therefore had to deduce them from publicly available documents.

China: The Chinese OOB is derived from best estimates in open-source intelligence, principally from IISS, Jane’s weapons descriptions, and the annual report by DOD to Congress about the Chinese military.¹⁶⁹ The lack of documents corresponding to the U.S. Future Years Defense Program and reports on Programs of Record means that some educated guesswork about Chinese aircraft and ship production is required. However, there is less uncertainty in projecting a 2026 scenario than one in the 2030s or later.

The Chinese missile inventory is particularly important. In the base case, all Chinese conventional ballistic missiles are available within the timescale of the game (generally three to four weeks) and have warheads that are appropriately matched to whatever land-attack mission they are tasked to perform. For example, warheads used against aircraft parked on U.S. and Japanese air bases are optimized for such attacks by using 3-pound bomblet submunitions.

However, Chinese missile inventories, their warhead types, and their availability are highly uncertain because of the lack of Chinese published material. Because missiles account for so many of the U.S. air and naval losses across all scenarios, the project explored two Chinese missile-related excursion cases.

Excursion: China has increased TBM inventory.

This excursion case explores the effect of additional TBMs (beyond the base case) in China’s inventory by 2026.¹⁷⁰ China has stopped adding short-range ballistic missiles to its ballistic missile inventory (and may be reducing such inventories) in favor of other forms of firepower for short-range missions (particularly strike aircraft and long-range Multiple Launch Rocket

168 U.S. Department of Defense, *DOD Dictionary of Military and Associated Terms* (Washington, DC: November 2021), 162, <https://irp.fas.org/doddir/dod/dictionary.pdf>.

169 See “Chapter Six: Asia,” in International Institute for Security Studies, *The Military Balance*, 218–313; Jane’s Group UK, “Janes: China”; and Office of the Secretary of Defense, *Military and Security Developments Involving the People’s Republic of China*, 2020.

170 Office of the Secretary of Defense, *Military and Security Developments Involving the People’s Republic of China 2021* (Washington, DC: Department of Defense, 2021), <https://media.defense.gov/2021/Nov/03/2002885874/-1/-1/0/2021-CMPR-FINAL.PDF>. SRBM numbers have remained relatively constant, while the report highlights growth in the number of DF-26s deployed.

Systems) and longer-range missile systems, particularly the DF-26. China could shift additional force structure toward longer-range TBMs, particularly those with boost-glide hypersonic missiles. In this excursion case, the Chinese inventory of intermediate-range ballistic missiles (IRBMs) and boost-glide missiles is 50 percent larger than that stipulated in the base case, both for land-attack and anti-ship missiles.

Excursion: China has reduced TBM inventory.

Conversely, China's TBM inventory might be reduced if more TBMs are withheld for nuclear missions or as a hedge against other conflicts. Despite the PLA's new emphasis on joint operations and jointness, PLARF assets have only partially been integrated into the Theater Command (TC) structures, which are designed to facilitate joint operations. Unlike the other services, there is, for example, no PLARF deputy commander within the TC staffs.¹⁷¹ The PLA or its political overseers might opt to withhold some DF-26 launchers, with their interchangeable nuclear and conventional warheads, for an enhanced nuclear deterrent.¹⁷²

Furthermore, China's TBMs may not have an optimal warhead to target match. The base case assumes that China has analyzed and built the ratio of unitary to submunition warheads that maximizes their impact in each iteration played. However, it is possible that China's targeting plans are either wrong or that they are forced to change them in the war. This would force China to use less-efficient unitary warheads against aircraft in the open.

Given possible missile holdouts and a less than ideal mix of warhead types, an excursion case reduces the number of Chinese medium-range ballistic missiles (MRBMs) and IRBMs by 25 percent.

Taiwan: As mentioned above, the sheer volume of Chinese missiles makes Taiwan's air and naval forces almost irrelevant; besides a few squadrons that are isolated in Taiwan's underground shelter until they are dug out, these forces are destroyed in the first few days of an invasion. However, the same is not true of Taiwan's ground forces, which become critical to the outcome of the operation.

The OOB for active units of the Taiwanese military comes from Ian Easton and the IISS 2022 *Military Balance*.¹⁷³ For the ground forces, two tweaks were required. First, Easton provides very specific brigade and battalion numbers for the whole force, and the ostensible force structure has remained relatively stable since his book was published. However, the botched transition to an all-volunteer force has caused personnel numbers to drop significantly and units to be undermanned.¹⁷⁴ To an extent, this could be

171 David C. Logan, "Making Sense of China's Missile Forces," in Phillip C. Saunders et al., *Chairman Xi Remakes the PLA: Assessing Chinese Military Reforms* (Washington, DC: National Defense University Press, 2019), 410–417, <https://ndupress.ndu.edu/Publications/Books/Chairman-Xi-Remakes-the-PLA/>.

172 Sky Lo, "Could China's 'Hot-Swappable' Missile Systems Start an Accidental Nuclear War?," *Bulletin of the Atomic Scientists*, April 8, 2022, <https://thebulletin.org/2022/04/could-chinas-hot-swappable-missile-system-start-an-accidental-nuclear-war>.

173 See Appendix III in Easton, *The Chinese Invasion Threat*; and "Chapter Six: Asia," in International Institute for Security Studies, *The Military Balance*, 308.

174 Paul Huang, "Taiwan's Military Is a Hollow Shell," *Foreign Policy*, February 15, 2022, <https://foreignpolicy.com/2020/02/15/china-threat-invasion-constription-taiwans-military-is-a-hollow-shell/>.

offset by having reservists backfill into active units, but Easton's numbers are still inflated. The base scenario therefore reduced the number of maneuver battalions in each brigade by one. These resulting notional battalions are still small by U.S. standards but comparable to their Chinese counterparts.

Second, the division between heavy and light mechanized infantry in the table is somewhat arbitrary. On the one hand, Taiwan's M-60 tanks (and M-1 tanks, if they arrive by 2026) are much heavier than the light armored vehicles associated with Chinese marine and airborne units.¹⁷⁵ On the other hand, Taiwan's mechanized infantry is mounted in old M-113s with 20-mm guns, and Taiwan still has many M-41 and M-48 tanks, which date from the 1950s and early 1960s. Furthermore, China's ZTL-05 amphibious assault gun is a derivative of the British 105-mm L7 gun that is likely able to penetrate Taiwan's M-60s.¹⁷⁶

Major sources for the Taiwanese reserves were Easton et al., IISS's 2021 *Military Balance*, and GlobalSecurity.org.¹⁷⁷ Information on Taiwan's reserve brigades is thin, but a few things are known. They are large but not well prepared. There is, however, some variation in quality and readiness. There are several levels. A-level brigades are the best prepared and reportedly include one battalion of active cadre per brigade as well as an artillery battalion. Other levels are less well defined. Some sources suggest a second level includes military personnel affiliated with military educational institutions and that the brigades include artillery. Beyond 21 or 24 "first-line" reserve brigades, there are coastal defense units and a very large but even less well-equipped force of local reserves or militia. The project models the "first-line" reserve battalion as having half the lethality of an active-duty battalion. For artillery, IISS lists 2,093 artillery pieces in the inventory.¹⁷⁸ Most are probably old, and many may not be serviceable but could be used to field 60 artillery battalions in the active and reserve forces.¹⁷⁹

Excursion: Taiwan has not received ground-launched Harpoons.

Because the PLA must come to Taiwan and land on one of a few suitable beaches, the invasion is vulnerable to short-range ASCMs. Indeed, the original article prescribing a "porcupine strategy" for Taiwan described mobile coastal-defense cruise missiles as "at the top of this list" of systems for Taiwan to acquire.¹⁸⁰ There is currently a deal for the United States to sell

175 100 M-1A2T tanks are scheduled to be delivered between 2024 and 2026. Inder Singh Bisht, "Taiwan to Receive First Two Abrams Tanks in June," *Defense Post*, March 17, 2022, <https://www.thedefensepost.com/2022/03/17/taiwan-to-receive-abrams-tanks/>.

176 Massimo Annati, "Wheels of Fortune: Armoured Vehicle Evolution," *Military Technology* 44, no. 6 (2020), <https://monch.com/ebooks/military-technology/2020/06tdc3qkm/12/>.

177 Ian Easton et al., *Transformation of Taiwan's Reserve Forces* (Santa Monica, CA: RAND Corporation, 2017), https://www.rand.org/pubs/research_reports/RR1757.html; "Chapter Six: Asia," in International Institute for Security Studies, *The Military Balance*, 308; and "Republic of China Army- Reserve Forces," Global Security, n.d., <https://www.globalsecurity.org/military/world/taiwan/rr.htm>.

178 "Chapter Six: Asia," in International Institute for Security Studies, *The Military Balance*, 308.

179 This assumes that 33 artillery pieces are used to generate 18-gun battalions.

180 William Murray, "Revisiting Taiwan's Defense Strategy," *Naval War College Review*, vol. 61, no. 3, March 29, 2018, 27, <https://digital-commons.usnwc.edu/nwc-review/vol61/iss3/3>.

100 ground-based Harpoon launchers and 400 missiles to Taiwan.¹⁸¹ If that sale goes through, those missiles would have a large impact on a Chinese invasion. However, there have been reports of a possible delay.¹⁸² Furthermore, the United States sent some Harpoons to Ukraine, which may delay the Harpoon delivery to Taiwan.¹⁸³ Therefore, an excursion case assumes that these Harpoons are not on Taiwan at the start of the invasion.

The United States: Many budget documents and official statements fed into the U.S. OOB, with some extrapolations to 2026 required. These included the Department of Defense's FY 2023 budget overview, the service budget highlight books, the Navy's 30-year shipbuilding plan, and, for the Army and Air Force, force structure projections contained in their operations and maintenance budget justification books. Location of individual units, where needed, came from the websites of individual military bases.¹⁸⁴

The reinforcement schedule assumes global sourcing: U.S. forces from around the world would be sent to the Pacific. Some U.S. forces head to Taiwan from the north and east. These appear on the game's operational map. Other forces would head there via the Indian Ocean. As noted in Chapter 3, these latter forces engage the Chinese in abstracted battles around the South China Sea.

As has been seen during the conflict in Ukraine, modern militaries expend munitions at a high rate. The game, therefore, tracks the most important munitions, especially those with limited inventories.¹⁸⁵

181 Mallory Shelbourne, "State Department Authorizes \$2.37B Harpoon Missile Sale to Taiwan," USNI News, October 26, 2020, <https://news.usni.org/2020/10/26/state-department-authorizes-2-37b-harpoon-missile-sale-to-taiwan>.

182 Zhu Ming, "[Insider] The U.S. Is Delaying the Delivery of the Shore-Mounted Harpoon Missile System and Calling for a Price Increase. The Department of Defense Is Jumping – Report/Investigation," Up Media, March 6, 2021, https://www.upmedia.mg/news_info.php?Type=1&SerialNo=107839.

183 Lee Ferran, "US Sends Another \$1 Billion in Weapons for Ukraine, Including Truck-Mounted Harpoon Systems," Breaking Defense, June 15, 2022, <https://breakingdefense.sites.breakingmedia.com/2022/06/us-sends-another-1-billion-in-weapons-for-ukraine-including-truck-mounted-harpoon-systems/>.

184 For specific citations, see Office of the Under Secretary of Defense (Comptroller)/Chief Financial Officer, *Department of Defense Budget Overview for FY2023* (Washington, DC: Department of Defense, April 2022), https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2023/FY2023_Budget_Request_Overview_Book.pdf; Assistant Secretary of the Army, *FY 2023 Budget Highlights* (Washington, DC: U.S. Department of the Army, April 2022), <https://www.asafm.army.mil/Portals/72/Documents/BudgetMaterial/2023/pbr/Army%20FY%202023%20Budget%20Highlights.pdf>; Deputy Assistant Secretary of the Navy, *Highlights of the Department of the Navy FY 2023 Budget* (Washington, DC: U.S. Department of the Navy, 2022), https://www.secnav.navy.mil/fmc/fmb/Documents/23pres/Highlights_Book.pdf; and Department of the Air Force, *FY 2023 Budget Overview* (Washington, DC: Department of Defense, 2022), https://www.saffm.hq.af.mil/Portals/84/documents/FY23/SUPPORT_/BOB_28Mar_1125_LoRes.pdf?ver=5nrA8bBfhWoUSrvZ09CeHA%3d%3d. One of the authors does an annual analysis of military forces which feeds into the U.S. OOB: Mark Cancian, *U.S. Military Forces in FY 2022: Peering into the Abyss* (Washington, DC: CSIS, January 2022), <https://www.csis.org/programs/international-security-program/us-military-forces> The FY 2023 analysis will come out in the spring of 2023 with the FY 2024 budget.

185 These include a wide variety of systems. On the Chinese side, they include all variants of conventionally armed ballistic missiles, such as the DF-11, DF-15, DF-16, DF-21, DF-26, and DF-17, as well as long-range air- and ground-launched land-attack cruise missiles and ASCMs. On the U.S. and partner side, they include the LRASM, JASSM-ER, JASSM-XR, Tomahawk and Maritime Strike Tomahawk, JSM, SLAM, Harpoon, ARRW, Hsiung Feng variants (Taiwan), and Type-12 (Japan).

U.S. munitions inventories were estimated from budget documents and allowed for production lead times, generally two years. Some munitions, such as the Army's Precision Strike Missile (PrSM) and the Navy's JASSM, are not expected to be available in large numbers in 2026 and were therefore not included.¹⁸⁶ Other munitions not specifically tracked, such as air-to-air, were assumed to be available in sufficient numbers.

This inventory is distributed globally. Although large elements are in the Pacific already and in the United States, available for shipment overseas, other elements are in Europe and the Middle East. The base case assumes that all these munitions would be available for the conflict against China. The OOB has a decrement to strategic airlift to redistribute these munitions and other supplies.

This approach accepts risk in other theaters, particularly in Europe and the Middle East. However, this would likely be the U.S. approach, given the immediacy of the conflict against China. Other regions would still have access to alternative munitions such as the Joint Direct Attack Munition (JDAM) or the Small Diameter Bomb (SDB) I and II, which are available in large numbers. Using these short-range munitions would increase risk to U.S. forces if conflict occurred, but given the lower capability of regional air defenses, this risk would likely be judged acceptable. Further, allies and partners could provide some standoff capabilities in these other theaters.

Excursion: Submarines are withheld for other missions.

Although they would likely be effective hunters of a Chinese amphibious force, U.S. SSNs have several other missions with which they are tasked. Most notably, they trail adversary ballistic missile submarines (SSBNs) to hold at risk the nuclear capability of hostile countries.¹⁸⁷ The base case assumed that all available SSNs are reassigned to either defeating the invasion of Taiwan or clearing the South China Sea since a conflict with China is an immediate and grave demand. However, some SSNs might be withheld for these other missions and therefore not be available for operations near Taiwan. Therefore, an excursion case assumes that two fewer submarine squadrons (eight SSNs total) are available to the U.S. player.

Japan: As in the U.S. case, Japanese defense holdings and deployments are relatively transparent, allowing the game OOB to be built from a variety of documents. The baseline for 2022 was established using IISS's Military Balance and cross-checked with information in Japan's annual Defense of Japan white paper.¹⁸⁸

186 Because PrSM full-rate production does not begin until 2025, the potential inventory in 2026 is under 100. Department of the Army, *Precision Strike Missile Selected Acquisition Report* (Washington, DC: April 2021), https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Selected_Acquisition_Reports/FY_2021_SARS/22-F-0762_PrSM_SAR_2021.pdf. Navy JASSM is unavailable because the Navy does not begin procurement until late in the five year planning period, many years after the Air Force. Air Force JASSM is available.

187 Sherry Sontag, Christopher Drew, and Annette Lawrence Drew, *Blind Man's Bluff: The Untold Story of American Submarine Espionage* (New York: PublicAffairs, 2016).

188 See, for example, Japan Ministry of Defense, *Defense of Japan* (Tokyo: 2022), https://www.mod.go.jp/en/publ/w_paper/wp2022/DOJ2022_EN_Full_02.pdf.

A Medium-Term Defense Program outlines broad future plans every five years.¹⁸⁹ For production and acquisition rates and other specifics, the OOB used data from annual military budgets, published in English in abbreviated detail and in full detail in Japanese.¹⁹⁰ Japanese defense spending has been trending upward since 2013, increasing 26 percent through 2021, with the declared intention of increasing spending further in the future. Within Japan’s proposed 2023 budget, the acquisition of additional standoff strike capability is listed as the number one priority for strengthening defense capability, and this project assumes that it will have acquired a small inventory of Joint Strike Missiles (JSMs), among others, by 2026.

WARNING AND MOBILIZATION

Although in all scenarios conflict was assumed to occur after a period of crisis, China’s attack was still able to achieve tactical surprise. (See next section for discussion of mobilization.) The reason is the precedent of Ukraine, where adversary forces freely relocated without triggering conflict, though the other side made precautionary moves.

In the base case, China takes measures to minimize warning time by, for example, using a large exercise to mask its preparation and delaying measures that would provide unambiguous warning, such as requisitioning large numbers of civilian lift ships, until late in the process. The project team postulates that these unambiguous signals would begin at D minus 30. Although the United States and Taiwan would see these preparations, there would likely be considerable uncertainty about Chinese motivation and intentions. Thus, the base case assumes that Taiwan and the United States would have unambiguous warning at D minus 14.

With this warning, the United States alerts its forces and moves some forward in an effort to deter China. The United States frequently moves forces forward to signal its resolve during periods of crisis in accordance with doctrine about “Phase 0.” If deterrence fails, then under this concept forward-based forces would strengthen the US military response. In the base case, these deployments consist of a CSG sent to the Ryukyus (in addition to the CSG in Japan) and two bomber squadrons sent to Guam.

Excursion: There is no U.S. “show of force.”

Although forward deployed forces might strengthen deterrence, they become highly vulnerable when inside the Chinese defensive bubble. Thus, if the United States were reasonably certain that China could not be deterred, it would be prudent to keep forces far from the Chinese mainland before D-Day. In this excursion case, the CSG stays outside of the second island chain, while the bomber squadrons stay in the contiguous United States until D-day. The effect is that China cannot destroy them in a surprise attack with TBMs.

189 See, for example, “Medium Term Defense Program (FY 2019 – FY 2023),” Japan Ministry of Defense, December 18, 2018, https://warp.da.ndl.go.jp/info:ndljp/pid/11591426/www.mod.go.jp/j/approach/agenda/guideline/2019/pdf/chuki_seibi31-35_e.pdf. A new program is due shortly after this document goes to press and has been discussed in the media.

190 For the full 2022 Ministry of Defense budget, see “一般会計歳予算各目明細書、令和4年度防衛省所管” [General Appropriations Budget Statement under the Jurisdiction of the Ministry of Defense in FY2022], Japanese Ministry of Defense, August 31, 2021, <https://www.mod.go.jp/j/yosan/kakumoku/2022/kakumoku-ippan.pdf>.

Nevertheless, even after unambiguous strategic warning from the intelligence community, there would be some hesitation. Residual uncertainty about Chinese intentions, fears of escalating the crisis, and concerns about alarming the public would mitigate against aggressive action. Thus, the base case assumes that the United States surges some but not all its forces. However, the alert allows forces to move more quickly once the conflict begins.

John Culver, a former national intelligence officer for East Asia and now an Asia expert at the Carnegie Endowment for International Peace, argues that Chinese preparations to invade Taiwan would be seen months or even years ahead of time.¹⁹¹ It is certainly true that China would need to prepare, and many of these actions would be visible. However, it is not clear how quickly these preparations would be interpreted as signaling an invasion and how quickly military action would be taken in response. Leaders in target or allied states may also fear that defensive preparations would prompt or provoke attacks that might not otherwise occur or, alternatively, might cause self-inflicted harm from damage to economic markets or panic buying.¹⁹²

Excursion: The United States mobilizes late.

In a Taiwan crisis, U.S. leaders might misinterpret Chinese preparations, wish to avoid exacerbating tensions, or be ambivalent about accepting the risks of direct conflict with a nuclear-armed power. The “late U.S. reaction” excursion case eliminates the two-week reaction period prior to hostilities and delays the arrival of U.S. forces by two weeks relative to the base case. Thus, no U.S. air elements reinforce peacetime presence in Japan or Guam, and U.S. naval forces arrive later than in the base case.

The base case assumes that Taiwan responds quickly to invasion. This means that there is no hesitation or delay caused by political indecision or Chinese actions such as propaganda, sabotage, or special forces attacks. Furthermore, Taiwanese command and control has dispersed or taken cover, so they are not vulnerable to a decapitating Chinese first strike.

Excursion: Taiwan has a delayed reaction.

An excursion case examines what might happen if the Taiwanese response were delayed because of Chinese action or Taiwanese political hesitation. In this excursion case, military forces in the threatened zone operate, but other forces are frozen for one turn (one half week).

RULES OF ENGAGEMENT

Rules of engagement are “directives issued by competent military authority that delineate the circumstances and limitations under which United States forces will initiate and/or continue combat

191 John Culver, “How We Would Know When China Is Preparing to Invade Taiwan,” Carnegie Endowment for International Peace, Commentary, October 3, 2022, <https://carnegieendowment.org/2022/10/03/how-we-would-know-when-china-is-preparing-to-invade-taiwan-pub-88053>.

192 Jake Thomas, “Zelensky Reveals Why He Didn’t Warn His Citizens of Russian Invasion,” *Newsweek*, August 16, 2022, <https://www.newsweek.com/zelensky-reveals-why-he-didnt-warn-his-citizens-russian-invasion-1734268>; and Amy Mackinnon and Mary Yang, “Ukraine Urges the West to Chill Out,” *Foreign Policy*, January 28, 2022, <https://foreignpolicy.com/2022/01/28/ukraine-urges-the-west-to-chill-out/>.

engagement with other forces encountered.”¹⁹³ They are important for wargames because they govern the actions that players can take.

Chinese Strikes against the United States: Because the United States will be striking the Chinese homeland, the base case assumes that the U.S. homeland is not a sanctuary. However, the ability of the Chinese to conduct strikes against the U.S. homeland and thereby affect operations in the Western Pacific is extremely limited. A few special forces might infiltrate and attack a small number of high-value targets but not enough to materially affect military operations in the Western Pacific.

In theory, the Chinese might send a submarine to the U.S. West Coast to attack cities and maritime facilities. In the play of the game, the Chinese submarine fleet was fully occupied fending off U.S. and Japanese warships in the Western Pacific. Even if the Chinese decided to divert a few submarines to such attacks, their effect on military operations would be small. Their psychological effect on the U.S. population might be large, but this would take time to affect military operations. Some game participants hypothesized that the Chinese would mine U.S. ports, thereby preventing the exit of Navy ships.¹⁹⁴ Such an attack might, in theory, be done stealthily. However, prewar surveillance during a time of heightened crisis would identify any Chinese military forces operating near the West Coast, and the Chinese have not demonstrated an ability to do such operations from merchant ships.¹⁹⁵

The Chinese might launch economic, information, and diplomatic initiatives to isolate the United States and undermine popular support for the conflict. However, the effects of such efforts would not be manifest in the short time duration of this game.

U.S. Strikes against Mainland China: There is ongoing debate about whether the United States would strike targets on mainland China during a conflict. On the one hand, striking a nuclear power’s territory threatens nuclear escalation. State adversaries have been extremely careful about attacking the homeland of a nuclear power.¹⁹⁶ In providing HIMARS to Ukraine, for example, the United States

193 U.S. Department of Defense, DOD Dictionary, 188.

194 For discussions in the popular press, see Lyle J. Goldstein, “Chinese Sea Mines Are Threatening the U.S. Navy,” *National Interest*, September 13, 2019, <https://nationalinterest.org/blog/buzz/chinese-sea-mines-are-threatening-us-navy-80251>. For a more general guide on Chinese naval mining, see Andrew S. Erickson, Lyle Goldstein, and William S. Murray, *Chinese Mine Warfare: A PLA Navy “Assassin’s Mace” Capability* (Newport, RI: China Maritime Studies Institute, U.S. Naval War College, 2009), <https://digital-commons.usnwc.edu/cmsi-red-books/7/>.

195 Such an attack is not impossible. An earlier CSIS study looked at ways that the United States might be surprised in the opening moves of a great power conflict. One of the surprise vignettes involved cruise missile strikes against West Coast cities. However, the probability of such an attack is low, and its ability to significantly delay deployments, as opposed to terrorizing the civilian population, is unclear. The United States does have defenses, though these are not robust. See Cancian, *Coping with Surprise in Great Power Conflict*, especially vignette #11 “Cruise missile strike against the U.S. homeland,” 109–110.

196 Ukrainian attacks during the Russo-Ukrainian war mostly target Russian-claimed territory in Ukraine although there have been a few attacks on military facilities in the Russian homeland. For a good summary of the debate regarding Chinese nuclear policy up to 2017, see Caitlin Talmadge, “Would China Go Nuclear? Assessing the Risk of Chinese Nuclear Escalation in a Conventional War with the United States,” *International Security* 41, no. 4 (April 2017): 50–92, doi:10.1162/ISEC_a_00274.

reportedly attached the condition that no attacks on undisputed Russian territory be conducted with them.¹⁹⁷ Similarly, the United States has refused to supply Ukraine with ATACMS because it could strike deep into Russian territory. In the case of the Korean War, which occurred before China had acquired nuclear weapons but after the Soviet Union had, the United States refrained from striking bases in both China and the Soviet Union.¹⁹⁸

On the other hand, military advantage would come from attacks on the Chinese mainland. U.S. airpower could attack Chinese aircraft on the ground when they are most vulnerable and sink Chinese amphibious ships in port. The United States has built a large inventory of JASSM-ERs for this purpose. Additionally, there will be a desire for revenge against China: China will have killed thousands of Americans and, if it strikes Guam, attacked U.S. territory. In World War II, the United States struck the Japanese homeland through the Doolittle raid as soon as it was able, not for military advantage but to achieve propaganda value for striking back at an aggressor.

Some experts have speculated about the United States striking the first blow and attacking the Chinese fleet in port when unambiguous warning has been received.¹⁹⁹ This would inhibit or even prevent the Chinese from establishing a beachhead in the first place. However, it would initiate a war with the United States as the aggressor, provoking all the adverse political consequences related to such an action. Further, arguments for striking on unambiguous warning would run into the memories of Iraqi weapons of mass destruction in 2003, when unambiguous strategic warning turned out to be erroneous.

The base case assumes limited, non-preemptive attacks on the Chinese mainland. The United States can attack Chinese air bases and ports that are directly involved in Chinese strikes on Taiwanese and U.S. forces. It rules out a broader air campaign aimed at destroying Chinese infrastructure, industry, leadership, and command and control as being too provocative. This appears to be a middle course between a preemptive strike or broad attack on Chinese society and a prohibition against any homeland strikes at all.

Excursion: U.S. National Command Authority rules out strikes on mainland China.

Regardless of what U.S. military planners may assume during peacetime about the most efficient application of U.S. military force in a Taiwan scenario, major rules of engagement and especially questions related to mainland strikes will ultimately be decided by the president, who will weigh a wide variety of military, political, and diplomatic considerations. The president may judge that the risk of escalation is too high given the potential benefits. The president might also believe that the United States could prevail without strikes against the mainland. Thus, this excursion case assumes a presidential prohibition against any mainland strikes.

197 Leo Sands and Robert Greenall, “Ukraine War: Russia Says US ‘Adding Fuel to Fire’ by Sending Longer-Range Rockets,” BBC, June 1, 2022, <https://www.bbc.com/news/world-us-canada-61655577>.

198 William Stueck, *Rethinking the Korean War: A New Diplomatic and Strategic History* (Princeton, NJ: Princeton University Press, 2002), 118–141.

199 For example, Karl P. Mueller et al., *Striking First: Preemptive and Preventive Attack in U.S. National Security Policy* (Santa Monica, CA: RAND Corporation, 2006), 100–101, <https://www.rand.org/pubs/monographs/MG403.html>.

Operational and Tactical Assumptions: Competence, Weapons, and Infrastructure

The base case assumes that U.S., Chinese, and Taiwanese forces have equivalent levels of operational competence. Unless there was strong evidence to the contrary, the project assumed that they would maintain operational competence. For capabilities where some doubt existed, excursion scenarios investigated what would happen if forces were not able to match their announced capabilities.

In the case of conflicts between the United States and potential opponents (including China), this assumption tends to bias against the United States since its training standards are higher than most. Taking all sides' capabilities at face value may give a modest boost to China since it has more unproven capabilities than the United States—from the ability to execute an anti-ship ballistic missile strike to simply moving troops from ship to shore in an amphibious landing.

The decision to assess capabilities at face value also recognizes the great uncertainty in such judgments, given the dynamic condition of China's military capabilities. Chris Dougherty, a wargaming expert at CNAS, made this argument in cautioning against downgrading estimates about the PLA because of overestimates about the Russian military. He noted that “Chinese military reforms over the last 20 years, combined with President Xi Jinping's counter-corruption policies, had created a more professional and accountable force” and “built advanced weaponry at a scale far exceeding that of Russia.”²⁰⁰ Equivalency also incorporates continued Chinese advances in operational competence over the next four years, particularly as they conduct exercises of increasing size.

OPERATIONAL COMPETENCE

As highlighted by the recent Russo-Ukrainian war, different militaries conduct operations with varying degrees of competence. These variations are often unclear a priori.

PLA Amphibious Competence: The base case assumes a high level of Chinese amphibious competence. This requires that the Chinese military increases the scale, intensity, and realism of landing exercises between now and 2026, that they are astute in evaluating and codifying lessons learned and in formulating and diffusing doctrine, and that they can execute doctrine in combat.²⁰¹ In calculating the ability of a Chinese amphibious fleet to get troops and materials ashore, the base case employs offload rates similar to those associated with late-World War II U.S. operations, including Operation Neptune

200 Christopher Dougherty, “Strange Debacle: Misadventures in Assessing Russian Military Power,” War on the Rocks, June 16, 2022, <https://warontherocks.com/2022/06/strange-debacle-misadventures-in-assessing-russian-military-power/>.

201 This would require exercises of increased size beyond the current battalion and lower landings. For an assessment of current PLA amphibious capabilities, see: Dennis Blasko, “China Maritime Report No. 20: The PLA Army Amphibious Force,” China Maritime Studies Institute, April 1, 2022, <https://digital-commons.usnwc.edu/cmsi-maritime-reports/20>.

(for the D-Day landings) and Operation Iceberg (the invasion of Okinawa).²⁰² These rates reflect hard won wartime experience that the Chinese do not have. On the other hand, modern technologies like helicopters and widely available amphibious infantry fighting vehicles facilitate more rapid offload.

Excursion: China has reduced amphibious offload rates.

While high competence is possible and useful to assume as the base case, it is entirely plausible that China's actual performance may be less skillful. Even if China continues to expand its amphibious training and exercises, it will lack the practical combat experience of the United States in World War II. The U.S. Marine Corps focused on amphibious attack prior to the war, conducting annual landing exercises of increasing scale between 1932 and 1941 and systematically developing procedures. Many of the operations conducted earlier in the war, such as Operation Watchtower (Guadalcanal) and the Torch landings in North Africa, were less smooth but provided valuable experience. Only after addressing those issues were the high offload rates (from D-Day and Okinawa) achieved.²⁰³ Although China may benefit from and build upon the documented lessons learned by the historical experiences of others, only large-scale experimentation and the codification of lessons learned from exercises can create practical capabilities.

In the Falklands War of 1982, for example, the lack of recent experience with amphibious operations and the impact of Argentine air and missile attack produced lower British offload rates than those achieved by Allied forces almost four decades earlier.²⁰⁴

This excursion case reduces Chinese amphibious lift by 30 percent to match the offload rate of the British in the Falklands instead of the Americans in World War II.

Taiwanese Army Training: The project assumed the Taiwanese units were as effective as similarly sized and equipped Chinese units. The project team recognizes that there is a vigorous debate about the quality of the Taiwanese armed forces. Some argue that its training is stylized and unimaginative, the readiness of units is poor, and conscripts acquire few useful military skills. On the other hand, the Taiwanese would be defending their homeland and might show the tenacity and ingenuity that the Ukrainians have shown in their struggle against Russia. Nevertheless, even with high morale, the lack of training and top-tier equipment means that Taiwanese reserve forces operate at half strength in the base case.

202 The project's definition of "offload" rates represents the percentage of theoretical lift capacity (in personnel and tons of equipment) of the total invasion fleet that is put on shore during a day of operations. Although LSTs, both then and now, are theoretically capable of disgorging their entire cargos in a matter of several hours, the historical average is far slower, with many LSTs left waiting offshore for days.

203 On the pre-war marine experience, see Jetek A. Isely et al., *The U.S. Marines and Amphibious War: Its Theory, And Its Practice In The Pacific* (Marine Corps Association Bookstore, 1998). On World War II operations, see Historical Division, Headquarters, *Western Pacific Operations: History of U.S. Marine Corps Operations in World War II* (Washington, DC: U.S. Marine Corps, 1971).

204 The lack of air superiority and the threat of air attack caused the British to unload at night and remove their transport ships from the San Carlos area during the day. Kenneth L. Privratsky, *Logistics in the Falklands War: A Case Study in Expeditionary Warfare* (Barnsley, United Kingdom: Pen and Sword Books, 2014).

Excursion: Taiwanese ground units are understrength.

Taiwan's ground forces may not be as ready and competent, unit-for-unit and type-for-type, as China's. Taiwan's military, and especially its army, was identified with the authoritarian politics of KMT rule, and the transition to democracy during the late 1980s and early 1990s brought suspicion of the institution. The attempted transition to an all-volunteer force, which originally aimed to phase out all conscription by 2013, has failed to produce the intended results. Recruiting shortfalls have required the continued use of conscription but with terms of service reduced from one year to four months.²⁰⁵ Moreover, even with continued conscription, the army has been unable to fill its ranks, with just 81 percent of its positions filled in 2020 (and personnel levels of between 60 and 80 percent in many combat arms units).²⁰⁶ Potentially disruptive reductions in force structure have also been undertaken, and the combination of those reductions and the failure to fully staff units has reduced the army's size from 200,000 in 2011 to 94,000 in 2022.²⁰⁷

Reserve personnel may fill vacancies in active-duty units during wartime, and Taiwan is exploring a variety of ways to increase numbers and improve the realism of its training.²⁰⁸ Nevertheless, 2026 is just a few years away, so Taiwan is running out of time to overcome these shortfalls.

This excursion case sets the combat power of Taiwan's active-duty army units at 75 percent that of similar Chinese units (i.e., the combat power of a Taiwanese light mechanized battalion is set at 75 percent that of a Chinese light mechanized unit).

Taiwan's reserve forces, already set at 50 percent of the combat power of corresponding active-duty units, are reduced to 75 percent of that strength, giving them combat power equal to 38 percent ($0.5 \times 0.75 = 0.38$) of a corresponding Chinese active-duty unit.

PLAAF Parity: The base case assumes that each "generation" of aircraft has equal capability, regardless of nationality. While the U.S. Air Force has hitherto undoubtedly been superior to the PLAAF, Air Force leaders and defense scholars warn that this superiority is eroding.²⁰⁹ The Air Force's greater experience with large air campaigns and stealth aircraft is counterbalanced by Chinese superiority in air-to-air missiles and their geographic advantage.

While U.S. air planners have run large air campaigns in recent decades, their Chinese counterparts

205 Vanessa Molter, "Taiwan's All-Volunteer Force Transition Still a Challenge," *The Diplomat*, August 31, 2019, <https://thediplomat.com/2019/08/taiwans-all-volunteer-force-transition-still-a-challenge>.

206 Paul Huang, "Taiwan's Military is a Hollow Shell: The End of Conscription Has Left the Army Critically Undermanned," *Foreign Affairs*, February 15, 2020, <https://foreignpolicy.com/2020/02/15/china-threat-invasion-conscription-taiwans-military-is-a-hollow-shell/>.

207 Personnel numbers are drawn from "Chapter Six: Asia," in International Institute for Security Studies, *The Military Balance*; and "Chapter Four: Europe," in International Institute for Security Studies, *The Military Balance* 111, no. 1 (London: 2011): 73–172, doi:10.1080/04597222.2011.559835.

208 "Taiwan Weighs Extending Compulsory Military Service beyond 4 Months," Reuters, March 23, 2022, <https://www.reuters.com/world/china/taiwan-weighs-extending-compulsory-military-service-beyond-4-months-2022-03-23/>; and Qin and Chien, "As China Rattles Sabers, Taiwan Asks: Are We Ready for War?"

209 John Xie, "Will China Surpass the US in Military Air Superiority?," VOA News, October 13, 2021, <https://www.voanews.com/a/when-will-china-surpass-the-us-in-military-air-superiority-/6270069.html>.

lack such experience.²¹⁰ The last wartime employment of large formations of Chinese aircraft was during the Korean War, and the last time that a Chinese combat aircraft shot down a manned aircraft of any type was in 1967, when a U.S. Navy F-4 was downed in southern China.²¹¹ During China's incursion into Vietnam in 1979, Central Military Commission directives prevented PLAAF combat missions beyond the border, and air units operating within Chinese airspace achieved sortie rates averaging only one flight every five days.²¹² Doctrinally, Chinese air practice has historically placed heavy emphasis on centralized control in both planning and execution and a heavy degree of ground control over flying units.

China has been working to address this shortfall in aerial planning and execution. In recent years, as new airframes have been brought into service, the PLAAF and People's Liberation Army Naval Air Force (PLANAF) have sought to adopt more flexible Western methods, such as giving authority to flight leaders, conducting unscripted and competitive exercises, and holding "golden helmet" competitions in air-to-air combat.²¹³ However, given the magnitude of the cultural adjustments required, doctrinal change is very much a work in progress.²¹⁴ Moreover, flight training continues to have stovepiped career progression with little movement of pilots between training and combat billets. Perhaps most importantly, there is no Chinese equivalent of the U.S. Air Force Air Weapons School ("Red Flag") or U.S. Navy's Strike Fighter Tactics Instructor program ("Top Gun"), schools designed to train selected pilots who then return to line units to become training planners and instructors.²¹⁵

Balancing the United States' superiority in doctrine and training are the advantages brought by China's long-range air-to-air missiles and geographic advantage. The Chinese PL-15 air-to-air missile outranges most Air Force Advanced Medium-Range Air-to-Air Missile (AMRAAM) variants, meaning that the Chinese will often get the first shot in combat beyond visual range.²¹⁶ Furthermore, the proximity of Taiwan to

210 For example, during a single day during the Gulf War (January 24, 1991), the US-led coalition flew 2,570 attack sorties, with additional sorties in support. "The Gulf War: A Chronology," *Air & Space Forces Magazine*, January 1, 2001, <https://www.airandspaceforces.com/article/0101chrono/>.

211 Kenneth Allen and Cristina Garafola, *70 Years of the People's Liberation Army Air Force* (Montgomery, AL: China Aerospace Studies Institute, April 2021), [https://www.airuniversity.af.edu/CASI/Display/Article/2564684/70-years-of-the-peoples-liberation-army-air-force/https percent3A percent2F percent2Fwww.airuniversity.af.edu percent2FCASI percent2FArticles percent2FArticle-Display percent2FArticle percent2F2564684 percent2F70-years-of-the-peoples-liberation-army-air-force percent2F](https://www.airuniversity.af.edu/CASI/Display/Article/2564684/70-years-of-the-peoples-liberation-army-air-force/https%20percent3A%20percent2Fwww.airuniversity.af.edu%20percent2FCASI%20percent2FArticles%20percent2FArticle-Display%20percent2FArticle%20percent2F2564684%20percent2F70-years-of-the-peoples-liberation-army-air-force%20percent2F).

212 Andreas Rupperecht, *Chinese Air Power in the 20th Century: Rise of the Red Dragon* (Harpia Publishing, 2019), 124–125.

213 Michael S. Chase, Kenneth W. Allen, and Benjamin S. Purser III, *Overview of People's Liberation Army Air Force "Elite Pilots"* (Santa Monica, CA: RAND Corporation, 2016), https://www.rand.org/pubs/research_reports/RR1416.html.

214 Derek Solen, "PLA Air Force Remedies Self-Defeating Training Culture," Jamestown Foundation, *China Brief*, vol. 22, no. 13, July 15, 2022, <https://jamestown.org/program/pla-air-force-remedies-self-defeating-training-culture/>.

215 Lyle J. Morris and Eric Heginbotham, *From Theory to Practice: People's Liberation Army Air Force Aviation Training at the Operational Unit* (Santa Monica, CA: RAND Corporation, 2016), 20–23, https://www.rand.org/content/dam/rand/pubs/research_reports/RR1400/RR1415/RAND_RR1415.pdf.

216 Douglas Barrie, "Air-to-Air Warfare: Speed Kills," IISS, September 9, 2022, <https://www.iiss.org/blogs/military-balance/2022/09/analysis-air-to-air-warfare-speed-kills>.

Chinese bases on the mainland will give China several advantages. First, Chinese pilots will be fresher during air combat than U.S. pilots, who will often have had to fly long distances from bases in Japan. Second, although Chinese SAMs could not effectively target U.S. fighter/attack aircraft over Taiwan, these SAMs give Chinese pilots a sanctuary from U.S. pursuit while ensuring that U.S. pilots must keep one eye on the ground during air combat. U.S. pilots will also need to watch for Chinese surface ships that push east of Taiwan. Third, Chinese AEW platforms will be more survivable because they can quickly retreat under the SAM umbrella of the mainland.²¹⁷

Excursion: The U.S. Air Force is more competent than the PLAAF.

It is possible that the United States' superiority in training and planning outweighs the technology and basing advantages that China has. As Baron von Richthofen, the World War I ace, observed, "the quality of the box matters little. Success depends upon the man who sits in it."²¹⁸ Therefore, an excursion case explores the impact of U.S. air-to-air lethality that is 30 percent greater than that of the Chinese.

Beyond the general strengths and weaknesses of the PLAAF and Air Force is the specific question about the relative quality of both sides' fifth-generation fighters. As a result of the U.S. aviation industry's more established and competitive position, the United States has operated stealth aircraft for longer and has more mature fifth-generation designs.²¹⁹ U.S. combat experience with stealth dates back to 1989 when two stealthy F-117As delivered ordinance against an airfield in Panama. Desert Storm in 1991 saw widespread stealth use. After thorough vetting, the F-22 achieved initial operational capability as the world's first fifth-generation aircraft in December 2005. It remains the only aircraft to have supercruise capability (i.e., the ability to maintain flight at supersonic speeds without the use of afterburners).²²⁰ The Air Force declared the F-35A combat capable in 2016 after prolonged development problems. It was designed without supercruise but has an extremely low radar cross-section and unparalleled sensor fusion, providing pilots with excellent situational awareness.²²¹

217 For a more in-depth discussion, see Biddle and Oelrich, "Future Warfare in the Western Pacific."

218 Manfred von Richthofen, *The Red Baron* (Norderstedt, Germany: Books on Demand, 2009), 160.

219 According to a 2018 estimate, U.S. firms accounted for 49 percent of the global aerospace market. According to a separate 2022 source, five of the top seven firms were American, while AVIC, China's leading aerospace company, was ranked twelfth. "The Global Aerospace Industry: Size & Country Rankings," Teal Group Corporation, July 16, 2018, https://aerodynamicadvisory.com/wp-content/uploads/2018/07/AeroDynamic-Teal_Global-Aerospace-Industry_16July2018.pdf; and "Top Aerospace Companies ranked by Revenue," FlightGlobal, August 19, 2022, <https://www.flightglobal.com/aerospace/top-100-aerospace-companies-ranked-by-revenue/149900.article>.

220 John Haire, "F-22A Took Long Road to Initial Operational Capability," Air Force, December 27, 2005, <https://www.af.mil/News/Article-Display/Article/132369/f-22a-took-long-road-to-initial-operational-capability/>; and "Air Force Declares F-35A Lightning II 'Combat Ready'," U.S. Department of Defense, August 3, 2016, <https://www.defense.gov/News/News-Stories/Article/Article/900930/air-force-declares-f-35a-lightning-ii-combat-ready/>.

221 Kris Osborn, "Sensor Fusion: The Secret Sauce That Makes the F-35 Revolutionary," *The National Interest*, September 1, 2021, <https://nationalinterest.org/blog/buzz/sensor-fusion-secret-sauce-makes-f-35-revolutionary-192873>.

Far less is known about the Chinese J-20 than U.S. stealth aircraft.²²² However, although the J-20 first flew in 2011, China's defense industry has not yet been able to produce the WS-15 engines that were intended to provide the J-20 with supercruise.²²³ It is equipped with canards and, with the latest WS-10C engines, thrust vectoring, which will give it high maneuverability, perhaps similar to the F-22. However, most analysts believe that it will also have a higher radar cross-section (i.e., less stealth) than either the F-22 or F-35.²²⁴ Little is known of the J-20's electronics. While the sensors will certainly have range and electronic warfare capability, the system is unlikely to incorporate the same degree of sensor fusion as the F-35.

Excursion: U.S. fifth-generation aircraft are superior to Chinese counterparts.

An excursion case explores the possibility that U.S. fifth-generation aircraft are more capable than Chinese fifth-generation aircraft. Although the J-20 will likely evolve into a fully capable fifth-generation fighter, it may not reach that stage within the 2026 timeframe of the game and thus may not be equal to the F-22 or F-35 in direct combat. This excursion case reduces the lethality of the J-20 to 4.5-generation standards while maintaining benefits that accrue to stealthy aircraft (e.g., reduced vulnerability to naval or ground-based SAMs).

WEAPONS EFFECTIVENESS

As noted above, the project generally accepted weapons effectiveness at face value. However, two particularly consequential cases vary this assumption.

JASSM-ER vs. Ships: The JASSM, a conventional, stealthy, air-launched ground-attack cruise missile, is a special case. Its long-range precision guidance and stealthy characteristics make it an important munition for the United States. The basic version is designed for ground attack. A critical judgment is whether the extended-range version, the JASSM-ER can strike naval targets. Although there is an anti-ship variant, the Long-Range Anti-Ship Missile (LRASM), relatively few of the latter will be available in 2026 (roughly 450 LRASMs vs. 3,650 JASSM-ERs).²²⁵

222 Even some superficial aspects of the aircraft have been misunderstood, as its length was initially reported at two meters longer than it actually is, and aspects of other Chinese aircraft have, in some cases, also proven wildly incorrect (and generally exaggerated).

223 Mark Episkopos, "China's Air Force Is Massively . . . As in Massively Flawed for One Reason," *The National Interest*, July 18, 2021, <https://nationalinterest.org/blog/reboot/chinas-air-force-massively-as-massively-flawed-one-reason-189870>. China continues to report progress with the WS-15, as it has done for a decade.

224 Mark B. Schneider, "Professional Notes: The U.S. F-35 versus the PRC J-20," U.S. Naval Institute, Proceedings, October 2017, <https://www.usni.org/magazines/proceedings/2017/october/professional-notes-us-f-35-versus-prc-j-20>.

225 LRASM inventory includes both Navy and Air Force projected for 2026, allowing for the long production lead time and some congressional additions. Data from U.S. Department of the Navy, *Department of Defense Fiscal Year (FY) 2023 Budget Estimates, Weapons Procurement, Navy* (Washington, DC: U.S. Department of Defense, April 2022), https://www.secnv.navy.mil/fmc/fmb/Documents/23pres/WPN_Book.pdf; Air Force JASSM inventory from U.S. Department of the Air Force, *Department of Defense Fiscal Year (FY) 2023 Budget Estimates, Missiles Procurement, Air Force* (Washington, DC: U.S. Department of Defense, April 2022), https://www.saffin.hq.af.mil/Portals/84/documents/FY23/PROCUREMENT_/FY23%20Air%20Force%20Missile%20Procurement.pdf?ver=QeRLpOSY7vcLmsKbr3C-Qw%3D%3D. Navy inventory of its JASSM version (AGM-158C) in 2026 will be only 31.

Publicly available information about the capabilities of the JASSM-ER is unclear. There are hints that it could have some anti-ship capability. In its FY 2022 budget request, the Navy introduced the AGM-158B JASSM-ER to “enhance long range strike and existing OASuW [offensive anti-surface warfare] capability.”²²⁶ The document suggests that it will be possible to “convert JASSM-ER software to a C++ software baseline, similar to LRASM, and focus on combining JASSM-ER strike capability and LRASM OASuW capability into a merged Navy JASSM baseline. Future efforts will expand both Navy strike and OASuW capabilities within Navy JASSM.”²²⁷ The Air Force also continues to upgrade variants of the JASSM-ER. Depending on the adjustments required to make the missile capable of anti-ship operations, it is possible that the capability could be retrofitted onto existing systems.

If the JASSM-ER’s infrared target recognition seeker has even modest capability against moving ships at sea, the impact would be enormous. By mixing JASSM-ERs with salvos of LRASMs, Chinese ships would have to expend interceptors engaging incoming salvos of JASSM-ERs, allowing more LRASMs to survive.

The base case assumes that the JASSM-ER has some limited capability to strike ships at sea. High numbers of these munitions allows a much greater volume of fire against the Chinese fleet.²²⁸

Excursion: No Maritime Strike JASSM.

There is a high degree of uncertainty about whether the JASSM-ER will have anti-ship capability by 2026. Because the United States will have many JASSM-ERs, and the ability of the Chinese amphibious ships to survive is central to the success of an invasion, this assumption would make a large difference in the game outcome. Hence, this excursion case assumes that the JASSM-ER does not have anti-ship capability.

Ship Defenses: The base case assumes that the missile defenses of both sides work as described in publicly available documents. This produces a single-shot probability of intercept of 0.70 and, with a shot doctrine of two interceptors per incoming missile, a combined intercept probability of 0.91.

There are few publicly available Pk figures for interceptors against missiles, but the 0.70 figure is roughly consistent with modeling work in the public domain. A 2017 thesis for the Naval War College, for example, cites a Pk of between 0.60 and 0.80 for the Standard Missile-2. The author of that study stipulates that the values given are not “actual figures” but “are within reasonable magnitude of the actual to produce valid and applicable results.”²²⁹ In the context of national missile defense, longtime analyst Dean Wilkening writes that “BMD designers apparently expect interceptor SSPKs around 0.80 to 0.85,” though he suggests that such probabilities “may be difficult to achieve in the presence of

226 U.S. Department of the Navy, *Department of Defense Fiscal Year (FY) 2022 Budget Estimates, Weapons Procurement, Navy*, Vol. 1 (Washington, DC: Department of Defense, 107), [https://www.secnav.navy.mil/fmc/fmb/Documents/22pres/WPN_Book.pdf#search=JASSM percent2DER](https://www.secnav.navy.mil/fmc/fmb/Documents/22pres/WPN_Book.pdf#search=JASSM%20percent2DER).

227 Ibid.

228 An unpublished background paper examines in detail why this capability is uncertain and why the project made the judgment that it did. This paper is available on request.

229 Justin K. Davis, “Development of System Architecture to Investigate the Impact of Integrated Air and Missile Defense in a Distributed Lethality Environment,” (Master’s thesis, Naval Postgraduate School, 2017), 33, <https://apps.dtic.mil/sti/pdfs/AD1053193.pdf>. The probability of hit for the SM-3 missile is placed somewhat higher, while that for the ESSM is lower.

countermeasures.”²³⁰ The Missile Defense Advisory Alliance reports that 79 of 97 hit-to-kill intercept attempts have been successful across all programs since 2001, a rate of 0.81.²³¹ Similar figures recur throughout the literature.²³²

Excursion: Chinese and U.S. ship defenses do not work as well as expected.

The history of modern warfare is replete with examples of systems, particularly missile systems, that underperform in combat.²³³ Missile tests are frequently conducted under ideal conditions that begin with checks to ensure that all systems are in working order. There are many points where the fog and friction of combat could dramatically degrade a weapon’s effectiveness.²³⁴ Even after combat, the effectiveness of systems is unclear. There was a lengthy (and still unresolved) debate about the effectiveness of missile defense against Scud missiles in Desert Storm.²³⁵ This difference between peacetime testing and wartime employment could mean that ship-based cruise missile defense is much less effective than assumed in the project’s base case.

By how much could ship-based cruise missile defense be degraded? A 2020 study of all cruise missile attacks on warships since 1967 concluded that 60 of the 162 missiles launched (or 37 percent)

230 Dean A. Wilkening, “A Simple Model for Calculating Ballistic Missile Defense Effectiveness,” *Science & Global Security* 8, no. 2 (1998): 183–215, <https://scienceandglobalsecurity.org/archive/sgs08wilkening.pdf>.

231 “U.S. Missile Defense Test Record – Missile Defense Advocacy Alliance,” Missile Defense Advocacy Alliance, December 2018, <https://missiledefenseadvocacy.org/missile-defense-systems-2/missile-defense-intercept-test-record/u-s-missile-defense-intercept-test-record/>.

232 For example, 0.7 in Perry et al., *Measures of Effectiveness for the Information-Age Navy: The Effects of Network-Centric Operations on Combat Outcomes*, 34; 0.75 in Blodgett et al., “A Tabu Search Heuristic for Resource Management in Naval Warfare,” 158; and 0.5–1.0 in Bath, “Overview of Platforms and Combat Systems,” 9.

233 Before the Vietnam War, operational tests indicated that the AIM-7 air-to-air missile would hit 71 percent of the time and the AIM-9 would hit 65 percent of the time. Based on these expectations, the F-4 was designed without guns. In fact, the kill rates for the two missiles were 9 percent and 15 percent, respectively, and gun pods were retrofitted to the F-4. Robert G. Angevine, “Adapting to Disruption: Aerial Combat over North Vietnam,” *Joint Forces Quarterly* 96, February 10, 2022, <https://ndupress.ndu.edu/Media/News/News-Article-View/Article/2076617/adapting-to-disruption-aerial-combat-over-north-vietnam/>.

234 For example, many of the hits by ASCMs were against ships that, although in an active war zone, did not employ their defensive systems. See Cmde BR Prakash VSM, “Analysis of Missile Effectiveness – A Historical Perspective,” Defense Research and Studies, August 8, 2020, <https://dras.in/analysis-of-missile-effectiveness-a-historical-perspective/>. Prakash’s work builds on earlier work by John C. Schulte, “An Analysis of the Historical Effectiveness of Anti-Ship Cruise Missiles in Littoral Warfare,” Naval Postgraduate School, September 1994, <https://calhoun.nps.edu/handle/10945/27962>.

235 Theodore Postol, “Optical Evidence Indicating Patriot High Miss Rates during the Gulf War,” Statement before the House Committee on Government Operations, April 7, 1992, <http://ee162.caltech.edu/notes/postol.pdf>. The Israelis concurred with Reuven Pedatzur, “1992The Israeli Experience Operating Patriot in the Gulf War,” Statement before the House Committee on Government Operations, April 7, 1992, https://web.archive.org/web/20141209235250/http://www.fas.org/spp/starwars/congress/1992_h/h920407r.htm. They were contested by Peter D. Zimmerman, Testimony before the House Government Operations Committee, Legislation and National Security Subcommittee, April 7, 1992, https://web.archive.org/web/20100520002222/http://www.fas.org/spp/starwars/congress/1992_h/h920407z.htm.

struck the target.²³⁶ Of the 63 percent that did not, some fell victim to missile failures or soft kill, which are handled separately within this project's model. Against ships that were on high alert and defended against the attack, 124 missiles scored 34 hits (or 27 percent). This contrasts with the base case, wherein multiple independently adjudicated intercept attempts result in an average of only 5.6 percent of subsonic and 7.4 percent of supersonic cruise missiles hitting their target.²³⁷

The excursion case increases the effectiveness of anti-ship missiles by postulating that 25 percent of missiles fired hit their target. Although this higher Pk is applied against both sides' ships, this change affects the Chinese more because they have far more ships exposed to missile attack.

Cyber and ASAT: Given the lack of historical evidence on the effectiveness of cyber and ASAT tools in operational warfare, the project credited each with being moderately effective. As discussed in Chapter 3, each side possesses cyber exploits that give passive benefits and could be used for one-time active effects. These effects are significant but not magical. For example, the United States can shut down power to some Chinese ports and reduce their lift by 20 percent that turn but cannot shut down all power in eastern China.

For ASAT warfare, the project assumes (1) that both sides possess moderately effective dazzling and electronic warfare capabilities, (2) that they use these immediately and consistently to degrade each other's ISR, (3) that co-orbital interference will take longer than the length of a game iteration (i.e., a month), (4) that both China and the United States possess some direct-ascent capabilities, and (5) that the United States is politically constrained from being the first to use direct-ascent weapons, but also (6) that if China uses its direct-ascent ASAT weapons, the United States can respond in kind, and (7) that ASAT use would greatly degrade adversary ISR capabilities.

INFRASTRUCTURE

Hardened Aircraft Shelters: The base case assumes that neither the United States nor Japan builds additional HASs prior to war. During the 1980s, the United States and its allies constructed roughly 1,000 HASs in Europe, South Korea, and northern Japan. Against Chinese ballistic missiles, HASs would reduce aircraft losses by forcing China to target individual shelters with unitary warheads and deny it the ability to destroy multiple aircraft with a single missile equipped with submunitions (cluster munitions). Analysts have, therefore, long encouraged the construction of additional shelters in areas under Chinese missile threat today, though little has happened since the end of the Cold War.²³⁸

236 Prakash, "Analysis of Missile Effectiveness – A Historical Perspective."

237 These numbers include a 5 percent chance of a critical failure for defending systems. See inset in Chapter 2, "Anti-Ship Missile Interception."

238 Alan J. Vick, *Air Base Attacks and Defensive Counters: Historical Lessons and Future Challenges* (Santa Monica, CA: RAND Corporation, 2015), https://www.rand.org/pubs/research_reports/RR968.html; John Stillion, "Fighting Under Missile Attack," *Air Force Magazine*, August 2009, <https://www.airandspaceforces.com/PDF/MagazineArchive/Documents/2009/August%202009/0809missile.pdf>; and Carl Rehberg and Mark Gunzinger, *Air and Missile Defense at a Crossroads: New Concepts and Technologies to Defend America's Overseas Bases* (Washington, DC: Center for Strategic and Budgetary Assessments, 2018), <https://csbaonline.org/research/publications/air-and-missile-defense-at-a-crossroads-new-concepts-and-technologies-to-de>.

Excursion: Japan has more HASs.

There are signs that both the United States and Japan are recommitting to hardening as part of an effort to improve operational resilience.²³⁹ This excursion case assumes that the United States and Japan build 400 additional shelters, for an estimated cost of \$2.4 billion.²⁴⁰

Access to Civilian Airfields: Attacks against aircraft parked in the open is effectively a density problem, with the probability of kill for each aircraft in target areas being determined by total missile coverage (the numerator) divided by the total potential parking area (the denominator).²⁴¹ The base case assumes minimal dispersion to civilian airfields.

Excursion: Japan grants increased access to civilian airports.

Dispersing Air Force aircraft to civilian airports could greatly expand the parking area that China must attack and thereby reduce US and Japanese losses. There is likely a decrease in operational efficiency that comes from stretching maintenance and support personnel across multiple sites. However, with the alternative being operating from damaged military fields, this efficiency loss is probably acceptable. Each Japan Air Self-Defense Force (JASDF) base seems to be paired with a regional civilian airfield.

An excursion case therefore expands access to civilian airports. If the United States and Japan can space aircraft on the ground farther apart than the submunitions of a Chinese missile can cover, then China would have to expend one missile per aircraft. This would quickly deplete China's inventory.

239 Measures to strengthen resilience, in part through hardening, is one of the seven priorities listed under Japan's commitment to "fundamentally strengthen defense capabilities" in the Japanese Ministry of Defense's 2023 budget request. Japan Ministry of Defense, "我が国の防衛と予算：令和5年度概算要求の概要" [*Defense Programs and Budget of Japan: 2023 Defense Budget Request*] (Tokyo: 2022), 3, https://www.mod.go.jp/j/yosan/yosan_gaiyo/2023/yosan_20220831.pdf. Separately, "host nation support" has been redefined to cover support for alliance resilience (with correspondingly less focus on base recreation activities).

240 South Korea recently funded the construction of 20 HASs on the U.S. Kunsan Air Base for \$125 million, or a little more than \$6 million per shelter. Will Bracy, "Hardened Aircraft Shelters Constructed at Kunsan," Kunsan Air Base, August 4, 2020, <https://www.kunsan.af.mil/News/Article/2301980/hardened-aircraft-shelters-constructed-at-kunsan/>. The Indian Air Force has built 108 HASs for roughly the same unit cost. "Indian Air Force Plans Building 108 Hardened Aircraft Shelters," *DefenseWorld.net*, July 3, 2017.

241 There are, of course, other aspects relevant to actual results of missile attacks, including the accuracy and reliability of missile and warhead, construction of the HASs, and the energy and effectiveness with which on-base dispersion is pursued.

Results

This chapter describes the results of the iterations. They are grouped in five categories of scenarios: base, pessimistic, optimistic, “Taiwan stands alone,” and “Ragnarok” (highly pessimistic).

The overall finding is that China is unlikely to succeed in an invasion of Taiwan in 2026 if four conditions hold.

1. Taiwan must vigorously resist. If it does not, the rest is futile.
2. The United States must join hostilities within days and with the full range of its capabilities. Delays and half measures make the defense harder, increase U.S. casualties, and raise the risk of the Chinese creating an irreducible lodgment on Taiwan.
3. The United States must have use of its bases in Japan. Without them, the United States cannot use its numerous fighter/attack aircraft.
4. Finally, the United States must possess enough air-launched, long-range ASCMs.

However, even a successful defense of Taiwan comes at great cost. The United States and its allies lose dozens of ships, hundreds of aircraft, and thousands of personnel. The high losses would damage the United States’ global position for many years. While Taiwan’s military is unbroken, it is severely degraded and left to defend a badly damaged economy on an island without electricity and basic services. China’s navy is in shambles, the core of its amphibious forces is broken, and thousands of soldiers are taken as prisoners or war.

Key Outcome: Taiwanese Autonomy

The key condition for judging outcomes was the continued autonomy of Taiwan as a political entity. This condition excludes consideration of damage to the Taiwanese economy or the extent of U.S. losses. While these factors remain relevant and the concluding chapter of this report considers them in the context of the military outcome, the stated U.S. and Taiwanese policy goal is autonomy, without a discussion of cost.

Most iterations lasted around six turns, representing three weeks of combat, though some iterations went longer. If results were uncertain when game play ended for outside players, the project staff would sometimes play a few more turns to clarify the outcome. The project staff made a judgment at the end about how to score the outcome. It is important to note that the full campaign, taken to its conclusion, would generally take months. The game investigates the first three or four weeks, which are the most intense for air and maritime operations. The most intense ground operations would happen later, as ground forces sought a conclusion.

Chinese amphibious, airborne, and air assault capabilities gradually deteriorate under U.S., Japanese, and Taiwanese attack, so China cannot rely on them indefinitely. If China can secure ports and airfields and keep them operational, they will ultimately win. If they cannot, Chinese forces will eventually crumble. In optimistic scenarios, Chinese amphibious capabilities would be destroyed in a week. In pessimistic scenarios, the Chinese amphibious fleet might survive to the end of a month. The status of Chinese-held ports and airfields on Taiwan was therefore the critical factor in determining the outcome of the operation.

The outcome of each iteration was scored as follows:

1. **Chinese Victory:** Chinese ground forces outnumber Taiwanese forces on the island. Once that happens, and the Chinese control enough airports and ports to bring the bulk of their ground forces over, they will eventually prevail, though the complete conquest of an island the size of Taiwan would take many months, barring a capitulation. Two iterations continued until total conquest; most iterations were ended when Chinese victory appeared inevitable.
2. **Stalemate:** Chinese forces have a significant lodgment ashore, and neither side can make rapid gains. Chinese forces have captured a handful of ports and airports. The United States is striking those facilities to make or keep them fully unusable, while China is attempting to repair them and make them fully functional. This outcome typically occurred when China was able to secure the southern part of the island and the facilities there.
 - a. **Stalemate, trending toward China:** China has a solid beachhead that is not in danger of being eliminated. They have more than three ports or airports on Taiwan, although these may be damaged. To defeat the invasion, the United States and its allies would have to keep these ports and airports suppressed, resupply Taiwan, and, possibly, commit ground forces to rescue the Taiwanese position. China would have to clear ports or airports with the engineers landed, possibly while under attack.
 - b. **Stalemate, indeterminate:** An ambiguous situation, often involving the loss of the entire Chinese amphibious fleet, but with Chinese forces securely ashore and having occupied several damaged port or airport facilities. Resolution depends on whether China can restore the captured facilities to supply and expand its forces before Taiwanese forces counterattack in strength. The campaign would take an extended period.

- c. **Stalemate, trending against China:** Although the Chinese have a significant beachhead, they do not possess a favorable enough force ratio to make quick gains against opposing Taiwanese ground forces. The Chinese amphibious fleet has suffered high attrition, and they have no working ports and airports on Taiwan. China is trying to substitute small civilian craft for the large amphibious carriers that it has lost, but as the British found at Gallipoli, this results in a dramatically lower supply throughput.²⁴² An important question on the Taiwan side would include the state of its ammunition stocks and the ability to resupply. Whatever the eventual outcome, it is not where the Chinese would want to be.
3. **Chinese Defeat:** The Chinese amphibious fleet is mostly destroyed, and the Chinese have not taken sufficient ports or airports such that major landing operations can continue. Relatively small Chinese forces are confined to a small landing area, and they are only receiving small amounts of supplies from airdrops and small civilian boats. At this point, it would be a matter of time for the Taiwanese forces to mop up Chinese survivors. The main challenge for the United States would not be in eliminating the remaining invaders but finding an acceptable off-ramp for hostilities.

Teams played five types of scenarios: base scenarios, pessimistic scenarios, optimistic scenarios, the “Taiwan stands alone” scenario, and “Ragnarok” scenarios. The latter four examined the impact of adjusting critical assumptions from their most likely base case to less likely excursion cases (discussed above in Chapter 4). This section summarizes the design of the scenarios run, the operational outcomes, the losses incurred, and which variables appeared to be critical.²⁴³ The discussion provides specific numbers and detailed descriptions. However, these are not intended to imply that these are precise predictions but rather to share the raw data on which the authors formed their judgments.

BASE SCENARIO

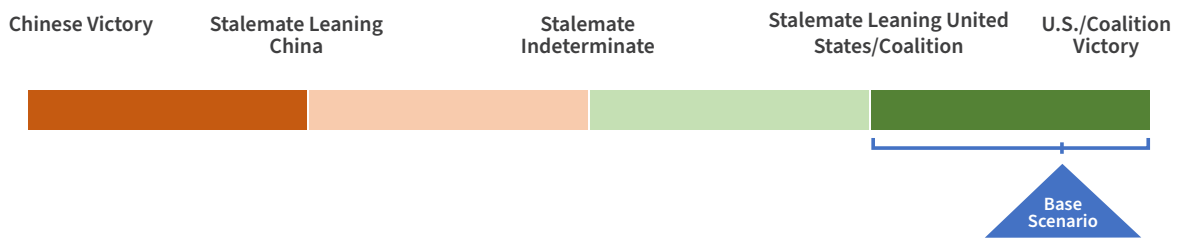
Design: The project team conducted three iterations of the base scenario (using only base case assumptions without any of the excursion cases described in Chapter 4).

Operational Outcomes: Two out of three of these iterations were decided quickly, with the Chinese forces ashore unable to capture major cities and out of supplies within 10 days. In one iteration, PLA forces landed in the south and captured the port at Tainan. However, U.S. air strikes prevented its use, and the Chinese position was untenable by D plus 21. This was the only iteration of the base scenario that was not judged to be a decisive Chinese defeat, instead scoring as “Stalemate, trending against China.” In all cases, at least 90 percent of the Chinese amphibious fleet was destroyed, leaving the forces ashore supported only by air drops and heliborne supplies.

242 At Gallipoli, the British were only able to deliver 300 to 400 tons of supplies daily to the peninsula. That is approximately 1/50th of the speed of China’s initial offload capacity in this project’s model. A primary limiting factor was the speed of offloading at the beach, rather than the number of craft; China’s larger fleet of civilian craft would therefore be of limited use until a port was captured. See James Eling, “Firepower 11: Artillery Logistics over the Shore at Gallipoli,” *The Principles of War Podcast*, September 11, 2019, <https://theprinciplesofwar.com/firepower/firepower-11-artillery-logistics-over-the-shore-at-gallipoli/>.

243 These do not include speculation about losses from a simultaneous operation in the South China Sea, for which sizable forces were withheld in game design on both sides. See “Abstracting Battles Elsewhere” in Chapter 3.

Figure 4: Operational Results: Base Case Scenario, Range, and Average



Source: CSIS tabulation of iteration results.

Chinese teams attempted different strategies that affected outcomes in all scenarios, including the base scenario. However, even with a sound Chinese strategy, the combination of challenges facing PLA invasion forces was too great to overcome. Despite the base cases assumption about a large but plausible number of civilian ships incorporated into the Chinese amphibious fleet, the buildup of PLA forces ashore is slow. Throughout the duration of the buildup and until ports and airports are captured and repaired, amphibious ships will be anchored off the invasion beaches, with ships shuttling between Taiwan and the Chinese ports as they empty. This is particularly true after the initial supply of amphibious assault vehicles is expended. In every iteration of the base scenario, U.S., allied, and partner forces were able to destroy shipping before the forces ashore were large enough to conduct sustained offensive action against defending forces flowing toward the beachhead. Anti-ship missiles delivered by Taiwanese shore batteries, U.S. aircraft, and U.S. and Japanese submarines all took a heavy and rapid toll.

Sound Chinese strategy could mitigate, but not stop, this attrition of the amphibious fleet. China has a substantial fleet of modern warships, and most Chinese teams placed SAGs, comprised of cruisers, destroyers, and frigates, to the east of Taiwan to serve as air and missile defense pickets. They also dispatched submarines further into the Western Pacific to keep U.S. surface forces at bay. These slowed attrition to the amphibious fleet while making the surface combatants themselves more vulnerable to attack. At the same time, Chinese missile forces were capable of suppressing Taiwanese air power and severely limiting (and attriting) the buildup of U.S. land-based tactical air capabilities in Japan. During the initial stage of the conflict, China's air forces enjoyed substantial air superiority over Taiwan and were able to employ ground-attack aircraft and bombers to obstruct the movement of Taiwanese reinforcements to the battle area. These strengths, however, were unable to offset the challenges of getting Chinese ground forces ashore in Taiwan and keeping them supplied once there.

In the base case iterations, China was able to land a total of 37 battalions. With losses deducted, China's strength at the end of the iteration averaged 30 battalions, or 30,000 personnel (including non-combat elements). On average, the size of the Chinese beachhead ashore measured roughly 2,600 km² (or 7 percent) of the total Taiwanese territory of roughly 36,000 km² by the end of game play.

Table 3: PLA Situation Ashore at End of Iteration, Base Case Average

	PLA End Strength Ashore (in thousands)	Controlled by PLA (km ²)	Duration of Campaign	Supply Capacity at End
Base Scenario	30	2,600	14 days	Air dropped only

Source: CSIS tabulation of iteration results.

Losses: Balanced against Chinese failure to achieve operational objectives in the base scenario were the large losses suffered by all the combatants. Considering the short period of time, U.S. air losses were greater than any witnessed since the Vietnam War. Naval losses were greater than anything experienced since World War II. Japan also suffered heavily: two out of the three base iterations saw strikes against airfields across the length of the archipelago. Taiwanese losses in personnel and infrastructural damage were great. China’s losses were also staggering and included large numbers of aircraft, virtually its entire fleet, and thousands of personnel. Although losses were high for both sides, the speed with which the base scenario ends (often decided by the sinking of China’s amphibious fleet after 10 days) limits losses in the ground campaign for both sides.

Table 4: U.S., Japanese, and Chinese Air and Naval Losses, Base Scenario

	Combat Aircraft Losses				Ship Losses			
	United States Total (USAF)	Japan	United States/Japan Total	China	United States	Japan	United States/Japan Total	China
Base Scenario	270 (206 USAF)	112	449	155	17	26	43	138

Source: CSIS tabulation of iteration results.

The relative strength of U.S. and Chinese air-to-air capability was unimportant because most aircraft were destroyed on the ground. The lack of U.S. and allied air bases within practical range of Taiwan led to crowding at the few bases available. Furthermore, most of those bases lack any HASs to mitigate damage. Thus, Chinese missiles destroyed many aircraft—about 90 percent of total U.S., Japanese, and Taiwanese losses—on the ground, despite the large number of U.S. and Japanese air and missile defenses on Okinawa.

The United States lost between 168 and 372 aircraft in the three base scenario iterations. Subtracting the 96 Navy fighter/attack aircraft lost on U.S. aircraft carriers in all base scenario iterations, the Air Force suffered losses between 70 and 274 aircraft, mostly on the ground. In one of the base scenario iterations, the Chinese team did not attack bases in Japan, but China did strike Andersen Air Force Base in Guam in every iteration, producing losses there. Japanese air losses were also high in two out of three iterations, averaging 122 aircraft, and were also largely incurred on the ground.

In all iterations of the base scenario, U.S. Navy losses included two U.S. aircraft carriers as well as between 7 and 20 other major surface warships (e.g., destroyers and cruisers). These losses were partly an artifact of U.S. forward deployment aimed at deterring China, as the scenario begins with two carriers and an additional SAG positioned in vulnerable positions off Okinawa. It also reflects the vulnerability of surface ships to large salvos of modern anti-ship missiles. These salvos exhausted the ships' magazines of interceptors; even with the base case assumption that shipborne missile defense works very well, there are simply too many attacking missiles to intercept. The JMSDF suffered even more heavily, as all its assets fall within the range of Chinese anti-ship missile systems, which include anti-ship ballistic missiles and long-range ASCMs as well as submarines and shorter-range munitions.

In all iterations of the base scenario, U.S. Navy losses included two U.S. aircraft carriers as well as between 7 and 20 other major surface warships (e.g., destroyers and cruisers).

Taiwan's air losses included roughly half of its operational air force, the majority lost on the ground to missile strikes. Even within the scope of these relatively short iterations, the 26 ships of Taiwan's navy (22 frigates and 4 destroyers) were destroyed by a combination of China's joint fire strikes and aggressive hunting by China's second-tier naval ships. The land battles were fierce but limited in scale, with Taiwanese army casualties averaging about 3,500, with about a third of those killed.

China's losses in the base scenario were also high. In all iterations, PLAN ships around Taiwan were the primary focus of attack, and China's naval losses averaged 138 major ships in the three iterations of the base scenario. On average, these included 86 amphibious ships (90 percent of the total) and 52 other major surface warships.²⁴⁴ Chinese aircraft losses, averaging 161 fixed-wing combat aircraft per iteration, were smaller than those for the United States. But in the base iterations, the United States never attacked Chinese bases (though they were permitted to do so according to the scenario assumptions), so all of China's air losses were suffered in the air. Therefore, China would have lost many aircrews but had no losses to ground crews.

China's overall personnel losses were high. In ground combat, China suffered an average of 7 battalion-equivalents destroyed, equal to Taiwan's ground losses. This would translate to about 7,000 casualties, roughly a third of whom are assumed killed. Another roughly 15,000 soldiers were lost at sea, with half assumed killed. Finally, many (and probably an overwhelming majority) of the 30,000-plus Chinese survivors on Taiwan would likely become prisoners at the end of combat.

Critical Variables: The LRASM was particularly useful because of its ability to strike Chinese naval forces and directly reduce Chinese invasion capabilities. In every iteration, the United States expended its entire global inventory of LRASMs (about 450 missiles) within the first week of the conflict.

244 Note: "Amphibious ship" losses refer only to losses of larger amphibious ships (e.g., civilian RO-ROs, LSTs, LPDs, and LHDs), not to smaller lighterage.

Because LRASM inventories were so limited, the base case assumption about the effectiveness of the JASSM-ER against ships played a critical role in the speed and effectiveness of that attrition campaign. In the base scenario, the inventory of several hundred LRASMs, with a range of 600 km, combined with thousands of JASSM-ERs, with even greater range and modest anti-ship capability, allowing U.S. bombers and tactical aircraft to rapidly attrite the Chinese fleet from beyond the range of its anti-aircraft defenses. Thus, the large inventory of JASSM-ERs provided the numbers necessary to conduct the anti-ship campaign quickly and at standoff distances (the implications of this are discussed in Chapter 6).

Because of the large JASSM-ER inventory and the uncertainty of its ability to strike ships, varying that assumption became a critical part of the research agenda. Long-range missiles were critical because Chinese air defenses were initially so formidable that no aircraft could get close enough to drop short-range munitions. Even stealth aircraft were at risk.

Pessimistic Scenarios

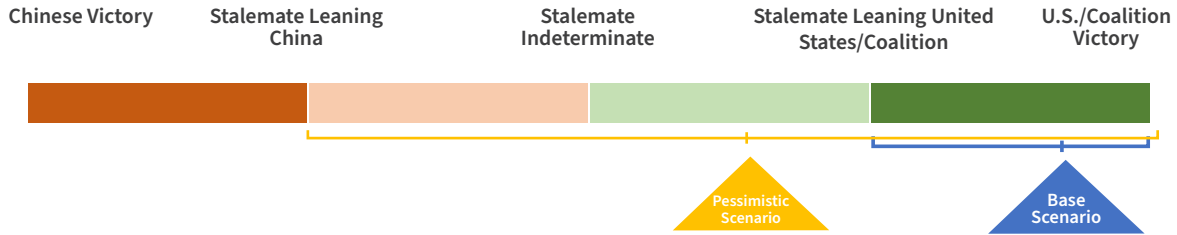
Nineteen iterations were run with pessimistic scenarios that incorporated excursion cases more favorable to China. The extreme “Taiwan stands alone” or “Ragnarok” scenarios are discussed separately. The large number of pessimistic iterations was driven by the operational results of the base scenario and the desire to examine how robust the base scenario outcomes would be in the face of plausible changes to assumptions.

Design: All 19 pessimistic iterations included the assumption that the JASSM-ER missile possesses no capability against ships at sea. As noted in the discussion of the base scenario, the JASSM had a decisive impact on outcomes, but its actual anti-ship capabilities are not well established. The first four pessimistic iterations used only the “No maritime strike JASSM” excursion case. The remaining 15 iterations included at least three additional pessimistic excursion case assumptions.

Twelve of the iterations included delayed U.S. mobilization, late engagement, or larger U.S. holdouts for other ongoing contingencies. Twelve of the iterations included pessimistic assumptions about Taiwanese operational competence or ability to react to the invasion quickly. Three included U.S. rules of engagement that prohibited strikes on mainland China. One iteration included an increased number of Chinese IRBMs, and one included Japanese prohibition of JSDF offensive action outside of Japanese water or airspace, even after attacks on Japan.

Operational Outcomes: The results of the pessimistic scenarios were significantly better for China than the base scenarios. Nevertheless, none resulted in a clear Chinese success (i.e., a Chinese occupation of Taipei or even more than a quarter of the island). Three of the 18 iterations resulted in a clear and decisive Chinese defeat, and the remainder had not produced decisive results at end of play, some 14 to 35 days into the campaign. Of those 13 cases of stalemate, 3 were judged to end “stalemate, trending toward China,” 7 were judged to end “stalemate, trending against China,” and 2 were “stalemate, indeterminate.”

Figure 5: Operational Results: Average and Range by Scenario Type



Source: CSIS tabulation of iteration results.

In stalemates judged to be trending toward China, the PLA controlled (or were soon to complete occupation of) Kaoshiung, Tainan, and much of the southern third of the island. In those cases, areas under Chinese control included several ports and airports; the United States had to devote many airstrikes against these facilities, while the Chinese raced to repair them.

Had the stalemated iterations been continued, the result would have been decided by the relative ability of the two sides to supply themselves from existing stocks or from new shipments to the island. For Taiwan, the United States, and its partners, this would have required running convoys to the island under air and missile attack. In China’s case, it would have required repairing logistical infrastructure while under air and missile attack. The United States was attempting to flow whatever tactical aircraft remained into the theater, while the PLA had used all of its ground-launched conventional ballistic missiles and had only a third of the long-range cruise missile inventory remaining to counter these final U.S. squadrons.

The more pessimistic assumptions used in a scenario, the worse the outcome for the United States. The three iterations run with only one pessimistic assumption (the “no maritime strike JASSM” excursion case) produced one decisive Chinese defeat and two that were trending against China. Those scenarios with additional pessimistic assumptions produced a wider range of results—with an average result significantly worse for the United States and its partners than the three more moderately pessimistic scenarios.

In all the pessimistic iterations, the PLA was able to land an average of 60 battalions. The final strength of PLA forces ashore, after losses, averaged 43 battalions, or 43,000 combat soldiers and accompanying support personnel. At the end of game play, the PLA controlled an average of 6,240 km² (or 17 percent) of Taiwan’s 36,000 km², though, as noted, there was considerable variation between games. Finally, it should be noted that the games lasted an average of six turns (or 21 days of campaign time). Although the result was often clear at that point, getting to final resolution would require many additional weeks of combat. In the case of stalemate, the war might have continued for many months.

Table 5: PLA Situation Ashore at End of Game Play, Pessimistic Case Average

	PLA End Strength Ashore	Territory Controlled by PLA (km ²)	Duration of Campaign	Supply Capacity at End
Base Scenario	30,000	2,600	14 days	Air dropped only
Pessimistic Scenarios	43,000	6,240	21 days	Damaged ports and airports; air; sometimes a few ships

Source: CSIS tabulation of iteration results.

Losses: Losses in the pessimistic scenarios (i.e., those more favorable to China) were again heavy, with average air and ground force losses higher for the United States, Japan, and China than in the base scenario and ship losses that were roughly comparable.

Table 6: U.S., Japanese, and Chinese Air and Naval Losses, Pessimistic Case Scenario

	Combat Aircraft Losses				Ship Losses			
	United States	Japan	United States/Japan Total	China	United States	Japan	United States/Japan Total	China
Base Scenarios	270(206 USAF)	112	454	155	17	26	43	138
Pessimistic Scenarios (Favors China)	484 (412 USAF)	161	646	327	14	14	28	113

Source: CSIS tabulation of iteration results.

The United States lost an average of 484 aircraft, roughly 70 percent higher than in the base iterations, with the Air Force losing almost twice as many as it did in the base iterations. Greater U.S. air losses were primarily a function of campaigns that were generally longer than the relatively quick Chinese defeats experienced in the base scenario iterations. The longer time horizons allowed the United States to bring more aircraft into theater—and to lose a significant portion of them on the ground.

In addition, with the “no maritime strike JASSM” assumption in effect, the United States relied relatively more on tactical aircraft to launch shorter-range munitions (JSMs and Joint Standoff Weapons, or JSOWs) against the Chinese fleet. This resulted in additional losses in the air as well as higher incentives for the Chinese to seek their destruction on the ground—often entirely exhausting the Chinese inventory of air- and ground-launched standoff missiles in the process.

U.S. air losses varied greatly from game to game, from a low of 90 to a high of 774 in these iterations. Variation was primarily a function of U.S. strategy, with some particularly aggressive teams bringing in reinforcements as quickly as possible, basing them close to Taiwan, and losing them in enormous numbers; other teams took a more cautious approach. Japanese losses averaged a third higher than in the base scenario iterations and were relatively consistent across iterations. China struck bases in Japan in every one of the pessimistic iterations.

China lost an average of 327 aircraft per iteration, ranging from a low of 48 to a high of 826. These air losses were roughly twice as high as in the base scenario. In half of the iterations, the U.S. team attacked Chinese air bases with JASSM-ERs. These attacks destroyed between 66 and 748 aircraft, depending on the extent, scale, and target of attacks. Losses in the air were fewer than ground losses but similarly varied according to whether the U.S. team challenged the Chinese CAP over Taiwan and how aggressively the Chinese team sought to extend air operations beyond Taiwan.

Ship losses for the United States and Japan were similar to the base scenario. The pessimistic scenarios often provided fewer naval reinforcements during the first several weeks of the conflict. The greater surviving Chinese capabilities tended to make the U.S./Japanese player more cautious with the use

of surface forces. Any surface ship that approached Taiwan was destroyed in both scenarios, and the remainder were often not a high priority for China since they posed only a limited threat to the Chinese operation.

Chinese naval losses (120 ships) were 14 percent lower than in the base scenario, despite iterations that often lasted more than twice as long. Several of the assumptions in these scenarios, particularly the lack of open-ocean maritime capability for the JASSM-ER and slower or reduced U.S. reinforcements, pushed the U.S. teams to concepts of operation that required more time to bring to fruition. Nevertheless, Chinese ship losses were severe. In most of those cases where the amphibious fleet had not been destroyed outright by the end of the iteration, picket ships east of Taiwan were sufficiently attrited that the final destruction of the amphibious fleet would have occurred within days or a week thereafter.

Losses from ground combat—an average of 17,000 PLA casualties and 22,000 Taiwanese—were significantly higher in pessimistic scenarios than in the base scenario because more Chinese units got onto Taiwan and could fight more intensively.

Critical Variables: Some variables had greater impacts than others. As mentioned above, the “no maritime strike JASSM” excursion case was especially difficult for the United States. In all scenarios, the clearest, fastest, and most direct way to defeat the invasion is to attack the amphibious fleet off Taiwan using standoff munitions. Without JASSM-ER’s anti-ship capability, the ability of the United States to pursue this strategy is limited by a shortage of appropriate missiles. However, even without the ability to attack ships at sea, the JASSM-ER can contribute to defeating invasion. In the pessimistic scenarios, U.S. teams used the JASSM-ER to attack Chinese air bases and ports. The former can attrite Chinese combat aircraft and disrupt Chinese air support for operations on Taiwan, while the latter can disrupt the loading of amphibious ships or destroy them at the pier.

However, when the U.S. rules of engagement prohibit strikes on China’s mainland, perhaps because of concerns over escalation, the assumption about the JASSM’s lack of open-ocean anti-ship capability becomes more consequential. The missile still has a role, but a much-circumscribed role. The JASSM can be used to attack captured ports and air bases on Taiwan to prevent their use by the PLA. It can also be used for strikes against Chinese ground forces on Taiwan, though it is not well suited for that role because of its unitary warhead.

Another impactful excursion case was delayed U.S. mobilization until D-Day. In scenarios wherein the United States only begins mobilization after the start of the war and does not engage in combat operations until after the first week, China’s amphibious fleet suffered less early attrition and was, therefore, able to get far more forces ashore, putting China in a better position to make rapid gains.

A second condition with a large impact was diminished Taiwanese ground force effectiveness and, especially, diminished reaction speed. Under conditions in which Taiwan was delayed in transferring forces from one army area to another, China was better able to make gains on the ground and consolidate its position. That was especially significant when China made its primary landing in the southern Taiwan, where the defending forces are relatively sparse.

Finally, two conditions produced a larger impact when incorporated into the scenario together than they did separately.

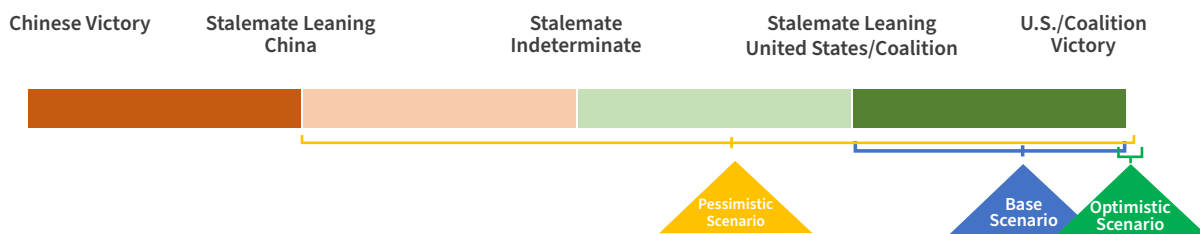
Optimistic Scenarios

The base case assumptions could just as plausibly prove incorrect in ways that might advantage the United States and its coalition. Running iterations with optimistic assumptions illustrated under what circumstances U.S., Japanese, and Taiwanese losses might be lower than the base scenario. Two such iterations were conducted.

Design: One of the iterations run with optimistic assumptions incorporated four optimistic assumptions, including expanded U.S. access to dual-use facilities in Japan, Chinese missile holdbacks, reduced ship defense effectiveness, and a resilient force posture on Turn 1 (i.e., no bombers on Guam or aircraft carriers forward of Guam). The second iteration incorporated seven optimistic assumptions, including: additional HASs, expanded access to Japanese dual-use facilities, Japanese authorization to use force from Turn 1, lower Chinese amphibious operational competence, superior U.S. fifth-generation aircraft, superior U.S. pilot training, and less effective ship defenses for all combatants.

Operational Outcomes: Both optimistic iterations produced decisive Chinese defeats (or U.S., Taiwanese, and Japanese victories). The Chinese fleet was heavily damaged in the first three days and was unable to land more than three amphibious brigades ashore during the critical first three days, supplemented by one to two brigades of airborne and air assault forces. Follow-on waves consisted of individual battalions.

Figure 6: Operational Results: Average and Range by Scenario Type



Source: CSIS tabulation of iteration results.

On average, the PLA was able to land a total of 25 battalions, with a final strength of 22 battalions after losses. The force was unable to gain more than a small foothold ashore, amounting to less than a single game hex (780 km²). With the amphibious fleet effectively destroyed after the first two turns, the game was declared finished, though some combat might have sputtered along for a few weeks.

Although escalation decisions were not part of the game, participants in the optimistic scenarios suggested that escalation might have been least likely in these scenarios since defeat was quick and there were relatively few forces ashore to rescue or support.

Table 7: PLA Situation Ashore at End of Game Play, Optimistic Case Average

	PLA End Strength Ashore	Territory Controlled by PLA (km ²)	Duration of Campaign	Supply Capacity at End
Base Scenario	30,000	2,600	14 days	Air dropped only
Pessimistic Scenarios	43,000	6,240	21 days	Damaged ports and airports; air; sometimes a few ships
Optimistic Scenarios	22,000	780	7 days	Air resupply only

Source: CSIS tabulation of iteration results.

Losses: Due to the brevity of combat operations, the optimistic scenarios produced lower losses for all combatants than other scenarios. Nevertheless, losses to the Chinese fleet were crippling, and China was still able to inflict significant losses on coalition air and naval forces.

Table 8: U.S., Japanese, and Chinese Air and Naval Losses, Optimistic Case Scenarios

	Combat Aircraft Losses				Ship Losses			
	United States	Japan	United States/ Japan Total	China	United States	Japan	United States/ Japan Total	China
Base Scenario	270 (206 USAF)	112	449	155	17	26	43	138
Pessimistic Scenarios (Favors China)	484 (412 USAF)	161	646	327	14	14	28	113
Optimistic Scenarios (Favors United States/ Japan/ Taiwan)	200 (151 USAF)	90	290	18	8	16	24	129

Source: CSIS tabulation of iteration results.

All Chinese amphibious ships at sea and most of the picket force were sunk. Missiles from shore batteries on Taiwan, U.S. submarines, bombers, and tactical aircraft all contributed to these sinkings. The excursion case of reduced ship-based defenses greatly accelerated the rate at which Chinese ships were sunk. With Chinese forces ashore not posing a pressing threat to Taiwanese cities or ports, the United States did not feel pressured to attack Chinese aircraft on the mainland: the relatively light Chinese aircraft losses were therefore mostly due to ground fire over Taiwan itself.

The China team, confronted with the prospect of extremely high and rapid losses to its amphibious fleet, sought to mitigate those losses by attacking air bases in Japan and Guam from the first days of the conflict. Despite the brevity of the campaign, China exhausted all of its long-range missile inventories against those targets, destroying many of the aircraft in Japan. However, because the United States did not have the time to flow as many aircraft into theater as in other scenarios, there were fewer aircraft for China to destroy. US air losses were only 74 percent of what they were in the base scenario and 54 percent what they were in the pessimistic scenarios. Japanese air losses were 80 percent and 70 percent of the base and pessimistic cases, respectively.

With limited ground combat, casualties to ground forces on Taiwan were similarly light. On the Chinese side, these amounted to 3 battalions rendered combat ineffective, with perhaps 3,000 Chinese casualties (including 1,000 fatalities). Casualties on the Taiwanese side were roughly twice as high, many of which were caused by Chinese aircraft conducting ground support operations. Barring a ceasefire to allow the evacuation of stranded Chinese soldiers, roughly 24,000 Chinese soldiers associated with units ashore would have been taken prisoner, in addition to the survivors from sunken ships who might have been taken prisoner after swimming to shore.

Critical Variables: To the extent that Chinese losses were lighter in this set of scenarios than in others, the outcome was a function of the shorter scenario combined with U.S. and partner priorities that were affected by the conditions of the scenario, as described above. If no off-ramp to peace were found, Chinese naval and air losses would continue to climb (in the former case limited by the size of the fleet and in the latter probably more dramatically as the United States turned its attention to attacking aircraft).

Three factors significantly reduced U.S. losses in both iterations: dispersion across more locations (including civilian airports), reduced missile coverage on the part of China (due to missile holdouts and less-well-optimized warheads), and early attacks on Japanese air bases. The latter was motivated by the increased danger to the Chinese fleet posed by tactical aircraft and resulted in fewer aircraft being at the bases when attacked since fewer reinforcements had flowed in from other U.S. bases around the world. Additionally, the building of new HASs reduced aircraft losses in one of the iterations, while not placing bombers in Guam or aircraft carriers forward deployed reduced aircraft losses in the other.

Two optimistic assumptions had little impact: superior U.S. pilot training and superior fifth-generation aircraft. There was little air-to-air combat in the optimistic scenarios, largely because of the employment of long-range standoff munitions. Had a mix of pessimistic and optimistic assumptions been in play, it is possible that superiority of U.S. air-to-air combat capability might have been more significant. However, it probably would not have factored among the most important variables due to most U.S. air losses occurring on the ground.

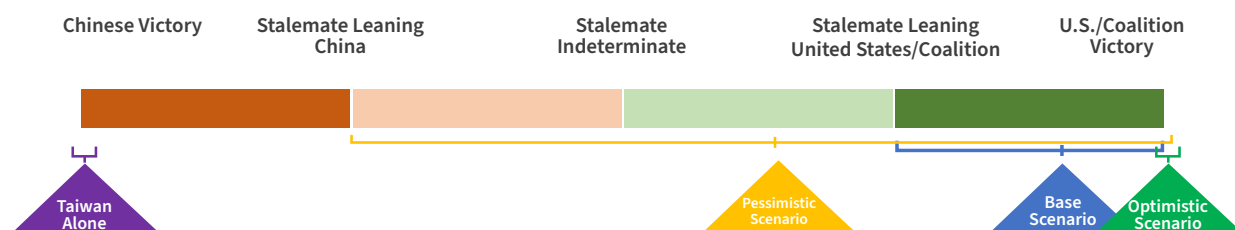
Taiwan Stands Alone

Design: The “Taiwan stands alone” scenario was designed to examine how Taiwan might fare with no direct material assistance from the United States. This provides a baseline against which to measure the U.S. and partner contribution to the defense of Taiwan. The project team conducted one iteration of this scenario. Because the United States remained on the sidelines, the assumption was that no other country would intervene because the risks would be too high for any second-tier power. None of the excursion cases run in the other scenarios were incorporated into this scenario, but this scenario did have two unique assumptions.

First, Taiwan’s operations would be weakened by a long-term shortage in ammunition. The scenario assumed that after two months of operations, ammunition shortages would force Taiwan to fire half as frequently, with a corresponding reduction in effectiveness. After three months, ammunition exhaustion forces artillery crews to be reformed into infantry units.

Second, China would need to withhold some aircraft to deter U.S. and Japanese intervention, even if that intervention was ultimately not forthcoming. This had the effect of limiting the number of aircraft supporting Chinese ground forces on Taiwan. After withholding squadrons for deterrence, China was left with 14 squadrons for ground support, with 6 additional squadrons to replace losses as they occurred.

Figure 7: Operational Results: Average and Range by Scenario Type



Source: CSIS tabulation of iteration results.

Operational Outcomes: The “Taiwan stands alone” scenario resulted in a PLA victory. The outcome was never in doubt, with the PLA making slow but steady progress throughout the operation. PLA commanders landed forces in the south, took Tainan and Gaoshiung after three weeks, and occupied Taichung (halfway up the coast) by the end of the sixth week. Frustrated with slow progress up the west side of the island and with ground forces to spare, PLA commanders then opened a second front at Hualian. PLA armor occupied the president’s palace in Taipei after 10 weeks. In the actual event of a Chinese invasion without third-party intervention, the Taiwanese government might capitulate before the bitter end.

During the iteration, Taiwan’s commander flowed forces to meet the attack and defended successive river lines. To dislodge those positions, China brought up heavy armor, engineering support, and artillery. However, transporting these units to the island required substantial time. To dislodge particularly stubborn positions, the PLA also dispatched light infantry forces to work

around the flanks in the foothills of Taiwan’s steep mountains. Once defenses were broken or flanks were turned, Taiwanese forces retreated to the next river line and continued the fight. A close parallel to the scenario is the Allied campaign in Italy in World War II, where the Germans withdrew slowly, defending each river and mountain ridge.

During the two-and-a-half-month campaign, the PLA landed a total of 230 battalions on Taiwan. Despite Taiwanese shore-based ASCMs, the amphibious fleet remained viable throughout the campaign. PLA commanders were able to transport the engineers necessary to repair damage to ports and airports as they were captured. When Taipei fell, 165 Chinese battalions were on the island (another 65 battalions having been rendered combat ineffective). This force was more than four times the number present at the end of the base scenario iterations involving U.S. intervention. Including personnel not associated with combat battalions, this force might number 300,000, a number comparable to the invasion force considered for Operation Causeway, the planned U.S. 1945 invasion of Taiwan that was never launched.

Table 9: PLA Situation Ashore at End of Game Play, “Taiwan Stands Alone”

	PLA End Strength Ashore	Territory Controlled by PLA (km ²)	Duration of Campaign	Supply Capacity at End
Base Scenario	30,000	2,600	14 days	Air dropped only
Pessimistic Scenarios	43,000	6,240	21 days	Damaged ports and airports; air; sometimes a few ships
Optimistic Scenarios	22,000	780	7 days	Air resupply only
Taiwan Stands Alone	165,000	36,000	70 days	Ports and airports; civilian lift; amphib; air

Source: CSIS tabulation of iteration results.

Although the results are sobering, the campaign was also enlightening in other ways. If Taiwanese forces are willing to fight, Chinese forces would require a prolonged period of combat before occupying Taiwan’s major cities. This buys time for a delayed U.S. intervention or international diplomacy. Regardless, the results show how much damage resilient Taiwanese armed forces can inflict. Increasing their lethality and survivability would also likely enhance deterrence.

Losses: Casualties were high in this campaign because of the protracted and intensive nature of ground combat. However, the composition of losses was very different from other scenarios. PLA ground forces suffered roughly 70,000 casualties in ground combat, including 23,100 killed.

Over the first 10 days of combat, Taiwanese anti-ship shore batteries sank 17 amphibious ships and the same number of escort ships (roughly 16 percent of PLA totals in both categories) before being destroyed or running out of missiles. With Taiwan’s navy having been defeated by missile, air, submarine, and surface attack, and the surviving elements of Taiwan’s air force struggling to survive, no additional losses were inflicted on China’s fleet. However, the PLAAF suffered attrition from ground fire and SAMs throughout the campaign, losing a total of 240 aircraft.

As with every scenario, Taiwan lost its entire navy. The Taiwanese air force squadrons that survived China's joint fires strike were eventually destroyed in air-to-air combat. Its army suffered 85,000 casualties, with perhaps 28,000 killed. Casualties amounted to roughly half of its total mobilized army strength.

Ragnarok

Design: The “Ragnarok” scenario was designed to ascertain what conditions would be necessary for China to be victorious in the face of Taiwanese resistance and U.S. intervention. The need for a special scenario became clear after China failed to secure a total victory in a range of pessimistic scenarios. This scenario should therefore not be taken as a likely future but rather as a tool to illustrate what would be necessary to invalidate the project's main result (that China is unlikely to succeed if Taiwan resists and the United States intervenes).

To be victorious, China must negate U.S. airpower, both fighter attack and bombers.

U.S. fighter/attack aircraft could not effectively participate in operations if Tokyo remained strictly neutral and did not allow the United States to operate from its bases in Japan. While it is possible to use tankers with aircraft based on Guam, this would (1) be vulnerable on the ground to Chinese ballistic missiles, (2) be vulnerable in the air if tankers were intercepted, and (3) be unable to generate enough sorties over Taiwan to significantly affect the battle.

Second, China would need to negate U.S. bombers. This is hard to do because bombers can be based beyond the range of most Chinese ground-attack missiles, approach the theater from several angles, and launch standoff missiles beyond the range of defending SAMs. If China attempted to interdict U.S. bombers with its surface ships, then the United States could attrite these ships down until it had created a path to the amphibious fleet (not unlike most other scenarios, wherein the United States must attrite the pickets east of Taiwan). An extreme-range SAM would be limited by the curvature of the Earth and therefore be unable to intercept U.S. bombers before they fired their missiles.²⁴⁵ However, without U.S. fighters based in Japan for escorts, U.S. bombers would be vulnerable to Chinese fighters armed with extreme-range air-to-air missiles.²⁴⁶ Alternatively, if China either did not have these missiles or could not complete a kill chain with them, the United States could negate its own bombers by failing to procure sufficient long-range, air-launched ASCMs.²⁴⁷

Operational Outcomes: As expected, Ragnarok ended in a PLA victory.²⁴⁸ Without having to worry about U.S. forces in Japan, the PLA was able to focus its land-attack missiles on Guam, negating it as

245 It would hypothetically be possible to surmount this problem with an active seeking missile supplemented by targeting data from a forward-deployed AEW aircraft, satellite, or over-the-horizon radar.

246 It is possible that such a missile is already operational. See “Chinese and Russian Air-Launched Weapons: A Test for Western Air Dominance,” in International Institute for Security Studies, *The Military Balance* (London: February 2018), doi:10.1080/04597222.2018.1416966; and Tyler Rogoway, “Shadowy New Missile Appears Under The Wings Of Chinese J-16 Fighter,” *The Drive*, November 21, 2016, <https://www.thedrive.com/the-war-zone/6108/shadowy-new-missile-appears-under-the-wing-of-chinese-j-16-fighter>.

247 Relying on bombers creates a single point of failure, highlighting the criticality of the U.S.-Japan alliance

248 Ragnarok, as enthusiasts of crossword puzzles know, is the great battle at the end of the world in Norse mythology.

a base. Despite the absence of U.S. bombers, the Chinese amphibious fleet still took a large number of casualties from ASCMs on Taiwan and U.S. SSNs infiltrating into the straits. By the time these attackers were out of ammunition or attrited, they had reduced the amphibious fleet to one-third of its beginning strength. However, the absence of U.S. fighter/attack aircraft allowed the Chinese to focus their aircraft on supporting the ground invasion. This allowed the PLA to make steady progress ashore and eventually compensate for destroyed amphibious ships with captured ports and airports.

The last serious challenge to the invasion came from an unsuccessful attack by the massed U.S. fleet. After three weeks of conflict, a U.S. fleet of 29 cruisers and destroyers, two carriers, and 10 SSNs approached Taiwan. Under withering fire from Chinese submarines, air-launched ASCMs, and surface ships, the US fleet was largely destroyed without relieving Taiwan. At this point, the game was called.

Losses: Casualties in this scenario were very different from other scenarios. The only U.S. aircraft that were destroyed were either on Guam initially or flew from carriers. The reliance on SSNs meant that 10 SSNs were lost even before the climactic naval showdown. In total, the United States lost four carriers, 43 cruisers and destroyers, and 15 SSNs. If Taiwan continued to fight to the end, their casualties would be similar to those in the “Taiwan stands alone” scenario.

Critical Variables: This scenario demonstrated the centrality of two variables: basing in Japan and the ability of the United States to deliver ASCMs en masse. Without the ability of U.S. aircraft to operate out of Japan, the PLAAF can concentrate against targets in Taiwan while the PLA delivers more troops ashore. While U.S. bombers could hypothetically still deliver a decisive amount of ordnance, the outcome would rest on their effectiveness. This could be neutralized either by PLA advances in anti-air missiles or by insufficient stockpiles of standoff anti-ship missiles. Without U.S. airpower, Taiwanese ground-launched ASCMs and U.S. SSNs are insufficient to defeat a Chinese invasion; furthermore, the vulnerability of surface ships prevents the U.S. surface fleet from being effective. While it must be emphasized that this was an unlikely scenario, it is analytically helpful.

All the excursion assumptions noted in Chapter 4 (“Assumptions and Excursions”) were included in some subset of the scenarios. Based on outcomes and analysis of game play, it is apparent that some of these had a larger impact than others (see Figure 8 below).

Among those that worked to China’s advantage, two had a particularly pronounced impact. First was “Taiwan stands alone,” in which Taiwan had no support from the United States or other allies and fell to China’s inexorable advance. Second was “Japan neutral,” in which Japan does not permit U.S. basing, limiting U.S. operations to those that could be sustained from Guam, Hawaii, Alaska, or at-sea naval forces. Three others had significant and notable effects. The “U.S. combat starts D plus 14” excursion case saw late intervention by the United States and allowed China to establish more forces ashore before suffering major attrition to its amphibious fleet. The “no maritime strike JASSM” excursion case slowed attrition of the Chinese fleet. The “Taiwanese forces paralyzed to D plus 4” excursion case prevented Taiwan from rapidly reinforcing the beachhead and enabled Chinese forces ashore to expand the beachhead during the first days after landing.

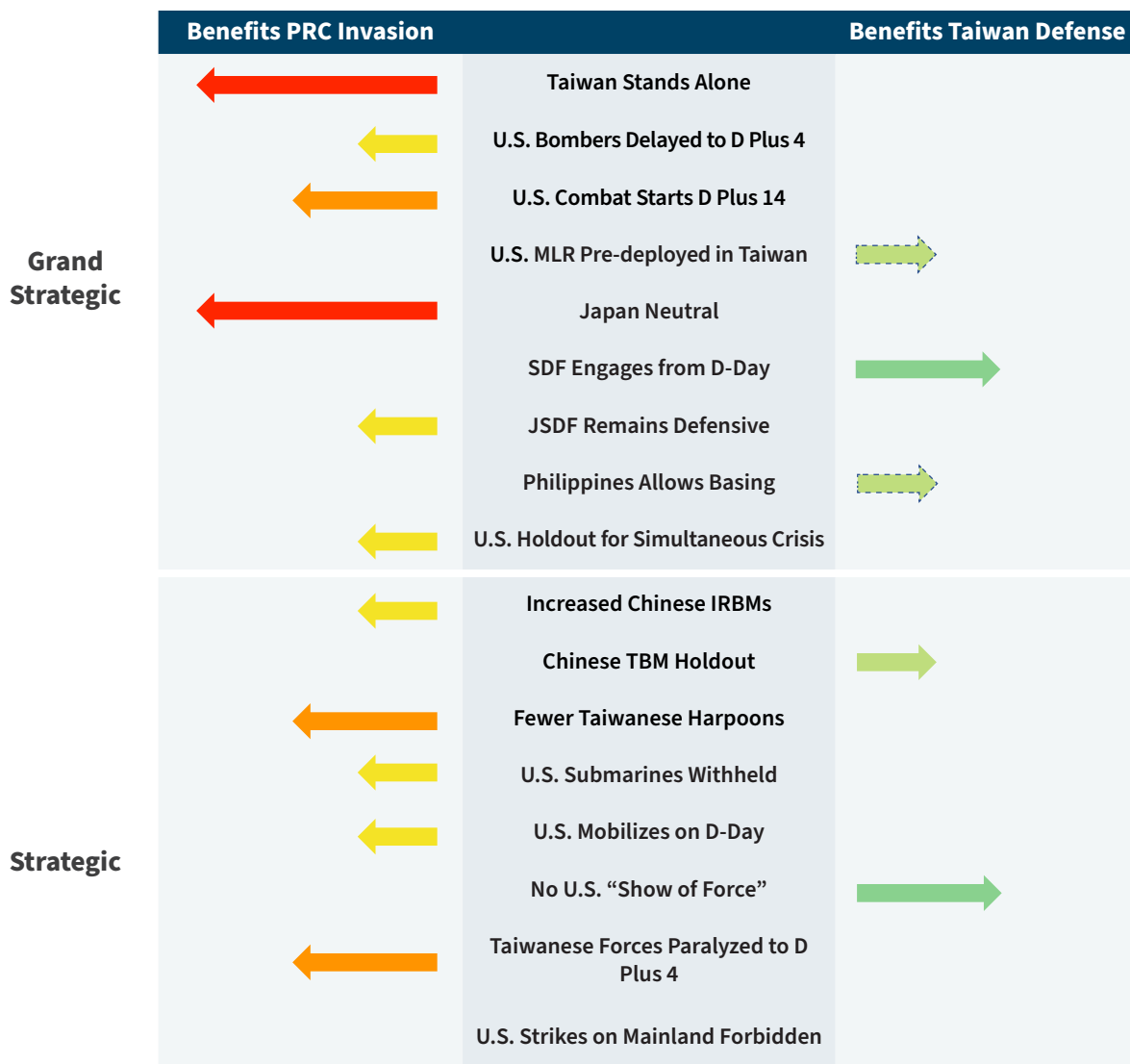
Among those excursion assumptions that favored the United States and its partners, two were particularly important in affecting operational outcomes. First, the “ship defenses poor” excursion case resulted in the rapid sinking of amphibious ships and their escorts and further diminished China’s prospects. Second, the “reduced PLA amphibious competence” excursion case similarly diminished the

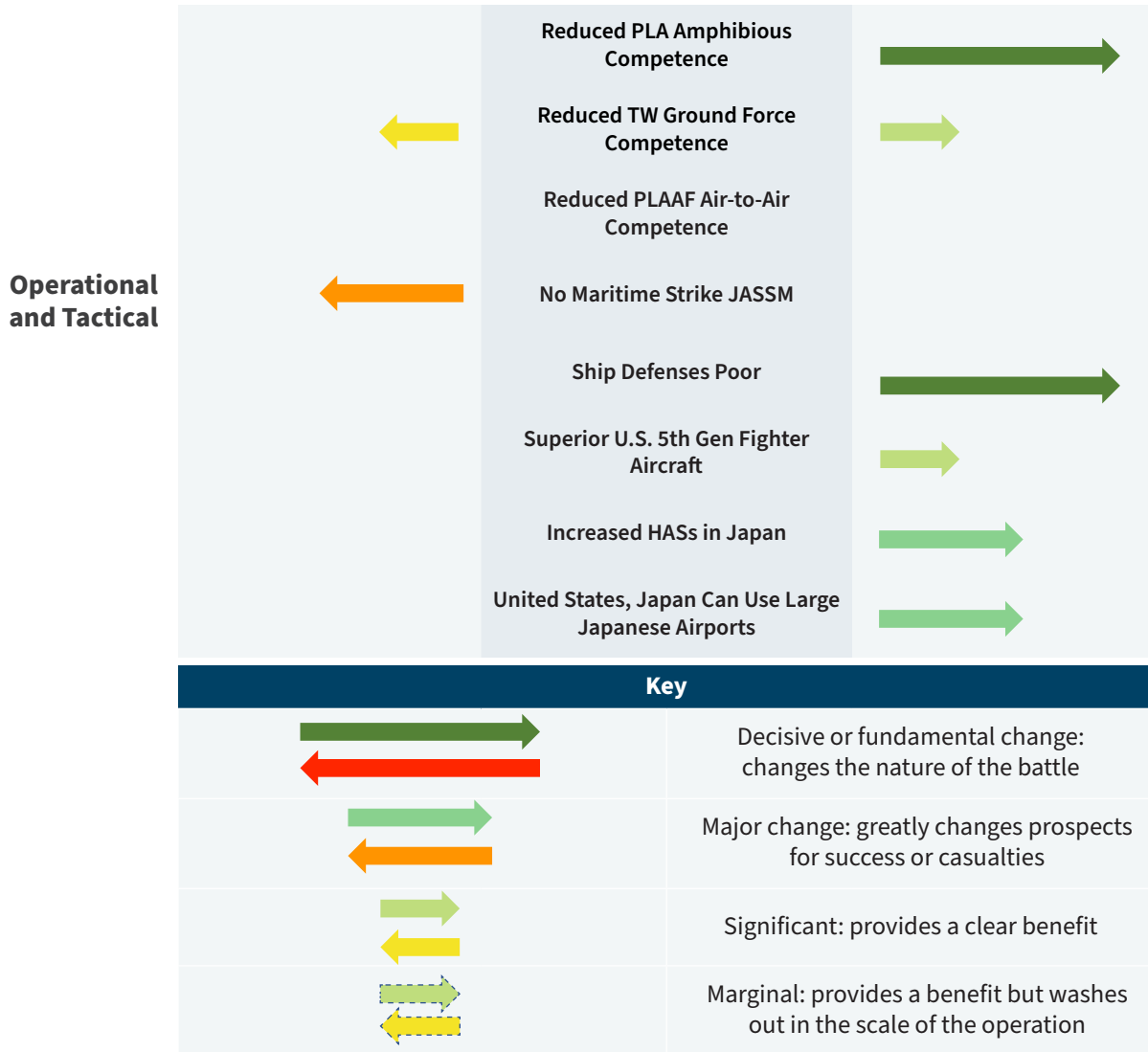
already limited number of troops that China can land on beaches during a given period.

Two excursion cases diminished U.S. losses during the campaign while maintaining Taiwanese autonomy. The “U.S., Japan can use large Japanese airports” excursion case permits the dispersion of U.S. and Japanese aircraft over more facilities and reduces the impact of Chinese missile attacks against allied airpower. The “no U.S. show of force” excursion case allows the U.S. team to start its carriers, bombers, and tankers outside of China’s primary threat rings.

Figure 8 summarizes in graphic form the impact of changing assumptions. The direction of arrows indicates whether the change benefits the Chinese invasion (to the left) or the Taiwanese defense (to the right). The significance of the assumption is denoted by the length of the arrow and its color.

Figure 8: Evaluation of Variant Impact—Taiwan Invasion Scorecard





Source: CSIS.

Summary

The base scenario produced relatively rapid and clear Chinese defeat, a result produced largely by the ability of U.S., Taiwanese, and Japanese anti-ship missiles to destroy the Chinese amphibious fleet before the PLA forces ashore can capture ports and airports to increase the force flow across the strait. Optimistic scenarios (favoring the United States and its partners) produced the same results but more quickly and with lower casualties. Pessimistic scenarios (favoring China) produced more protracted fighting and a wider range of operational outcomes, ranging from decisive Chinese defeat to stalemates in which China controlled damaged ports and airports. The “Taiwan stands alone” scenario produced inexorable Chinese advance, concluding with the Chinese occupation of the entire island—an unambiguous PLA victory.

Losses in all iterations were high and sobering for both sides. In all but the “Taiwan stands alone” scenario, China lost the large preponderance of its surface fleet, including amphibious ships, surface combatants, and carriers as well as a portion of its submarine fleet. In most iterations, the U.S. Navy lost two carriers and more than a dozen surface ships as well as four submarines. It was only able to avoid that outcome in optimistic scenarios because the United States did not push its fleet forward as a deterrent signal prior to the start of conflict.

Air losses varied greatly for both sides. On the U.S. side, they numbered in the hundreds under all scenarios and averaged 283 in the base scenario, 484 in pessimistic scenarios, and 200 in optimistic scenarios. Across all iterations, U.S. aircraft losses ranged from a low of 90 to a high of 774. Japan also lost more than 100 aircraft in most iterations, and Taiwan lost its entire air force. Chinese aircraft losses varied greatly, as the United States only attacked Chinese air bases in iterations run under pessimistic assumptions—and in only half of those. Chinese air losses averaged 161 under the base scenario, 327 under pessimistic assumptions, and 290 under optimistic scenarios. Chinese air losses varied from a low of dozens to a high of 748.

Ground losses varied primarily according to the duration of the campaign and the number of forces landed on Taiwan.

Why Are These Results Different from Classified DOD Games?

Why does this project find that a Chinese invasion of Taiwan would be difficult and fail under most conditions when the purported results of classified wargames indicate much higher chances of Chinese success, as do the intuitive views of many commentators who see the large disparity of forces in the Western Pacific between China and Taiwan?

As noted in Chapter 2, publicly available information on the results of classified wargames indicates high U.S. casualties and unfavorable outcomes. The amount of information is limited, however, because of the restrictions regarding classified information. Nevertheless, examination of public descriptions of classified wargames and what is known about the conduct of wargames in general allows the project to make informed guesses about why results differ between the classified games and this project.²⁴⁹

Invasions Are Difficult to Model with the Method of P_k s: Classified models tend to prioritize the method of P_k s over the method of history because of the richness of data on individual systems that is available at the classified level. However, this might lead classified wargames to overestimate the quickness at which amphibious invasions would proceed.

The task of loading and transporting troops, landing on a hostile shore, building up forces, and then moving inland is inherently difficult. In 1944, the United States considered an invasion of Taiwan as the next step in the Pacific campaign. The move was rejected because of the difficulty. As Ben Jensen, a CSIS expert on wargaming, noted: “Crossing a contested sea only to fight on complex, canalized terrain against

249 Lauren Thompson, “Why the Air Force’s Plan for Fighting China Could Make Nuclear War More Likely,” *Forbes*, June 15, 2021, <https://www.forbes.com/sites/lorenthompson/2021/06/15/why-the-air-forces-plan-for-fighting-china-could-make-nuclear-war-more-likely/?sh=787c8e3d24b1>. Other commentaries have touched on the same issue, for example, Geist, “Defeat Is Possible.” The 2018 National Defense Strategy Commission raised similar concerns. Unclear is whether these commentaries are providing additional information about wargames or pointing back to the handful of reports that have filtered out.

a deliberate defense-in-depth makes amphibious assault in Taiwan a more complex operation than even the famed 1944 Operation Overlord—the D-Day landings.”²⁵⁰ Taiwan is a particularly difficult target because it has only about a dozen suitable landing beaches and the terrain inland is highly defensible.

Another insight comes from the naval author and historian C.S. Forrester in his thought piece “If Hitler Had Invaded England.” In it, he considered how a German invasion of Britain in the summer of 1940 might have played out. Germany faced a problem like that of China—a powerful army facing a contested air and naval environment that made crossing even a narrow strip of water difficult. There was an invasion plan, called Operation Sealion, which the Germans prepared for but ultimately did not execute because it lacked the air and naval supremacy needed. In his counterfactual history, Forrester gives the Germans every advantage. The Germans can land successfully with paratroopers and amphibious forces, but the British response in the air and on the sea throttled sustainment and reinforcement. British army counterattacks defeated the now isolated German troops on the ground.²⁵¹

The many successful Allied amphibious operations of World War II made opposed landings look easy. They are not. The allies were successful because of many years spent refining doctrine and building specialized capabilities. Learning steps such as the catastrophic raid on Dieppe in 1943 were part of that learning process. The Chinese will not have those opportunities.

Different Purposes: As noted in Chapter 2, wargames have different purposes, not all of which are intended to simulate the most likely course of events. For example, some games test concepts and are not intended to represent likely futures. Such a game might assume that Chinese forces land in the Philippines to see whether U.S. forces could use mobility, anti-air capabilities, and anti-ship missiles to contest the invasion. Other games might hypothesize U.S. forces being on islands in the South China Sea or the Philippines and attempting to prevent the breakout of Chinese naval forces from the first island chain. (These are actual scenarios for the game, *Littoral Commander: The Indo-Pacific*.²⁵²) These games are useful to test concepts about weapons capabilities and force structure. Because the scenarios are improbable, however, they are not particularly helpful in trying to ascertain the course of future events. To use the Philippines example, it is hard to imagine a set of circumstances where Chinese amphibious forces would land on the main islands of the Philippines.

Many U.S.-China wargames have short time increments, which allows detailed assessment of forces and weapons but means that game play covers only the first few days of a conflict. This is the time of greatest U.S. and partner weakness, after initial Chinese attacks but before substantial reinforcements begin to flow. Thus, results can give a skewed sense of what the whole campaign might look like.

250 Ben Jensen, “Not so Fast: Insights from a 1944 War Plan Help Explain Why Invading Taiwan Is a Costly Gamble,” *War on the Rocks*, September 8, 2022, <https://warontherocks.com/2022/09/not-so-fast-insights-from-a-1944-war-help-explain-why-invading-taiwan-is-a-costly-gamble/>.

251 C.S. Forrester, “If Hitler Had Invaded England,” in *Gold from Crete: Ten Stories* (Boston, MA: Little, Brown and Company, 1973).

252 *Littoral Commander: The Indo-Pacific* is a battalion-level wargame published by the Dietz Foundation and designed by Sebastian Bae, a civilian employee of the U.S. Marine Corps. Marine Corps schools use it for education about future conflict, though the game is commercially available. “Interview with Sebastian Bae of the Littoral Commander: The Indo Pacific from the Dietz Foundation,” *The Players Aid*, February 7, 2022, <https://theplayersaid.com/2022/02/07/interview-with-sebastian-bae-designer-of-littoral-commander-the-indo-pacific-from-the-dietz-foundation/>.

Related to the notion of testing concepts is the notion that wargames can be designed to “stress test” for potential weaknesses in new operational concepts.²⁵³ David Ochmanek, a senior analyst at RAND and experienced wargamer, noted this purpose: “Even the games that the United States loses are not necessarily reflective of how a war would unfold in real life; the main purpose is to evaluate American vulnerabilities. We learn a lot from these.”²⁵⁴ This is a reasonable approach when evaluating risk or exploring policy boundaries. However, the results of particularly pessimistic scenarios do not constitute the most likely results.

Many games are intended primarily to educate the players. Game designers often want to challenge the players and counteract complacency. This is a reasonable approach for educating an officer corps about what future conflict might entail, especially since the officer corps has been accustomed to having military superiority for generations. However, the outcomes of these games do not necessarily represent a full spectrum of possibilities.²⁵⁵

Adjudication by Judgment vs. Analysis: Another difference might be the adjudication mechanism. Many classified wargames are conducted as seminars, where two sides discuss a scenario and a “white team” adjudicates the results of moves by the two teams. Results, therefore, are heavily dependent on the personal perspectives of the white team members. To combat this source of possible bias, the project developed explicit adjudication mechanisms based on historical experience. (This is described in detail in Chapter 2.)

Asymmetric Assumptions about Capabilities: Another possibility is attributing a high level of capabilities and abilities to the Chinese while decrementing U.S. capabilities because of known limitations. This might be done as a hedging mechanism to avoid underestimating a potential adversary. Some analyses, reflected in the fictional speculation of 2034 and Ghost Fleet, hypothesize powerful and previously unknown Chinese capabilities, such as cyber in one case and space weapons in the other.²⁵⁶

Attribution of high capabilities to adversaries has a long history. A classic example occurred before the Persian Gulf War of 1991. There was an intensive period of wargaming prior to the war, with the gaming of scenarios related to an attack on Kuwait occurring more than a year before the actual attack and the first planning scenarios for the counterattack commencing the same day as the Iraqi invasion. Gaming was also used to develop several aspects of the final operations plan.²⁵⁷ However, results depended heavily on whether Iraq’s military was viewed as “war hardened” or “war weary” as a result of its recently concluded eight-year war with Iran. A war-hardened military would fight fiercely and skillfully. Comparison was often made to the North Vietnamese. A war-weary military might collapse

253 Elizabeth Bartels, *Building Better Games for National Security Policy Analysis: Towards a Social Scientific Approach* (Santa Monica, CA: RAND Corporation, 2020), 11, doi:10.7249/RGSD437; and Copp, “It Failed Miserably.”

254 Dexter Filkins, “A Dangerous Game over Taiwan,” *New Yorker*, November 14, 2022, <https://www.newyorker.com/magazine/2022/11/21/a-dangerous-game-over-taiwan>.

255 Recent examples of wargames designed for PME include *Littoral Commander* and *Assassin’s Mace*.

256 Elliot Ackerman and James Stavridis, *2034: A Novel of the Next World War* (New York: Penguin Press, 2021); and P.W. Songer and August Cole, *Ghost Fleet: A Story of the Next War* (Boston, MA: Houghton Mifflin Harcourt, 2015).

257 Matthew Caffrey, “On Wargaming,” *The Newport Papers* 43 (January 1, 2019): 130–34, <https://digital-commons.usnwc.edu/usnwc-newport-papers/43>.

quickly. Modeling took Iraqi forces at face value. This was a reasonable hedge, but models produced predictions for U.S. casualties several orders of magnitude higher than the actual casualty figures.²⁵⁸

The invasion of Ukraine in February 2022 provides a more recent example. At the beginning of the conflict, many commentators suggested that the campaign would result in a decisive Russian victory.²⁵⁹ This analysis was founded on the perceived increase in military effectiveness following what was purported to be an extensive modernization of the Russian military.²⁶⁰ However, this modernization did not translate to battlefield effectiveness, with warfighting shortcomings becoming apparent following the invasion, new systems not performing as assessed, and forces not fighting as expected.²⁶¹ There was an expectation of technical and tactical competency built into assessments that have not been in evidence following the invasion.

Deception: During the Soviet period, the United States routinely overestimated Soviet strategic nuclear capabilities. This occurred in part because the Soviets were actively trying to deceive Western intelligence agencies and in part because of Western concerns about avoiding complacency and surprise. Thus, the United States hypothesized a “bomber gap” when the Soviets flew the same bombers repeatedly over reviewing stands during a May Day celebration, thus giving the impression of having more long-range strike aircraft than they in fact had. Looking back on this incident, John Prados concluded in his study of U.S. intelligence estimates of the Soviet strategic forces, “where organizational interests impinge or turn upon certain conclusions, objective analysis of intelligence is likely to suffer.”²⁶²

258 “Potential War Casualties Put at 100,000: Gulf Crisis: Fewer U.S. Troops Would Be Killed or Wounded Than Iraq Soldiers, Military Experts Predict,” *Los Angeles Times*, September 5, 1990, <https://www.latimes.com/archives/la-xpm-1990-09-05-mn-776-story.html>; and Shawn Woodford, “Assessing the 1990-1991 Gulf War Forecasts,” Dupuy Institute, Mystics & Statistics, May 18, 2016, <http://www.dupuyinstitute.org/blog/2016/05/17/assessing-the-1990-1991-gulf-war-forecasts/>.

259 To provide a few examples of such expectations, Michael Kofman and Jeffrey Edmonds, “Russia’s Shock and Awe,” *Foreign Affairs*, March 22, 2022, <https://www.foreignaffairs.com/articles/ukraine/2022-02-21/russias-shock-and-awe>; Anatol Lievan, “Ending the Threat of War in Ukraine: A Negotiated Solution to the Donbas Conflict and the Crimean Dispute,” Quincy Institute for Responsible Statecraft, January 4, 2022, <https://quincyinst.org/report/ending-the-threat-of-war-in-ukraine/>; and “What Are Vladimir Putin’s Military Intentions in Ukraine?,” *The Economist*, January 29, 2022, <https://www.economist.com/briefing/2022/01/29/what-are-vladimir-putins-military-intentions-in-ukraine>.

260 Steven Pifer, “Pay Attention, America: Russia Is Upgrading Its Military,” Brookings Institute, February 5, 2016, <https://www.brookings.edu/opinions/pay-attention-america-russia-is-upgrading-its-military/>; and Anton Troianovski, Michael Schwartz, and Andrew E. Kramer, “Russia’s Military, Once Creaky, Is Modern and Lethal,” *New York Times*, January 27, 2022, <https://www.nytimes.com/2022/01/27/world/europe/russia-military-putin-ukraine.html>.

261 “Russia’s Military: Failure on an Awesome Scale,” Center for European Policy Analysis, April 15, 2022, <https://cepa.org/russias-military-failure-on-an-awesome-scale/>; and Andrew S. Bowen, *Russia’s War in Ukraine: Military and Intelligence Aspects*, CRS Report No. R47068 (Washington, DC: Congressional Research Service, April 2022), 5–6, <https://crsreports.congress.gov/product/pdf/R/R47068>.

262 John Prados, *The Soviet Estimate: US Intelligence Analysis and Soviet Strategic Forces* (Princeton, NJ: Princeton University Press, 1986). The story of the flyover and bomber gap is on page 43, the conclusion about the bomber gap is on page 49–50.

How Does the War Play Out?

This chapter lays out the broad features of the conflict, as it played out over the 24 game iterations. It also discusses some of the strategies pursued before moving, in Chapter 7, to the conclusions and recommendations derived from the course of these games.

The Situation on Taiwan

Once the conflict starts, Chinese air and naval units surrounded the island. The resulting Chinese defensive zone was so dense that no cargo ships could get through, and the danger to airlift aircraft was extreme. In one iteration, an attempt to insert a U.S. Army brigade onto Taiwan by air resulted in two of the three battalions (roughly 2,000 soldiers) being destroyed in the air. The U.S. Maritime Prepositioning Ships (MPS) squadron, which is designed to rapidly deploy large ground formations, could not get through.²⁶³ Taiwan as isolated. The United States could not move any significant forces onto Taiwan within the month that the game covers.

263 A maritime pre-positioning squadron is a group of cargo ships permanently loaded with equipment and supplies for military units. The largest component is for a Marine amphibious brigade. Currently, there are two such squadrons, one based at Diego Garcia in the Indian Ocean and another on Guam. Because troops are much easier to move than equipment, the concept is that the ships would bring equipment while the troops would fly in. The capability was used in a major way during Desert Storm and the 2003 invasion of Iraq. Elements of the pre-positioned stocks have been used in many smaller contingencies. “Prepositioning (PM3),” Official U.S. Navy Website, U.S. Navy’s Military Sealift Command, n.d., <https://www.msc.usff.navy.mil/Ships/Prepositioning-PM3/>.

The Chinese were always able to get troops onto Taiwan. The Taiwan Strait is so narrow, the Chinese forces so numerous, and Taiwanese defenses so limited that defeating the invasion at sea was not possible.²⁶⁴ The Chinese challenge is sustaining the forces landed on the island while bringing in new forces before the Taiwanese can contain the beachhead and counterattack in strength. The steady attrition inflicted by U.S. attacks on China's amphibious shipping imposes a time constraint on the Chinese invasion. However, once China captures an operational port or airfield, it can use civilian merchant ships and cargo planes to supply its invasion, easing demands on the amphibious fleet. The central question is whether Chinese forces can capture airfields and ports—and keep them operating—before U.S., Japanese, and Taiwanese attacks sink their amphibious ships. In the base scenario and most others, this was not achieved.

The Chinese supplemented the beach assault with airborne forces. When these attempted to seize airfields, they generally failed because of the weak combat power that airborne forces possess. This record is consistent with the mixed results of German attempts to employ airborne troops in seizing airfields during the invasion of Crete and Russians in Hostomel. When airborne forces attempted to isolate the battle area, they were more successful and assisted Chinese amphibious forces in establishing a significant beachhead ashore.

With limited ability to land substantial firepower during the early days of conflict, China's ability to advance off the beaches and establish a larger lodgment depended heavily on airpower. One role was to provide close air support to attacking forces.²⁶⁵ More important was the interdiction role, destroying bridges and overpasses that might be used by Taiwanese reinforcements moving to reinforce defenses around the beachhead.

The central question is whether Chinese forces can capture airfields and ports—and keep them operating—before U.S., Japanese, and Taiwanese attacks sink their amphibious ships. In the base scenario and most others, this was not achieved.

U.S. airpower, for its part, had a limited ability to influence ground combat directly. China's naval and air forces restricted U.S. strikes to standoff weapons, such as the JASSM-ER. Their unitary warheads were effective against ports and airfields but not against troops in the field because of their dispersion.

Chinese players considered attacking the northern part of the island where Taipei, the capital, is located. In this, they sought to replay Germany's amphibious and airborne assault on Norway's

264 A future U.S. force with a myriad of air-launched ASCMs combined with asymmetric Taiwanese anti-ship defenses might be able to prevent even an initial lodgment; however, such a massive shift in both countries' force structures is not possible by 2026.

265 The project's analysis indicated that China would largely dedicate its CRBM force to destroying strategic targets (e.g., government headquarters) and the Taiwanese navy and air force.

capital of Oslo in 1940 or Russia's attack on Kyiv in 2022. However, the Chinese players were generally dissuaded by the strength of defending Taiwanese forces deployed in the north around Taipei. About 46 percent of Taiwan's total battalions are in the northern third of the island, including half of Taiwan's mechanized forces.

Thus, in 21 of 24 iterations, the Chinese invasion force landed in the south, where Taiwanese defenses were lighter. This made it easier to get ashore and establish a beachhead or airhead but meant that the Chinese forces had to fight their way up the entire island to capture the capital and achieve a decisive result. The nature of the terrain is not, however, propitious for such an advance. The central parts of Taiwan are mountainous and difficult to traverse. The coastal plains are narrow, with rivers and cities that provide good defensive positions. Even capturing the large southern city of Kaohsiung was often a difficult and time-consuming task. Nevertheless, the southern landings met with greater success than did the few attempts at direct attack on the north. Interestingly, when U.S. planners considered invading Taiwan in 1944, they also planned to land in the south.²⁶⁶

In 21 of 24 iterations, the Chinese invasion force landed in the south, where Taiwanese defenses were lighter.

Thus, this campaign would not be a close parallel to that confronting German commanders at Normandy on the so-called "longest day." Then, Field Marshal Erwin Rommel believed that the coming Allied invasion of France had to be defeated on the beaches during the first 24 hours. If the invasion became established ashore, Allied air and naval power could sustain it. In 1944, that proved correct, but it does not apply to the challenge facing Taiwan today.²⁶⁷

A Chinese invasion of Taiwan would be different because the Chinese invasion fleet, though numerous, is not nearly as large as the fleet that supported the D-Day invasion. For that operation, the Allies had 229 amphibious ships (LSTs) and 345 troop ships and cargo ships for a total of 547 ships, serviced by more than 3,000 smaller landing craft (LCIs, LCMs, LCTs, and LCVs).²⁶⁸ The anticipated Chinese amphibious fleet of 2026 includes 28 LSTs, 18 LHD/LPDs, 20 LSMs, and 30 large civilian RO-ROs, for a total of 96 ships, serviced by 305 landing craft. At Normandy, the Allies put 90,000 troops

266 For a discussion of these plans, see: Ben Jensen, "Not so Fast: Insights from a 1944 War Plan Help Explain Why Invading Taiwan Is a Costly Gamble," *War on the Rocks*, September 8, 2022, <https://warontherocks.com/2022/09/not-so-fast-insights-from-a-1944-war-help-explain-why-invading-taiwan-is-a-costly-gamble/>.

267 Rommel's comment is cited in Cornelius Ryan, *The Longest Day* (New York: Simon and Schuster, 1959), 8.

268 For naval ships, see Samuel J. Cox, "H-031-1: Operation Neptune—the Amphibious Assault on Normandy, 6 June 1944," *Naval History and Heritage Command*, June 2019, <https://www.history.navy.mil/about-us/leadership/director/directors-corner/h-grams/h-gram-031/h-031-1.html>. For a list of APAs and AKAs, see "American Merchant Marine Ships at Normandy in June 1944," U.S. Merchant Marine, n.d., <http://www.usmm.org/normandyships.html#anchor1064501>. See also S.E. Morison, *The Invasion of France and Germany: 1944-1945, History of United States Naval Operations in World War II* (Castle Books, 2001), <https://books.google.com/books?id=CBijPQAACAAJ>; and Kenneth Edwards, *Operation Neptune: The Normandy Landings, 1944* (Gloucestershire, United Kingdom: Fonthill Media LLC, 2013).

ashore on the first day, whereas the Chinese can put about 8,000 ashore on D-day/Taiwan (or 16,000 in 3.5 days). Thus, Chinese capabilities are much less than Allied capabilities on D-Day, and a successful initial lodgment does not guarantee eventual success.

Further, Allied forces had a virtual air and naval monopoly in 1944. The Luftwaffe had been diverted to operations over the homeland and in the east. The U-boat fleet, the only significant remaining German naval force, could not penetrate Allied screens. The Allies could build up forces ashore without serious opposition. If Taiwan faced China alone, the Chinese would have the same air and naval dominance. U.S. participation means that the airspace and seas around Taiwan would be vigorously contested, and the proliferation of long-range precision strike assets means that U.S. airpower could inflict steady losses on the Chinese fleet from long distances. Thus, establishing a beachhead is not enough to ensure a Chinese victory.

In World War II, the Japanese faced this same choice: defend on the beach or inland. Initially, they tried to defeat amphibious assaults on the beaches but found that impossible. They then shifted to a defense in depth, forcing the invader to take heavy casualties by attacking prepared fortifications inland. Thus, the capture of Iwo Jima and Okinawa involved prolonged and bloody campaigns ashore. For Taiwan, a prolonged campaign would allow time for U.S. intervention or a diplomatic solution.

In three iterations, the Chinese captured the island of Penghu off the west coast of Taiwan, planning to use the island as a staging base for an attack on the main island. Although they defeated Taiwanese forces there, their dwindling amphibious capabilities prevented a successful invasion of the main island. Thus, occupying Penghu during a campaign to invade Taiwan proper was an operational dead end.

The project did not examine whether capturing Penghu would succeed as a limited attack for intimidation and bargaining or as part of a longer-term strategy in which Penghu was used as a base of operations to stage forces for an attack on mainland Taiwan several years later. Penghu is politically important because, unlike the other offshore islands closer to the Chinese coast, it was explicitly included in the Sino-American Mutual Defense Treaty between the United States and Republic of China (Taiwan).²⁶⁹ The islands were also included in the Taiwan Relations Act of 1979.²⁷⁰ Thus, the fallout from a limited Chinese operation to seize Penghu bears separate investigation.

The U.S. and Taiwanese success in frustrating the Chinese invasion is tempered by the extensive damage done to the Taiwanese infrastructure and economy. Almost all Chinese players launched massive interdiction strikes against transportation infrastructure to prevent Taiwanese forces from moving to the beachhead invasion sites.

269 The islands are also known as the Pescadores, by which they are noted in the treaty. "Mutual Defense Treaty between the United States and the Republic of China; December 2, 1954," The Avalon Project, Yale Law School, https://avalon.law.yale.edu/20th_century/chin001.asp.

270 *Taiwan Relations Act*.

Figure 9: Penghu Province



Source: CSIS.

The U.S. and Taiwanese success in frustrating the Chinese invasion is tempered by the extensive damage done to the Taiwanese infrastructure and economy. Almost all Chinese players launched massive interdiction strikes against transportation infrastructure to prevent Taiwanese forces from moving to the beachhead invasion sites.

Another element was the major battles in port cities and around airfields as the Chinese sought to capture a facility to increase the flow of forces and supplies. The Taiwanese player sometimes sabotaged civilian airfields and ports to prevent them from falling into Chinese hands. Indeed, a few players employed a “scorched earth” strategy that preemptively destroyed the most vulnerable ports and airfields. In these cases, the Taiwanese player judged that the existential threat to Taiwan justified such destruction. As a military tactic, it was highly successful. However, because a port or airfield that is unusable for military purposes is also unusable for civilian purposes, this strategy did immense damage to the transportation hubs on which the Taiwanese economy depends.

The U.S. and Taiwanese success in frustrating the Chinese invasion is tempered by the extensive damage done to the Taiwanese infrastructure and economy.

The battles for cities near invasion beaches would inevitably cause heavy damage and loss of life in residential or commercial areas. Several players also argued that destroying Taiwanese industry and infrastructure would disrupt global supply chains and have effects far beyond the region. Taiwanese manufacturers account for 61 percent of global revenue in semiconductor manufacturing for 16-nm or smaller chips, and it is even more dominant in the manufacturing of the most advanced semiconductors. As a result, every nation on the planet would feel the effects of the war.²⁷¹

THE BLOODY AIR AND MARITIME BATTLE

On the wargame's larger operational map, air and sea missions are plotted over hundreds and often thousands of kilometers. Despite the distances involved, proximity matters, especially when persistence around the battle area is required. For example, U.S. bases on Okinawa are the closest U.S. bases to Taiwan, and air units flying air superiority missions from Okinawa can remain "on station" around Taiwan for longer periods of time than aircraft flying from more distant bases. However, proximity puts assets deep inside adversary threat rings and increases vulnerability.

To reduce exposure, players often exploited the full range of their systems. They launched air strikes, which require less persistence than air superiority missions, from extreme ranges. U.S. aircraft sortied from bases in northern Japan or even Guam and, with the assistance of tankers, struck targets in the Taiwan Strait or on mainland China. China, for its part, husbanded bombers in its inland bases and launched strikes from those deep bastions.

Despite the geographic scope of the "outer" air and naval battle, these operations nevertheless had a strategic center, revolving around the centrality of tasks on or near Taiwan. The focus of most teams remained squarely on the primary tasks at hand. For U.S. teams, this was the destruction of China's amphibious fleet, without which China cannot achieve victory. For China, this involved protecting the amphibious fleet, landing as many troops ashore as possible and supporting them, to the maximum extent possible, with airpower.

Opposing Strategies to Attack and Defend the Invasion Fleet: China's success or failure hinges largely on its ability to defend the amphibious fleet long enough to achieve its objectives ashore. Much of the maritime and air battle therefore revolves around the U.S. effort to sink that fleet, and China's effort to defend it.

U.S. and partner forces have many potent assets they can bring to bear in this fight. Taiwan's ground-based anti-ship missiles can engage from the outset and impose modest attrition on the fleet until those that are not destroyed by Chinese air and missile strikes are expended, which generally occurs in the second week of the conflict. Submarines are inherently stealthy and can also reliably inflict attrition on the Chinese fleet. However, submarines carry a limited number of munitions, so while they can impose steady attrition, submarines must periodically return to port to rearm, and their effect therefore plays out over an extended period of time. Given the high carrying capacity and rapid rearm times of aircraft, bombers and fighters equipped with long-range anti-ship missiles provide the most potent threat to Chinese shipping.

271 Laura Dobberstein, "Taiwan to Dominate Chip Biz for Foreseeable Future," *The Register*, April 26, 2022, https://www.theregister.com/2022/04/26/trendforce_foundry_capacity/.

In general, Chinese players adopted a two-pronged strategy to blunt these attacks. Defensively, the Chinese teams established a layered presence between the amphibious fleet and threats to it. They deployed some SAGs around the immediate perimeter of the amphibious fleet. Most sent SAGs to serve as air- and missile-defense pickets east of Taiwan and, beyond that, dispatched submarines into the Philippine Sea and Western Pacific to intercept and attack U.S. surface fleets. At the same time, Chinese teams employed offensive operations to strike U.S. (and often Japanese) naval forces whenever they could be located, and most teams attacked U.S. air bases throughout Japan.

China's more strictly defensive activities followed a predictable path. The Chinese picket forces, when deployed, successfully blunted U.S. attacks on the amphibious fleet for a while. However, in most iterations, the United States eventually overwhelmed the picket force with massive air and missile strikes of their own because the Chinese did not have enough combat aircraft and tankers both to provide CAP for these ships and conduct other high-priority operations (strikes and ground support over Taiwan). The use of the PLAN as a kind of "ablative" armor for the amphibious ships, while effective, resulted in heavy Chinese casualties.

While the approach outlined above represents a sound Chinese approach, the results were mixed. Chinese submarines inflicted some attrition on U.S. naval forces, though the large expanse to be patrolled, the prevalence of diesel boats in the Chinese fleet, and anti-submarine operations by the United States and Japan generally limited damage. More potent were Chinese long-range missile strikes and massed missile strikes, which almost always succeeded in overcoming U.S. naval defenses. Typically, the United States lost both forward-deployed carriers within the first turn or two.²⁷²

However, China's high-end anti-ship missiles were often exhausted relatively early. If the games had continued for additional weeks, it is likely that subsequent attacks (if they had taken place) would have been less lethal. By then, however, the battle on Taiwan might have been largely decided.

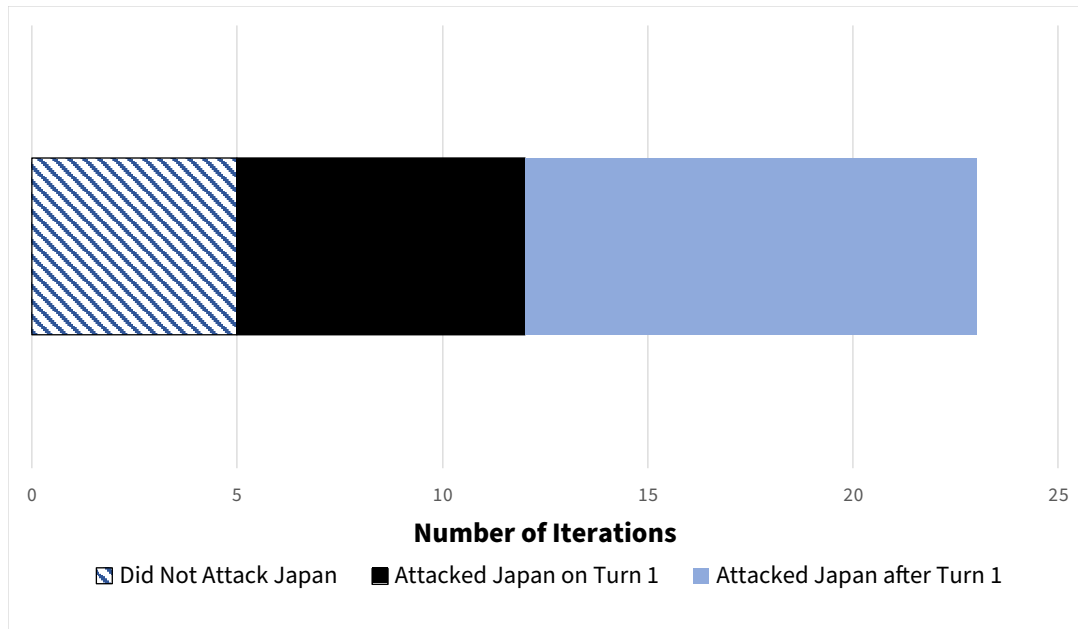
China Devastates U.S. Air Bases: As noted in previous chapters, the base case assumes that Japan remains neutral but allows U.S. forces to conduct combat operations from U.S. bases in Japan, including from Kadena, Iwakuni, Yokota, and Misawa. These bases are of tremendous value for the United States. Aircraft based in Japan can strike Chinese ships around Taiwan and escort bombers coming from Alaska or Hawaii. Aircraft flying from Kadena or southern Japan can also spend more time over Taiwan conducting air superiority operations and do not need as much aerial refueling.

However, the PLARF has many TBMs and ground-launched cruise missiles (GLCMs) that can range Japan. These highly accurate missiles, many of whose warheads are equipped with submunitions, could blanket all of the military air bases in Japan. The PLAAF's air-launched cruise missiles (ALCMs) supplement these ground-launched systems. Thus, China can conduct devastating attacks on air bases in Japan, sometimes including the element of surprise, despite the risk that such an attack would draw the JSDF into the war.

Whether to attack Japan was a critical decision for the Chinese player. As the chart below shows, the Chinese player usually did so.

272 "Losing" a carrier means that it was unavailable for the remainder of the conflict. "Loss" might mean actual sinking but could also mean damage so severe that the ship required many months of repairs to return to operations. "Loss" for nuclear ships might also mean that radioactivity had so contaminated the ship that it became unusable, even if still afloat.

Figure 10: Chinese Attacks against Japan



Source: CSIS

Frequently, the Chinese player did not attack immediately, being cautious about bringing Japan into the conflict and wanting to conserve the large but still finite inventory of missiles until they might have maximum effect. However, as the United States built up forces on Japanese bases and used these as sanctuaries to attack Chinese air and naval forces, the Chinese player then decided to attack. This delayed attack was highly effective, destroying hundreds of massed U.S. and Japanese aircraft on the ground.²⁷³

When Chinese players attacked U.S. forces in Japan, they attacked Japanese forces also, destroying many Japanese aircraft and surface ships. Surviving JSDF fought back, despite the initial losses caused by Chinese TBMs. Most valuable were the Japanese submarines, which could strike Chinese amphibious ships and the Chinese picket line around Taiwan. Also valuable were surviving Japanese aircraft and the country's significant ASW capabilities. JASDF aircraft added to the CAP over Taiwan and strikes on the Chinese amphibious fleet. Japan's extensive fleet of MPA and its network of undersea sensors played an important role in attriting China's fleet of submarines. Like the U.S. surface fleet, the Japanese surface fleet had to maintain a cautious distance from Taiwan until the Chinese missile threat eased.

In those situations where Japan entered the war, its submarines stayed east or north of Taiwan to avoid fratricide with U.S. submarines. East of Taiwan, JMSDF submarines attacked the Chinese picket line to allow U.S. and Japanese airpower to strike more easily at the amphibious ships; north of Taiwan,

273 The devastating nature of the Chinese first strike on Japan has the paradoxical effect of softening the negative effects of a delayed U.S. mobilization because fewer aircraft were deployed and thus exposed. If the United States had months of mobilization and used this to deploy large numbers of aircraft to Japan, then a Chinese first strike would simply destroy more aircraft. The section on "Avoiding deployments that create vulnerabilities" in the next chapter discusses this phenomenon in depth.

they attacked Chinese amphibious ships departing ports outside of the Taiwan Strait. One caution in assessing these results is that these Japanese actions reflect the preferences of U.S. players. They may not reflect the actions of the Japanese government, which might hold substantial forces back for defense of the homeland or put other restrictions on the use of forces.²⁷⁴

The strategy of attacking Japan worked for China in an operational sense. The benefit of eliminating air bases near Taiwan exceeded the negative effects of having the JSDF join the United States. The results of those games in which China did not attack were poorer for China than those in which it did. This judgment, however, does not consider long-term political and diplomatic costs.

Strategies for Resource Constraints, Priorities, and Risk

A final observation about the course of conflict was that both sides often had to make trade-offs and balance risks.

A major area of trade-offs was that both sides wanted to undertake more activities than they had the forces to execute. For example, many China teams discussed placing air patrols east of Taiwan to protect the fleet or even over the Ryukyu Islands to disrupt U.S. and Japanese air strikes. However, the distances involved and the lack of Chinese tankers would have made the missions unwise in view of the other heavy demands on airpower. Most China teams therefore focused the air effort on maintaining air superiority over Taiwan itself and providing air support to ground forces ashore on Taiwan. Chinese players who tried to pursue multiple goals, such as protecting the homeland while invading Taiwan, quickly failed.²⁷⁵

U.S. and Japanese teams were confronted with similar dilemmas. While most saw value in contesting China's air presence over Taiwan with fighter sweeps and CAP, the top priority was conducting strikes against the amphibious fleet. Periodic Chinese missile against U.S. and Japanese air bases often left the U.S.-Japan alliance with insufficient aircraft to conduct both air superiority operations and strikes simultaneously. In cases where Chinese ground forces took ports and airports, the need to strike and damage those facilities lest they be used to facilitate additional lift heightened the U.S. dilemma. Similar choices confronted players on those infrequent occasions when U.S. players sought to escort transport aircraft into Taiwan, as forming escort groups would reduce commitments to other forms of missions.

In addition to dilemmas driven by having more tasks than resources, the teams confronted choices about how to balance the risk of suffering unsustainable casualties against the risk of applying insufficient force to achieve objectives. This was especially true of the U.S. team, which begins the conflict on its back foot and in possession of a brittle force posture. Initial Chinese missile strikes destroy much of the U.S. forward-deployed aircraft and naval strength. Although the United States receives a steady stream of air and naval reinforcements, it takes time to build up powerful capabilities in theater.

If the United States takes a defensive stance until these reinforcements arrive, China can seize ports

274 The project team is separately running a set of game iterations in Japan that will illuminate Japanese decisionmaking. These game iterations constitute a separately funded project.

275 In one iteration (#16), the Chinese players withheld substantial forces to protect the homeland, resulting in a catastrophic defeat on Taiwan because of the insufficient forces available.

and airports and establish a secure position on the island. Delay cedes the opportunity to attack Chinese forces before they can build forces ashore on Taiwan. On the other hand, massing forward too aggressively to maximize striking power leads to crippling losses from Chinese missile attacks. The game records suggest that extreme answers to this dilemma are punished. The two iterations in which airpower was thrust forward most aggressively (#12 and #13) resulted in very high U.S. air losses (774 and 750 aircraft, respectively) and stalemated outcomes, while the most cautious strategy (#18) produced lower aircraft losses (392 aircraft) but also failed to produce a favorable operational outcome. Iterations in which players adopted more mixed strategies (#4 and #16) appeared to fare relatively better. This dilemma was most severe in pessimistic scenarios, and all the examples mentioned here are drawn from those cases.

The teams confronted choices about how to balance the risk of suffering unsustainable casualties against the risk of applying insufficient force to achieve objectives.

New Domains Are Important but not Decisive: No players used direct-ascent weapons against adversary satellite constellations because of concerns about losing their own capabilities. It was a classic case of mutual deterrence. In counterspace operations, both sides contented themselves with electronic warfare and dazzling. They also launched co-orbital attacks that would only unfold beyond the time scale of a Taiwan operation. While space is a critical warfighting domain, it was relatively static in these scenarios.

Both sides employed offensive cyber actions, but again without decisive effect. One excursion case explored a delayed Taiwanese reaction to invasion, partially based on posited cyber disruptions. This delay had a serious impact on Taiwan's ability to contain Chinese forces on their initial beachhead. However, while cyber operations were useful for gaining temporary advantage, they were not by themselves war-winning tools. This is consistent with recent experience in the Ukraine war but not with the more imaginative effects proposed by some advocates and futurists.²⁷⁶ An important caution is that the game did not explore either of these domains with classified information. These are two domains where classified information might have an impact. A broader and more nuanced set of capabilities in both domains might produce different results, at least at the strategic or national level if not at the operational level.

276 For example, Ackerman and Stavridis make cyber capabilities decisive in their fictional story about a future U.S.-China conflict, depicting cyberattacks as incapacitating U.S. fleet capabilities for months and allowing adversaries to take control of an F-35 aircraft, Ackerman and Stavridis, 2034.

Recommendations

This chapter lays out recommendations arising from analysis of the results and the picture of the war developed above. The purpose is to help policymakers as they consider how the United States should respond to China's increasing ability to invade Taiwan. Whether the decision is made to defend Taiwan or not, following these recommendations would provide flexibility to decisionmakers. Although these recommendations do not address every aspect of U.S.-China competition (which involves many other factors), these recommendations are worth pursuing because invasion is the most dangerous scenario. Further, many of the recommendations would apply to other scenarios, for example, a blockade of Taiwan or a conflict in the South China Sea.

These recommendations are organized in three categories: (1) politics and strategy, (2) doctrine and posture, and (3) weapons and platforms.

Politics and Strategy

Although the game revolves around military operations, several political and strategic insights emerged with clear policy implications.

Prioritize deepening diplomatic and military ties with Japan.

The ability to operate from U.S. bases in Japan is so critical to U.S. success that it should be considered a sine qua non for intervention. Without Japanese basing, U.S. fighter/attack aircraft had to come from Andersen Air Force Base on Guam, which was then generally crippled by Chinese missile strikes. This enables China to mass its airpower forward and concentrate on support of ground forces on Taiwan. Furthermore, the non-participation of the JSDF improves the balance of forces in China's favor. The

United States in Japan has had close security ties for 70 years. These linkages need to be maintained and enhanced.

Several game participants who had experience with the Japanese military recommended closer operational coordination between the U.S. and Japanese military establishments. Although the two militaries conduct many peacetime exercises together, the current interpretation of Japan's constitution prohibits the establishment of a combined (or joint) command with the United States. Moreover, the lack of a standing joint command within the JSDF and the existence of inconsistent geographic command boundaries among the different Japanese services inhibit effective alliance coordination at the operational level.²⁷⁷

In researching U.S.-Japanese wartime coordination, it became apparent that there may be a disconnect in the interpretation of bilateral treaties. The Status of Forces Agreement between the United States and Japan refers to a requirement for “consultation” between Japan and the United States, but both it and the original defensive alliance are vague about what this requires.²⁷⁸ Many Japanese officials interpret this as requiring the United States to obtain permission before flying combat missions from Japanese soil for any purpose other than the defense of Japan. However, U.S. officials tended to view “consultation” as notifying Japan of U.S. intentions. This disconnect must be remedied immediately, lest it leads to delays or disruption of war plans during a crisis.

Clarify war plan assumptions.

Military planning appears to assume that U.S. forces will be able to deploy onto the sovereign territory of other countries during a crisis. In particular, the Army and Marine Corps seem to assume that the MLRs and Army MDTFs will be pre-positioned in the Philippines, Taiwan, or on forward Japanese islands before conflict begins.²⁷⁹ This is militarily desirable because it allows the units to get close enough to Chinese naval forces to engage with anti-ship missiles. China's ability to interdict U.S. force movement after D-Day makes prewar deployments critical to the functioning of many U.S. capabilities.

Nor would a simple one-time crisis deployment be sufficient. Any U.S. forces on the island would

277 See Eric Chan and Wallace “Chip” Gregson, “The Future of Taiwan-Japan Defense Cooperation,” Global Taiwan Institute, October 7, 2022, <https://globaltaiwan.org/2022/10/the-future-of-taiwan-japan-defense-cooperation/>; Grant Newsham, “Japan's Self-Defense Force Goes ‘Joint’ – Kind Of,” *Asia Times*, November 9, 2022, <https://asiatimes.com/2022/11/japans-self-defense-force-goes-joint-kind-of/>; and Ryo Nemoto, “Lack of NATO-Style Command in Focus as Japan Reviews Security Strategy,” *Nikkei Asia*, September 29, 2022, <https://asia.nikkei.com/Politics/International-relations/Lack-of-NATO-style-command-in-focus-as-japan-reviews-security-strategy>.

278 For the original treaty, see: “Treaty of Mutual Cooperation and Security between Japan and the United States of America,” Ministry of Foreign Affairs of Japan, <https://www.mofa.go.jp/region/n-america/us/q&a/ref/1.html>. For the original Status of Forces Agreement, see: “Agreement under Article VI of the Treaty of Mutual Cooperation and Security between Japan and the United States of America, Regarding Facilities and Areas and the Status of United States Armed Forces in Japan,” Ministry of Foreign Affairs of Japan, <https://www.mofa.go.jp/region/n-america/us/q&a/ref/2.html>. A full list of updates to these can be found at the Japanese Ministry of Foreign Affairs' website: <https://www.mofa.go.jp/region/n-america/us/security/scc/index.html>

279 The Marine Corps' *A Concept for Stand-In Forces*, November 2021, implies such prewar movement with its notion of “persistence presence” on the ground with allies and partners. Articles by senior Marine planners are more explicit.

need to have all their logistical sustainment in place before conflict begins because it is so hard to get shipments through once China establishes its defensive zone over the island. This sustainment would need to include hundreds of missiles. A single strike by a squadron of 12 bombers launches over 200 missiles. To be a significant factor in a conflict, forward-deployed ground forces would need to provide comparable levels of missile strikes repeatedly over the course of a conflict.

However, such permissions for forward deployments en masse do not seem likely. As noted in the chapter on assumptions, most countries in the region (with the exceptions of Australia and Japan) are cool to the idea of becoming involved in a U.S.-China war due to the immense destruction it would cause.

While Taiwan would welcome forward deployments, they would be politically fraught.²⁸⁰ The base case of this project did not allow such deployments because of current U.S. Taiwan policy, which follows from agreements made with China under the Three Communiqués and has historically prohibited the presence of uniformed U.S. military personnel on Taiwan. As noted in Chapter 4, stationing forces on Taiwan either in peacetime or during a crisis would elicit a strong, possibly even violent reaction from China. Many experts argue that such moves would trigger the conflict it was intended to deter. In 2020, Taiwanese authorities revealed the presence of elements of a rotational training detachment from the Marine Raider Regiment on Taiwan, but the stationing of combat elements would constitute a significant change to established U.S. policy.

There is therefore the potential for a fundamental disconnect between U.S. war plans and political realities. The Army and Marine Corps could assume they can move forward in a crisis to threaten the Chinese fleet, while the State Department might oppose the moves as provocative, and the White House prohibits deployment. The U.S. government needs to reach a clear internal consensus before a crisis occurs.

It is therefore imperative to clarify assumptions about war plans during peacetime and not as the crisis unfolds. The National Security Council would be the natural place to work the issue out because it can integrate perspectives from across the government. Senior civilian decisionmakers do not want to be in the position of Bethmann Hollweg, German chancellor who had to justify Germany violating Belgian neutrality in 1914 because that is what the war plans (over which he had no control) called for.²⁸¹

There is therefore the potential for a fundamental disconnect between U.S. war plans and political realities.

Even if stationing ground forces on Taiwan is not politically practical, it is important to improve

280 The project does not make a judgment about whether the military benefits of stationing forces on Taiwan outweigh the political risks.

281 Hollweg knew that his justifications were not credible but had to make them anyway. See Barbara Tuchman, *The Guns of August* (New York: McMillan and Company, 1962), 83.

inter-military coordination. This might include creating liaison groups to develop joint procedures, practicing procedures in joint tabletop exercises, expanding Taiwanese participation in U.S. military PME programs, and forming cross-national planning groups to develop concepts for joint defensive operations. All these peacetime activities would smooth wartime operations. Such activities are particularly urgent in the case of Taiwan if the United States believes that conflict is possible in the near or medium term. The United States might also consider pre-positioning equipment and munitions on Taiwan without stationing troops.

Furthermore, the United States cannot take too long deciding what to do in a crisis. The longer the United States delays entering the war, the more difficult the fight. Although the United States has enough advantages that it can still prevail in most scenarios, delay means more Chinese forces ashore on Taiwan, higher casualties, and more infrastructure destruction for all parties. Hence, it not only makes the U.S. task more difficult, it may also make off-ramps more difficult to find at the end of conflict. War plans for a Taiwan contingency will have to envision a quick U.S. response; civilian leaders must recognize this need for speed when the time for decision comes.

Furthermore, the United States cannot take too long deciding what to do in a crisis. The longer the United States delays entering the war, the more difficult the fight.

Recognize the need to continue operations in the face of heavy casualties.

Civilian decisionmakers must recognize that the decision to defend Taiwan during an invasion would result in heavy casualties. If civilian leaders decided to begin the defense, then change their mind after initial casualties, it would incur the worst consequences of intervention and non-intervention: the United States would effectively be at war with China without the benefit of having maintained Taiwan's autonomy. Again, this project does not argue whether these costs are worth the benefits, but that such an evaluation must be made with open eyes.

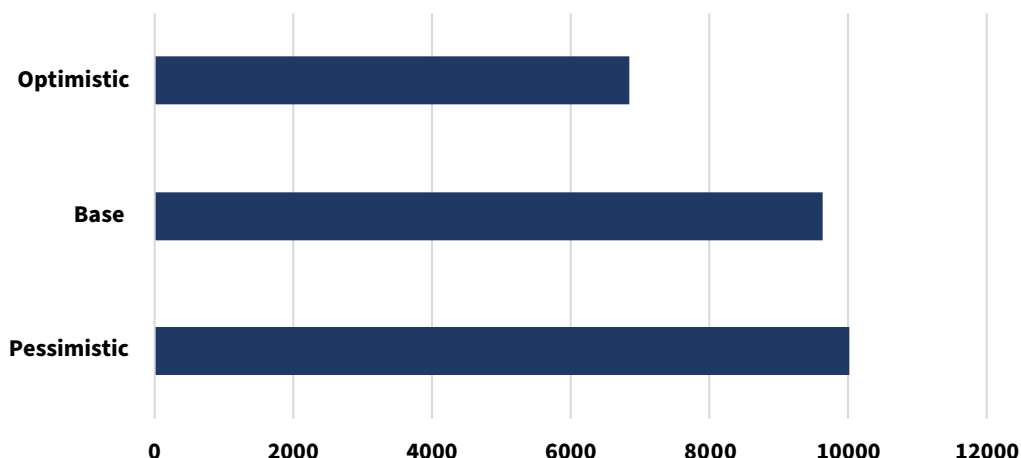
A conflict with China would be fundamentally unlike the regional conflicts and counterinsurgencies that the United States has experienced since World War II, with casualties exceeding anything in recent memory. Further, the casualty calculations shown in this report, as high as they are, do not encompass the full scope of the war. They cover only the first three or four weeks of the conflict and exclude casualties arising from the battles in the South China Sea, which the wargame abstracted. Thus, numbers presented here represent a floor, not a ceiling.²⁸²

Although the game mechanics did not track personnel losses directly, these could be estimated from equipment losses (e.g., ships and aircraft). The level of personnel losses is fortunately relatively low relative to the losses in equipment. Nevertheless, personnel casualties averaged 6,960, of which about

282 A RAND study similarly found high losses, though provided fewer specifics because of classification. David Gompert, et al., *War with China: Thinking Through the Unthinkable*, (Santa Monica, CA: RAND, 2016), https://www.rand.org/pubs/research_reports/RR1140.html

3,200 would be killed in action, in the base case even without adding losses from combat in the South China Sea, which the project did not model.

Figure 11: Total U.S. Personnel Casualties, Killed, and Total (killed, wounded, or missing)



Note: Calculations of losses excluded two iterations (#5 and #6) because they were so short.
Source: CSIS.

During the height of the wars in Iraq and Afghanistan, the United States sustained about three killed per day. At the height of the Vietnam War, in 1968, the United States lost 30 killed per day. The loss rate here, about 140 per day in the base case, approaches that of World War II, 300 killed per day. Deaths (vs. casualties, which includes wounded) in three weeks of combat around Taiwan (about 3,200) are about half the total from 20 years of combat in Iraq and Afghanistan (5,474).²⁸³

In addition to shocking the U.S. public, the scale of casualties and equipment loss would stagger a U.S. military that has dominated battlefields for a generation. These losses would be particularly difficult for the Air Force and Navy, which have essentially operated in sanctuary since the end of World War II.

To give an Air Force illustration, late-deploying units to Kadena Air Force Base on Okinawa will land at a base that has entire squadrons of wrecked U.S. and Japanese aircraft bulldozed to the side of the runway, hundreds of wounded in the base hospital, and temporary cemeteries to handle the many dead. Missile attacks and air combat will have wiped out squadrons that arrived only a few days earlier. Newly arriving personnel will be required to immediately conduct operations against the powerful Chinese forces that have caused so many casualties.

The Air Force understands this at an abstract level. The Air Force chief of staff, General Charles Brown, noted this challenge explicitly in his initial guidance: “Tomorrow’s Airmen are more likely to fight in highly contested environments and must be prepared to fight through combat attrition rates and risks

283 Iraq and Afghanistan deaths from “Casualty Status,” Department of Defense, November 14, 2022, <https://www.defense.gov/casualty.pdf>.

to the Nation that are more akin to the World War II era than the uncontested environment to which we have since become accustomed.”²⁸⁴ However, the challenge will be incorporating this into training and culture.

Figure 12: Depiction of Japanese Attack on Henderson Field on Guadalcanal, 1942



Japanese aircraft and naval gunfire wrecked many U.S. aircraft on the ground, but the airfield kept operating.

Source: "Fogerty's Fate" by LtCol A. Michael Leahy, USMCR available at the National Museum of the Marine Corps, Triangle, Virginia.

The Navy and Air Force will need to reject the notion that the next war will be long distance and “push-button,” not requiring personnel to face personal danger or operate under conditions of extreme hardship. Although such notions have been attractive since the end of World War II, they do not describe a twenty-first century conflict between great powers.²⁸⁵ The Air Force’s recent “multi-capable airmen” concept is a pragmatic acknowledgment of this grim reality. Under this concept, airmen will learn to do basic tasks outside their usual specialty, thus allowing easier adjustments to combat conditions.²⁸⁶

A broader question about leadership arises from the discussion about casualties and operational results: commanders will need to continue operations and move forward despite a high level of casualties not seen in living memory. It is easy to tell modern officers to emulate the tenacity in the face of adversity shown by their predecessors, such as Vice Admiral William Frederick “Bull” Halsey

284 C.Q. Brown and United States Department of the Air Force Chief of Staff, *Accelerate Change or Lose* (Washington, DC: Department of the Air Force, 2020), <https://books.google.com/books?id=KYzwwQEACAAJ>.

285 For a critique of technological and antiseptic notions of modern war, see H. R. McMaster, “Discussing the Continuities of War and the Future of Warfare: The Defense Entrepreneurs Forum,” *Small Wars Journal*, October 14, 2014, <https://smallwarsjournal.com/jrnl/art/discussing-the-continuities-of-war-and-the-future-of-warfare-the-defense-entrepreneurs-foru>. For discussion about why military personnel need military skills and discipline, see Mark Cancian, “Blue-Haired Soldiers? Just Say No,” *War on the Rocks*, January 18, 2018, <https://warontherocks.com/2018/01/blue-haired-soldiers-just-say-no/>.

286 “Air Force Doctrine Note 1-21 - Agile Combat Employment,” U.S. Air Force, August 23, 2022, 3, <https://www.dctrine.af.mil/Operational-Level-Doctrine/AFDN-1-21-Agile-Combat-Employment/>.

during the naval battles of the Solomon Islands, Major General Alexander Vandegrift on Guadalcanal, Lieutenant Colonel James Doolittle raiding Tokyo, or General George Patton at Kasserine Pass. However, the current generation of military officers has been trained on “force protection,” whereby the minimization of casualties is of paramount importance. That makes sense in a counterinsurgency operation where maintaining long-term political support is vital. It is counterproductive in a conventional conflict with clear geographic and political goals.

Commanders will need to continue operations and move forward despite a high level of casualties not seen in living memory.

All military services should incorporate the recognition of casualties into their training programs and emphasize that there will be no safe rear areas in a great power conflict. The combat forces already do this, but such expectations need to be expanded. For example, many Army support units such as air defense have not suffered significant casualties since 1945, but now they will be a prime target for Chinese missiles. Similarly, aviation organizations should be restructured to cope with wartime losses to aircraft, maintenance facilities, and support personnel.

Do not plan on striking the mainland.

Strikes on the Chinese mainland create grave risks of escalation. These risks are discussed in depth above in the justification for the “U.S. National Command Authority rules out strikes on Chinese mainland” excursion case. Even if the war plan developed in peacetime calls for mainland strikes, the National Command Authority might withhold permission in the actual event of war. It would therefore be wise to hedge planning on the question of striking the Chinese mainland. If permissions are granted, then military leaders should be ready with plans for strikes on high-value targets such as over-the-horizon radar, satellite uplink stations, and high-value aircraft that affect the fight on Taiwan.

Strengthen Taiwanese ground forces.

The United States will not be able to insert ground forces onto Taiwan in a timely manner. In some iterations, the U.S. player attrited the PLAN sufficiently that some U.S. ground forces might get through after four or more weeks of conflict, though with some risk from remaining Chinese air and naval power. By that time, however, the battle for Taiwan will likely be decided.

Once conflict begins, Taiwan’s isolation means that there can be no “Ukraine model.” In the Ukraine war, the United States and NATO have sent massive amounts of equipment and supplies directly to Ukraine during the conflict. Although Russia has made some efforts to interdict this flow by striking railroads with missiles, shutting down or even seriously impeding the flow has been beyond Russia’s military capability. However, China does have that capability. Therefore, all the equipment and munitions must arrive before China begins combat operations.

Once conflict begins, Taiwan’s isolation means that there can be no “Ukraine model.” . . . Therefore, all the equipment and munitions must arrive before China begins combat operations.

The United States should therefore encourage Taiwan to acquire sufficient munitions and weapons to fight the local battle against invading forces without any direct assistance for a prolonged period. For many munitions, Taiwan may be capable of producing its own stockpiles. For U.S.-supplied systems, foreign military sales provide a mechanism to get weapons to Taiwan before conflict begins. Taiwan has ordered billions of dollars of weapons, but deliveries have been slow. The United States should speed up the Foreign Military Sales process on its side and urge the Taiwanese to speed up on their side. There needs to be a sense of urgency.²⁸⁷

Furthermore, Taiwanese ground forces must immediately shift toward becoming more effective and survivable. Because defeating Chinese forces before they land is likely impossible, effective resistance ashore is critical. This requires an army that is ready, well-trained, well-led, and highly motivated. Without such a ground force, the rest will be in vain. Yet, it is not clear that the Taiwanese army has the necessary qualities. Taiwan needs to give its army a higher priority than it has received in the past.

The island of Taiwan contains many geographic features such as mountains and rivers that the Taiwanese forces should use to their advantage. This includes cities and urban sprawl. Although the defense of cities would result in severe damage, failing to defend them makes Chinese operations on the island much easier. The longer Taiwan can lengthen the war, the greater the attrition of the Chinese fleet and the possibility of external aid.

Move Taiwanese air and naval forces toward asymmetry.

Historically, Taiwan has built a military with broad capabilities, paralleling those of major powers such as the United States. Thus, it has sought large surface ships and advanced aircraft in addition to submarines and ground forces. Currently, it has an air force with 534 combat aircraft (474 fighter/attack, 60 support) and a navy with 38 major vessels (4 submarines, 26 surface combatants, and 8 amphibious ships).²⁸⁸ Such a structure made sense when Chinese air and naval forces were relatively weak. Taiwan’s ability to contest China in the air and at sea meant it could defeat an invasion before ground forces landed in strength. That minimized damage to Taiwanese infrastructure and its economy. Further, such a structure provided visible reminders of Taiwan’s power and status in peacetime and could counter peacetime Chinese efforts to test Taiwanese sovereignty.

287 Such a plea is made in Michael Spirtas, “Ukraine’s Dream Could Beat Taiwan’s Nightmare,” War on the Rocks, October 28, 2022, <https://warontherocks.com/2022/10/ukraines-dream-could-be-taiwans-nightmare/>. Many other experts make similar pleas.

288 International Institute for Security Studies, *Military Balance 2022*, 308–310

Maintaining a broad set of symmetrical capabilities today is inappropriate given the increasing strength of Chinese rocket, air, and naval forces. The Taiwanese surface navy would be quickly destroyed without inflicting significant damage on the Chinese fleet. Submarines are more survivable than surface ships but still vulnerable if China achieves surprise. Having a continuous at-sea submarine presence would mitigate this problem; however, such a presence is currently infeasible due to lack of numbers. The Taiwanese air force is similarly vulnerable. Chinese short-range ballistic missiles can cover all of Taiwan's military tarmac and HASs, destroying all Taiwanese aircraft not in underground shelters. The surviving aircraft would contribute only marginally to the air battle over the island before being destroyed.

The value of the "porcupine strategy" was demonstrated by the project's modeling and wargames. Because Taiwan cannot match China ship-for-ship or aircraft-for-aircraft, the "porcupine strategy" proposes that Taiwan invest more heavily in "agile and concealable weapons such as the portable Javelin and Stinger missiles" rather than expensive and vulnerable conventional weapons.²⁸⁹ The project's findings are consistent with many other studies of Taiwan and reflect the current debate within Taiwan.²⁹⁰ These asymmetric capabilities (e.g., coastal defense cruise missiles, mobile SAMs, and mines) could also play a role in counter-blockade strategies if China pursued such a strategy with strikes on Taiwan itself. The Taiwanese navy's budget would better contribute with coastal defense cruise missiles, missile boats, and mining rather than large surface combatants. Taiwanese ground-based ASCMs can survive a Chinese air and missile strike because of their mobility and were highly effective against Chinese surface ships. Mobile SAMs were more effective for air defense than fighters because of their greater survivability. They are also less expensive.

289 For a detailed discussion of a "porcupine strategy" for Taiwan, see Murray, "Revisiting Taiwan's Defense Strategy"; and "What is Taiwan's porcupine defence strategy?," *The Economist*, May 10, 2022, <https://www.economist.com/the-economist-explains/2022/05/10/what-is-taiwans-porcupine-defence-strategy>; James Timbie and James O. Ellis, Jr., "A Large Number of Small Things: A Porcupine Strategy for Taiwan," *Texas National Security Review* 5, no. 1 (Winter 2021/2022), <https://texasnsr.wpenginepowered.com/wp-content/uploads/2021/12/TNSR-Vol-5-Issue-1-Timbie-and-Ellis.pdf>.

290 For a selection of publications with recommendations on shifting Taiwan's capabilities, see, for example, Jim Thomas, John Stillion, and Iskander Rehman, *Hard ROC 2.0: Taiwan and Deterrence Through Protraction* (Washington, DC: Center for Strategic and Budgetary Assessments, December 2014), <https://csbaonline.org/research/publications/hard-roc-2-0-taiwan-and-deterrence-through-protraction>; CNAS, *Rising to the China Challenge* (Washington, DC: January 2020), <https://www.cnas.org/publications/reports/rising-to-the-china-challenge>; Pettyjohn, Wasser, and Dougherty, *Dangerous Straits*; and Terrence Kelly et al., *Employing Land-Based Anti-Ship Missiles in the Western Pacific* (Santa Monica, CA: RAND, November 2013), https://www.rand.org/pubs/technical_reports/TR1321.html. For a discussion on building Taiwan's own area denial capabilities, see "Building Taiwan's Own Area Denial Capabilities," *The Diplomat*, September 21, 2022, <https://thediplomat.com/2022/09/building-taiwans-own-area-denial-capabilities/>. Recently, Admiral Lee Hsi-ming, former chief of the Taiwanese general staff, has engendered significant debate by advocating for a defense in depth with more asymmetric capabilities. He describes this alternate approach in his book, *Overall Defense Concept: An Asymmetric Approach to Taiwan's Defense*, and in a short paper published by the Hoover Institution: Lee Hsi-ming, "Taiwan's Overall Defense Concept: Theory and the Practice," Hoover Institution, September 27, 2021, https://www.hoover.org/sites/default/files/210927_adm_lee_hoover_remarks_draft4.pdf.

Because Taiwan cannot match China ship-for-ship or aircraft-for-aircraft, the “porcupine strategy” proposes that Taiwan invest more heavily in “agile and concealable weapons such as the portable Javelin and Stinger missiles” rather than expensive and vulnerable conventional weapons.

Particularly important is the fulfillment of a current deal to supply Taiwan with ground-launched Harpoon missiles. In the game, the 400 missiles already programmed (but not yet delivered) had a large effect on weakening the initial Chinese invasion. Two hundred additional missiles would have as much impact on the naval battle as an MLR or MDTF but without the political risks of basing and the operational challenges of transportation and resupply.

Taiwanese progress toward such an asymmetric strategy has been halting. The United States has consistently urged the government of Taiwan to move away from boutique, vulnerable systems.²⁹¹ Progress toward a “porcupine strategy” seemed to be made with a 2017 strategy by the then-chief of the Taiwanese military forces, Lee Hsi-Min.²⁹² However, subsequent military chiefs have vacillated. Determining the correct combination of carrots and sticks to change Taiwanese attitudes is imperative for building an effective deterrent on today’s threat environment.

Doctrine and Posture

Next are recommendations for how the U.S. military plans to operate (doctrine) and how it positions its forces in the theater (posture).

Fortify and expand air base capacity in Japan and Guam.

The United States and Japan lose hundreds of aircraft in every iteration, from an average of 290 in optimistic cases to 646 in pessimistic cases. For the U.S. Air Force, this represents 12 to 32 percent

291 For the U.S. government discussions with Taiwan, see Air & Space Forces Magazine, e Lara Seligman, Alexander Ward, and Nahal Toosi, “In Letters, US Tries to Reshape Taiwan’s Weapons Requests,” *Politico*, May 10, 2022, <https://www.politico.com/news/2022/05/10/u-s-taiwan-weapons-request-00031507>; Edward Wong and John Ismay, “U.S. Aims to Turn Taiwan into Giant Weapons Depot,” *New York Times*, October 5, 2022, <https://www.nytimes.com/2022/10/05/us/politics/taiwan-biden-weapons-china.html>.

292 For more explanation of Taiwan’s asymmetric defense policy from Lee Hsi-Min, see Lee Hsi-Min and Eric Lee, “Taiwan’s Overall Defense Concept, Explained,” *The Diplomat*, November 3, 2020, <https://thediplomat.com/2020/11/taiwans-overall-defense-concept-explained/>.

of its operational fighter/attack strength after three to four weeks of conflict.²⁹³

The picture below shows U.S., Taiwanese, and Japanese losses (over 900) from one game iteration (#13), a pessimistic and intense encounter that ended in stalemate.²⁹⁴ The losses represent about 40 percent of the Air Force's fighter/attack operational inventory. This would degrade U.S. power for decades.

Figure 13: U.S., Taiwanese, and Japanese Losses from Game Iteration #13



Source: CSIS.

The dilemma for aircraft is that they are vulnerable if based close to Taiwan but less useful if based farther away. The United States must aggressively attack the Chinese amphibious ships to prevent the Chinese from establishing a foothold in Taiwan. However, this means moving many aircraft forward before the Chinese missile threat diminishes. As bases closer to Taiwan can be struck by more Chinese missiles, moving U.S. aircraft closer to Taiwan increases aircrafts' vulnerability to being destroyed on the ground.

Andersen Air Force Base on Guam cannot substitute for bases in Japan. The distance from Guam to Taiwan (roughly 2,800 km) makes it impos-

ible to generate many sorties from Andersen Air Force Base. Despite the high casualties suffered by aircraft based in Japan, most U.S. players preferred Japanese basing to Guam. However, in those iterations where Japan was strictly neutral, Andersen Air Force Base became the principal U.S. base. This gave the Chinese powerful reasons to attack it repeatedly. Aircraft on Andersen Air Force Base are particularly vulnerable because, as of 2022, the base has no HASs.

Because there is no viable substitute for using air bases in Japan, the United States needs to work with Tokyo to harden Japanese bases with shelters and expand their tarmacs for dispersing aircraft.

Concrete (hardening) lacks influential constituencies within military bureaucracies, but the large benefit justifies a strong effort. Although HASs do not provide complete protection, they require China to expend more missiles to destroy each aircraft. If every aircraft were in a shelter, China would be unable to use

293 Operational strength = aircraft in combat units. This excludes aircraft in maintenance, training units, testing, and development. It also excludes unmanned aircraft. Operational strength is about 60 percent of total strength, about 1,250 fighter/attack aircraft in 2022. "2022 USAF & USSF Almanac: Equipment," *Air & Space Forces Magazine*, July 1, 2022, <https://www.airandspaceforces.com/article/2022-usaf-ussf-almanac-equipment/>.

294 The counters in white on the left of the photograph are Japanese losses. Those in blue, whether in outline or as background, are U.S. losses. Green are Taiwanese losses. Note that aircraft losses are in large stacks.

Figure 14: U.S. Bases in the Western Pacific



Source: CSIS.

particularly large international ones. As Chinese missile attacks constitute an area attack problem, increasing the area those missiles must cover is an effective countermeasure. Although local political opposition may obstruct peacetime and possibly wartime access to Japanese civilian airports, the significant payoff justifies a strong effort.

Restructure U.S. Air Force doctrine and procurement to address vulnerability on the ground.

Faced with large losses on the ground, U.S. players often dispersed aircraft to regional civilian airfields in Japan. By spreading aircraft out and thus diluting the effect of any single Chinese missile attack, dispersion effectively reduced losses. Dispersion is a major element in contemporary discussions about

missiles with submunitions that destroy several aircraft each. In conjunction with deception and active defenses, the United States could shift the cost-exchange ratio of Chinese attacks on U.S. aircraft in Japan.

While active defenses are helpful, they cannot be thought of as the primary means of mitigating Chinese missile attacks. On the one hand, local commanders want active defenses because they offer a tangible counter against adversary aircraft, cruise missiles, and ballistic missiles. Investing in passive defenses such as hardening and dispersion that simply mitigate the effects of enemy attacks represents a tacit acceptance of losses. On the other hand, China's inventory of missiles means that even if active defenses are highly effective (as assumed in the project's modeling), then the sheer volume of fire will overwhelm U.S. active defenses. Active defense therefore must be used with a robust system of passive defenses.

Besides hardening, the United States and Japan should also work to secure access to civilian international airports. The base case assumed that the Air Force used one civilian regional airfield per military airfield. This could be augmented with access to a broader set of civilian airfields,

operational concepts in the Western Pacific.²⁹⁵

However, unprepared civilian airfields have drawbacks; there will always be a need for well-equipped military airfields. First, there is a logistical cost for dispersing and time lost in making the move to civilian airfields. Second, the United States needs basing for hundreds of aircraft, which is far beyond what regional airfields can handle. Third, as activities on a dispersion airfield expand, the airfield becomes functionally like a main operating base but without the hardened infrastructure, specialized logistics, and air defenses. Large, well-equipped—and fully hardened—bases remain indispensable for sortie generation.

Air Force doctrine is beginning to address this trade-off between preparation and dispersion through the agile combat employment (ACE) concept. ACE allows operations from a network of smaller, dispersed locations through a hub-and-spokes model that can complicate adversary planning while maintaining high sortie generation. These dispersed locations would be “defensible, sustainable, and relocatable.” This doctrinal adjustment will reduce the drawbacks of using civilian airfields. The Air Force is practicing the skills needed for ACE in a variety of exercises.²⁹⁶

However, these efforts do not go far enough. Rather than attempting to tack dispersion onto a predetermined force structure and doctrine, the Air Force needs to engineer survivability into its structure from the ground up. Sweden’s Flygbassystem 60/90 provides an example of hardening and dispersion to protect forces on the ground. Having observed the vulnerability of aircraft on the ground during World War II and the increasing power of nuclear weapons, the Swedish air force adopted Flygbassystem 60, a system of concrete command bunkers, mobile maintenance teams, and multiple dispersed runways designed to improve aircraft survivability in a potential war against the Soviet Union.²⁹⁷ This system was updated to Flygbassystem 90 after witnessing the effectiveness of air base attacks and runway cratering munitions in the Arab-Israeli wars.²⁹⁸ ACE is a sound first step, but it must be expanded into a more holistic doctrine such as with the Flygbassystem.

Do not plan on overflying the Chinese mainland.

In every iteration, the Air Force was never able to begin operations within Chinese airspace by the end of game play (typically after three to four weeks of conflict). Instead, U.S. Air Force had to focus

295 For a few examples, see Arash Heydarian Pashakhanlou, “The Underdog’s Model: A Theory of Asymmetric Airpower,” *Air & Space Power Journal* 35, no. 4 (2021), 16, https://www.airuniversity.af.edu/Portals/10/ASPJ/journals/Volume-35_Issue-4/F-Pashakhanlou.pdf; Michael E. Canfield, “Contingency Basing for Great Powers Competition,” Air University, March 5, 2021, <https://www.airuniversity.af.edu/Wild-Blue-Yonder/Article-Display/Article/2526242/contingency-basing-for-great-powers-competition/>; Patrick Mills et al., *Building Agile Combat Support Competencies to Enable Evolving Adaptive Basing Concepts* (Santa Monica, CA: RAND Corporation, 2020), https://www.rand.org/pubs/research_reports/RR4200.html; and “Air Force Doctrine Publication 3-01 - Counterair Operations,” U.S. Air Force, September 2019, 38, <https://www.doctrine.af.mil/Doctrine-Publications/AFDP-3-01-Counterair-Ops/>.

296 “Air Force Doctrine Note 1-21 Agile Combat Employment,” U.S. Air Force.

297 Jörgen Rystedt, “Flygbassystemet Bas 60,” *Förvarets Historiska Telesamlingar*, 2005, http://www.fht.nu/Dokument/Flygvapnet/flyg_publ_dok_flygbassystemet_bas_60.pdf.

298 “Bas 90 - Air Base System 90, Swedish Air Force (1986) [English Subtitles Available],” YouTube video, posted by HR, June 4, 2017, 10:46, https://www.youtube.com/watch?v=MNAk9lB_q00.

on the ground, air, and sea battles on and immediately around Taiwan and had little leeway to employ airpower over the mainland. Attrition was high enough without contending with China's integrated air defense system (IADS) on the mainland.

Strikes against military and civilian infrastructure on the mainland were counterproductive distractions. They require a massive and sustained air campaign that takes a long time to have operational effects and diverted attention from immediate battlefield needs. Bombers equipped with standoff munitions were effective against the mainland but employed solely against ports and airfields because these targets directly affected the situation on Taiwan.

Players were reluctant to risk B-2 bombers, the only long-range assets possibly capable of penetrating Chinese airspace, because of their limited numbers.

Nor will this problem become better in the 2030s. When the B-21 bomber becomes widely available and the B-2 is retired in the 2030s, China's IADS will have also progressed. Nevertheless, the B-21 program remains important, as it might be the only bomber capable of launching medium-range munitions (e.g., the JSOW) and surviving in the expanding Chinese air defense bubble.

The U.S. Air Force must therefore avoid force structure and doctrinal decisions that are geared toward overflying China's robust IADS on the mainland. This does not mean that stealth is unimportant: it is still necessary to destroy targets away from the coast that are protected by long-range air defenses. However, any program that envisions overflight of the Chinese mainland is unrealistic.

The U.S. Air Force must therefore avoid force structure and doctrinal decisions that are geared toward overflying China's robust IADS on the mainland.

Recognize the limitations of Marine Littoral Regiments and Army Multi-Domain Task Forces and cap their numbers.

The Marine Corps is building Marine Littoral Regiments (MLRs) to operate inside the Chinese defensive zone (which the Marine Corps calls the "weapons engagement zone") and contest Chinese air and naval assets. The Army envisions its Multi-Domain Task Forces (MDTFs) as having a similar function. Although these units could contribute to the fight, neither played heavily in most scenarios. The problems of operating inside the Chinese defensive zone were insurmountable.

The game assumed that by 2026, the Marine Corps had an MLR on Okinawa and another on Hawaii.²⁹⁹

299 Andrew Feickert, "New U.S. Marine Corps Force Design Initiative: Force Design 2030," Congressional Research Service, March 7, 2022, IN11281, <https://crsreports.congress.gov/product/details?prodcode=IN11281>. The Marine Corps *Force Design 2030 Annual Update* in May 2022 cited Okinawa and Hawaii as potential locations for the MLRs. See U.S. Marine Corps, *Force Design 2030 Annual Update* (Washington, DC: Department of the Navy, May 2022), https://www.marines.mil/Portals/1/Docs/Force_Design_2030_Annual_Update_May_2022.pdf?ver=7ul-eyF6RcSq_gHU2aKYNQpercent3dpercent3d.

The MLR on Okinawa was able to exert local influence, destroying two Chinese ships in one iteration (#19). However, its Naval Strike Missiles (NSMs) have a range of only 100 nautical miles, and Chinese fleets rarely came that close Okinawa, being focused on the waters around Taiwan.³⁰⁰

Although these units [MLRs and MDTFs] could contribute to the fight, neither played heavily in most scenarios. The problems of operating inside the Chinese defensive zone were insurmountable.

In several games, the U.S. player tried to move an MLR onto Taiwan by air or sea, but in all cases the unit and transportation assets were destroyed while trying to transit the extensive Chinese defensive zones.³⁰¹

In most scenarios, political assumptions prevented any U.S. forces from being pre-positioned on Taiwanese or Philippine territory before the conflict begins. (See Chapter 4 for a description of the base case assumptions and above for a recommendation on verifying war plan assumptions.) However, one scenario assumed that the United States was willing to risk provocation by putting U.S. forces onto Taiwan, whether because Chinese mobilization generated sufficient concern, or the U.S.-China relationship had changed.

In this scenario, before hostilities began, an MLR deployed from Okinawa with its load of missiles and one reload, augmenting the shore-based fires of Taiwanese Harpoons. The NSM's 100-nautical-mile range could easily enable attacks on Chinese amphibious ships from Taiwan. Assuming that the MLR deployed with a load of 72 NSMs on 18 launchers, modeling showed that the MLRs would sink an average of five major Chinese amphibious ships. Because of the MLR's ability to conduct distributed operations, it was assumed to be survivable in the face of Chinese counteraction.

However, resupply proved impossible. A resupply mission of C-17s escorted by fighters attempted to break through the Chinese CAP but was shot down. After that, no further attempts were made at resupply. The MLR became a ground infantry battalion, augmenting the 114 combat battalions of the Taiwanese ground forces.

300 The Marine Corps is also buying longer-range Tactical Tomahawk missiles for the MLRs, but the number delivered by 2026 will be under 100 because of the two-year production lead times. Department of the Navy, *Department Of Defense Fiscal Year (FY) 2023 Budget Estimates April 2022, Budget Justification Books, Procurement Marine Corps* (Washington, DC: Department of Defense, April 2022), 1-53–1-61, https://www.secnv.navy.mil/fmc/fmb/Documents/23pres/PMC_Book.pdf.

301 In iteration #13, the MLR and two squadrons of transports were destroyed during a contested insertion to Taiwan. In iteration #18, there was an attempt to move the MLR on an Amphibious Ready Group, which was destroyed. Because few light amphibious warships (LAWs) would be delivered by 2026, all amphibious movement was assumed to be by regular amphibious ships. In any case, the MLR needed to deploy as an entire unit to have a significant operational impact, and this was far beyond the capability of LAWs to support.

Ground units will not provide a significant volume of fire. A squadron of bombers armed with long-range cruise missiles has a greater volume of fire than an entire MLR but without the challenges of transportation and logistics. Ground-based anti-ship units must either deploy with a large number of missiles before the conflict begins or act as forward sensors for long-range air and naval power.

Similar stories emerged from MLR deployments to the western Ryukyus and Philippines. In one scenario, the MLR was prepositioned in the western Ryukyus. In that location, it could attack Chinese naval forces that moved north of Taiwan, but resupply was deemed too risky.

In another scenario, an MLR moved onto the Philippine islands north of Luzon. There, it could attack Chinese forces that moved south of Taiwan, but again resupply was impossible, limiting its value.³⁰²

All game iterations had an MLR and Army MDTF on Hawaii available for deployment by airlift, but no U.S. player called them forward. Instead, the U.S. player gave priority to Patriot battalions, which could add to the air defense of threatened airfields. These were needed because of repeated Chinese air and missile attacks.

Therefore, the project team recommends continuing to develop land-based forces to counter Chinese air and naval capabilities but also the need to recognize their employment challenges. While these new formations were more useful than traditional ground forces, multiplying these specialized units has limited value because only the first few can be deployed successfully. Others will sit unused. The maximum number is probably two or three.

The acquisition of long-range ground-launched missiles might overcome this limitation. If ground-launched Tomahawks have a similar range to their Vertical Launch System (VLS) counterparts, they could be employed from peacetime bases on Okinawa without moving in the Chinese defensive zone.

Avoid crisis deployments that create vulnerabilities.

U.S. warfighting doctrine includes a pre-hostility phase designed to strengthen deterrence and enhance U.S. warfighting capabilities should conflict occur. As a result, the United States routinely makes forward deployments in crises.³⁰³ Therefore, in a major confrontation with China, the United States might load up Japan and Guam with aircraft and move CSGs into the region to signal U.S. resolve. Unfortunately, as Thomas Schelling, the great strategist, observed, “A fine deterrent can make a superb target.”³⁰⁴ In early 1941, the United States transferred the home base of the Pacific Fleet from San Diego to Pearl Harbor, Hawaii, to deter Japanese aggression and station the fleet closer to the potential fight. However, this move put the fleet within range of Japanese striking forces, with results

302 Note: The situation would be very different for a conflict in the South China Sea, where Philippine participation would be critical. In that situation, the Philippines would play the role of an indispensable forward base that Japan plays in a conflict over Taiwan.

303 See flexible deterrent options in Joint Chiefs of Staff, *JP 5-0, Joint Planning* (Washington, DC: Department of Defense, December 2020), E-1, https://irp.fas.org/doddir/dod/jp5_0.pdf. For a discussion of the value of forward presence, see Department of Defense, *Deterrence Operations Joint Operating Concept* (Washington, DC: December 2006), 33–35, https://www.jcs.mil/Portals/36/Documents/Doctrine/concepts/joc_deterrence.pdf?ver=2017-12-28-162015-337.

304 Thomas Schelling’s introduction to Roberta Wohlstetter, *Pearl Harbor: Warning and Decisions* (Stanford, CA: Stanford University Press, 1962).

as tragic as they are well known. Similarly, U.S. deployments during a confrontation with China might tempt China to attack preemptively.

Thomas Schelling, the great strategist, observed, “A fine deterrent can make a superb target.”

In theory, the United States might be able to keep air and naval forces forward for deterrence but pull them back or disperse them to less vulnerable sites when deterrence was on the verge of failing. However, this cannot be relied on in practice. First, partners and allies will push hard to keep forces forward as long as possible. They would regard withdrawal as a sign of abandonment, not prudence. Further, it requires precise knowledge about when China intends to strike; however, China decides D-Day. The United States had such knowledge before the war in Ukraine, but warning may not always be as clear. Furthermore, China could plan on one D-Day, then reset it if the U.S. withdraws forward-deployed forces. Finally, it would take several days for all the vulnerable forces to get out of range, so withdrawal must begin with enough lead time before hostilities start.

The United States needs to develop mechanisms to enhance deterrence that do not also create a tempting target. As commentators have noted, the withdrawal of U.S. squadrons from Kadena probably enhances deterrence by reducing the temptation to strike a vulnerable target.³⁰⁵ Deploying defensive systems within the Chinese defensive zone would increase capabilities without increasing vulnerability. Deploying offensive systems to locations outside Chinese missile ranges, such as sending bombers to Hawaii or Australia, would indicate resolve without increasing vulnerability. Assuming enough warning to withdraw vulnerable assets prior to conflict breaking out is highly risky.

Weapons and Platforms

Finally, analysis of the game results generated recommendations about the procurement of specific weapons and platforms.

Shift to smaller, more survivable ships.

As with aircraft, the United States lost many surface ships in almost every iteration because of forward deployment within the Chinese defensive zone. U.S. losses of large surface ships typically totaled two carriers and 15 to 25 cruisers/destroyers. Although this represented only about 15 to 25 percent of total U.S. Navy surface combatants, losses typically included nearly all large surface ships in the Western Pacific. In the most intense iterations, the U.S. Navy was losing a major ship every day of the war.³⁰⁶

305 Stacie Pettyjohn, Andrew Metrick, and Becca Wasser, “The Kadena Conundrum: Developing a Resilient Indo-Pacific Posture,” *War on the Rocks*, December 1, 2022, <https://warontherocks.com/2022/12/the-kadena-conundrum-developing-a-resilient-indo-pacific-posture/>.

306 The wargame tracked major surface combatants—carriers, cruisers, destroyers—and attack submarines. It did not track other classes of ships, which collectively comprise over half the fleet and would also have taken losses in a U.S.-China conflict.

Until the Chinese ground-launched missile inventory was exhausted, it was too dangerous for U.S. or Japanese surface ships to approach Taiwan. Amphibious ships were particularly vulnerable because of their lack of defensive systems.

In some iterations, surface ships could approach Taiwan in week three or four when the Chinese anti-ship missile inventory had declined. Even then, the ALCMs of the PLAAF and PLANAF, the torpedoes and cruise missiles of PLAN submarines, and the ship-based anti-ship missiles of the PLAN meant that the survivability of U.S. surface ships was low. U.S. ships were rarely able to get within Harpoon or SM-6 range of Chinese ships.

Until the Chinese ground-launched missile inventory was exhausted, it was too dangerous for U.S. or Japanese surface ships to approach Taiwan.

Even after Chinese ASBMs (Anti-Ship Ballistic Missiles) had been expended, the utility of U.S. surface ships had limits. Although the range of the Maritime Strike Tomahawk (MST) allowed U.S. surface ships to attack Chinese ships from a distance, every MST in a ship's inventory meant one fewer interceptor or anti-submarine missile that the ship had for defense. A ship with enough MSTs to destroy multiple Chinese warships was a glass cannon, very vulnerable in turn to Chinese attack.

Just as there will be too many incoming missiles for active defense to adequately protect airfields, there will be too many anti-ship missiles for active defense to adequately protect surface ships. Therefore, active defense with interceptors must be paired with soft kill measures (e.g., reduced radar cross-section and electronic warfare) that complicate enemy targeting. To this end, the budget of the Surface Warfare Division of the Operational Test and Evaluation Force, which tests ship defenses, should be increased.³⁰⁷ Even with improved electronic warfare, many ships will be lost in a conflict with China because electronic warfare advantages are transitory. Procurement decisions must therefore consider the vulnerability of surface ships.

This all points to benefits in shifting toward a fleet of smaller, stealthier ships integrated with unmanned decoys. Such ships would be better disposed to the soft kill of incoming missiles. In addition, it will not be as devastating to lose smaller, cheaper, less-capable ships. The Navy should also have expendable or unmanned ships accompany CSGs to act as decoys.

Develop rescue mechanisms to deal with crippled ships and multiple sinkings.

Just because a ship is sunk does not mean that its problems are over. Hundreds or even thousands of U.S. sailors would be thrown into the water each time a ship sinks. Currently, the U.S. Navy has no way of rescuing these sailors except by diverting a warship, with all the associated risks and opportunity costs. Game participants with a naval background recalled the experience of the USS Juneau in World War II. The ship was torpedoed and sunk on November 13, 1942, leaving 100 sailors

307 "Surface Warfare," Operational Test and Evaluation Force, n.d., <https://www.cotf.navy.mil/surface-warfare/>.

in the water. However, the local commander judged it too risky to stop and look for survivors. Only 10 survivors were left when finally picked up eight days later.³⁰⁸ World War II convoys routinely included a rescue ship to pick up survivors so that warships did not have to be diverted. In addition to their humanitarian function, rescuing 4,200 shipwrecked crew during the war, rescue ships boosted morale by reassuring sailors about their chances of survival.³⁰⁹

Figure 15: Japanese Shin-Maywa US-2



Source: CSIS.

Further, many mission kills would not result in the ship being sunk but rather incapacitated. Without appropriate assets to tow disabled ships to port, they would have to be scuttled, depriving the Navy of an irreplaceable asset. For example, in World War II, all five U.S. fleet carriers lost in action were scuttled to keep them from falling into enemy hands after receiving severe damage.³¹⁰

The U.S. Navy needs to develop rescue ships that can accompany CSGs and SAGs. Such ships could both rescue shipwrecked sailors and tow disabled ships. Some version of the existing oceangoing tugs (Navy classification:

“ATS”) might be suitable. Although this is a lower-priority requirement in peacetime, the wartime need is clear. The nation would be unforgiving if the Navy left sailors to drown because it was too risky to save them. Unlike in 1943, ubiquitous social media would prevent suppression of information about the event. Further, the tugs might save some damaged ships that would otherwise be lost. The Navy will need every ship it has because of the long time required for new construction.

The U.S. Navy needs to develop rescue ships that can accompany CSGs and SAGs. Such ships could both rescue shipwrecked sailors and tow disabled ships.

The Navy might also consider acquiring an amphibious patrol aircraft that could help rescue sailors from sunken ships and aircrew from downed aircraft. In a situation where the United States and Japan

308 The sinking of the *Juneau* received particular attention because five Sullivan brothers were lost onboard. See the description in James D. Hornfischer, *Neptune’s Inferno: The U.S. Navy at Guadalcanal* (New York: Bantam Books, 2011), 330–332, 370–374. The loss of so many members from a single family became a national sensation. The abandonment of survivors in the water was not mentioned either in official descriptions at the time or in Hollywood’s later depiction of the event (*The Fighting Sullivans*, 1944).

309 John Winton, *Convoy: The Defence of Sea Trade, 1890–1990* (London: M. Joseph, 1983), 197–198.

310 *Princeton* and *Yorktown* were scuttled but probably too damaged to be saved in any case. *Lexington*, *Wasp*, and *Hornet* might have been saved if towed to port.

lose dozens of aircrew a week, each of whom requires millions of dollars and many years to train, such rescues make military sense aside from the humanitarian imperative. The picture shows the Japanese Shin-Maywa US-2, an amphibious aircraft designed for maritime rescue missions.

Prioritize submarines and other undersea platforms.

In every iteration, the U.S. player moved submarines into the Taiwan Strait, where they could attack Chinese amphibious ships directly. Indeed, in the base case, one U.S. submarine squadron begins in the strait because that likely constitutes current deployment practice.

Inside the straits, U.S. submarines wreaked havoc on Chinese shipping. Based on the agent-based modeling found in RAND's U.S.-China Military Scorecard and historical evidence from World War II, each submarine would sink two large amphibious vessels (and an equal number of decoys and escorts) over the course of a 3.5-day turn. Every submarine squadron (four submarines) in the strait sank eight Chinese amphibious ships and eight escorts or decoys, but at a price of roughly 20 percent attrition per 3.5 days.³¹¹ U.S. submarines operated on a "conveyor belt," whereby they hunted, moved back to port (Guam, Yokosuka, or Wake Island), reloaded, then moved forward again and hunted. Doing this cycle as quickly as possible was important because the number of submarine squadrons was limited during the early phases of the conflict and their contribution was so significant. Submarines were also needed to screen against Chinese submarines exiting the first island chain.

U.S. submarines wreaked havoc on Chinese shipping.

Given the value of submarines, acquiring more is an obvious recommendation. Most analyses of future naval force structure agree that the United States should build more attack submarines than are currently programmed.³¹² However, it is unlikely that the United States could build more than the current rate of two a year during the 2020s and early 2030s when it is also building the Columbia-class SSBN. Indeed, even achieving two per year may be a stretch.³¹³ However, the U.S. Navy should commit to funding those two per year even if shipbuilding funds get tight. The Navy should also

311 Although that attrition increased as Chinese ships employed more ASW minefields over the course of the game.

312 Navy force structure goals for attack submarines across both the Trump and Biden administrations have been in the range of 66 to 78 even though the current level hovers around 54. Ronald O'Rourke, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, CRS Report No. RL32665 (Washington, DC: Congressional Research Service, October 2022), 8, <https://sgp.fas.org/crs/weapons/RL32665.pdf>.

313 The Navy has noted this production constraint in Office of the Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2023* (Washington, DC: Department of the Navy, April 2022), 4, <https://media.defense.gov/2022/Apr/20/2002980535/-1/-1/0/PB23%20SHIPBUILDING%20PLAN%2018%20APR%202022%20FINAL.PDF>. Similarly, the Congressional Budget Office stated in its analysis of the 2022 shipbuilding plan that while attack submarines are currently constructed at a rate of two per year, "the 2022 plan indicates that the Navy would like to increase the attack submarine force sooner than that rate would allow," "An Analysis of the Navy's Fiscal Year 2022 Shipbuilding Plan," Congressional Budget Office, September 16, 2021, <https://www.cbo.gov/publication/57472>.

consider keeping submarines in service longer, as it has proposed by extending the service life of some 688-class boats.³¹⁴

The Navy should also ensure that it has reloading facilities in Yokosuka, Guam, and Wake Island. Forcing submarines to go back to Pearl Harbor to reload wastes valuable hunting time. Because China will likely target fixed facilities, mobile reloading from civilian ports should be practiced. The Navy also needs to ensure that it has enough torpedoes. Although the game did not model this munition, there is reason for concern. The historical record is that many torpedoes will miss or malfunction, some will be lost when the submarine carrying them is sunk, and others will be destroyed when shore facilities are attacked.

Finally, investment in unmanned underwater vehicles (UUVs) should be prioritized. There is guaranteed to be some submarine attrition in a fight against China, particularly in the constrained waters of the Taiwan Strait. Each loss would be a painful blow. A Virginia-class submarine has a crew of 135 and costs roughly \$3 billion.³¹⁵ While UUVs are not as capable as attack submarines, they could be programmed to fulfill some relatively straightforward missions (e.g., minelaying).

Procure sufficient stockpiles of standoff anti-ship weapons.

Munitions usage was high. In the three to four weeks of conflict, U.S. forces usually expended about 5,000 long-range precision missiles, primarily JASSMs and LRASMs. The United States expended its global LRASM inventory within the first few days in all scenarios. JASSM inventories were large enough that they did not run low until the third or fourth week of the war.

In games where the JASSM-ER has maritime strike capabilities, the abundance of U.S. munitions made U.S. strategy an almost uncomplicated exercise. With each squadron of 12 bombers carrying around 200 stealthy, standoff ASCMs, the United States could rapidly cripple the Chinese fleet and leave the invasion force stranded. For this reason, many studies that look at this problem recommend expanding the arsenal of anti-ship weapons.³¹⁶ However, as discussed in the assumptions chapter, the JASSM-ER might not have this capability.

314 In 2021, the Navy assessed each one of its Los Angeles 688-class submarines to ascertain if its service life could be extended for an additional two or three years, which would result in a “20 percent improvement in force projections.” Justin Katz, “Navy assessing LA sub fleet for possible life extensions,” *Breaking Defense*, November 18, 2021, <https://breakingdefense.com/2021/11/navy-assessing-la-sub-fleet-for-possible-life-extensions/>.

315 This costs only increases with the SSN(X), which is projected to cost \$5.5 billion. Megan Eckstein, “CBO: Navy’s Next Nuclear Attack Submarine Could Cost \$5.5B a Hull,” *USNI News*, October 10, 2019, <https://news.usni.org/2019/10/10/cbo-navys-next-nuclear-attack-submarine-could-cost-5-5b-a-hull>.

316 To cite a few examples: Elbridge Colby, “America Must Prepare for War over Taiwan,” *Foreign Affairs*, August 10, 2022, <https://www.foreignaffairs.com/united-states/america-must-prepare-war-over-taiwan>, in which he criticizes the DOD for not buying enough key munitions and especially criticizes the Navy for its slow acquisition of long-range antiship missiles. Also see, Jeff Schogol, “The US Military Needs a Lot More Artillery Shells, Rockets, and Missiles for the next War,” *Task & Purpose*, September 5, 2022, <https://taskandpurpose.com/news/military-artillery-shells-rockets-missiles-war-russia-china/>; and Tom Shugart, “Trends, Timelines, and Uncertainty: An Assessment of the State of Cross-Strait Deterrence,” *Written Testimony before the U.S.-China Economic and Security Review Commission*, February 18, 2021, <https://www.cnas.org/publications/congressional-testimony/trends-timelines-and-uncertainty-an-assessment-of-the-state-of-cross-strait-deterrence>.

The United States expended its global LRASM inventory within the first few days in all scenarios.

JASSM-ERs were still somewhat useful in excursion scenarios where they could not strike ships at sea. In this case, JASSM-ERs could strike Chinese ports and airfields. However, these attacks against the homeland of a nuclear power raised questions about escalation. Attacks against ships at sea do not raise that concern to the same degree.

Furthermore, without a deep magazine of standoff anti-ship weapons, the Air Force had to use shorter-range JSMs and JSOWs to attack Chinese ships once the LRASMs were gone. The limited range of JSMs and JSOWs meant that aircraft had to get within range of Chinese SAMs and CAP for strikes, which resulted in higher attrition and aborted missions. With a deeper magazine of LRASMs instead of JASSM-ERs, this problem would not have arisen.

Missile inventories reflect service priorities. The Air Force prefers to strike land targets as part of an air superiority campaign, while naval targets have lower priority. Thus, in 2026, the available Air Force inventory of JASSM (all variants) will number about 6,500, while its LRASM inventory will be only about 100.³¹⁷ Although the Navy has more LRASMs, it does not have the ability to launch them en masse in the way that only Air Force bombers can.

The Air Force needs to embrace and implement the anti-ship mission. The need to attack Chinese amphibious forces makes this mission critical. Maritime strike has a long history with the Air Force, dating from its earliest days, with the sinking of the Ostfriesland in 1921 and the interception of the Rex in 1938.³¹⁸ General George C. Kenney's World War II operations in the Southwest Pacific also constitute a pertinent precedent, as his 5th Air Force supported ground and naval operations.³¹⁹

317 Navy LRASM inventory will be about 350. LRASM inventory includes both Navy and Air Force projected for 2026, allowing for the long production lead time and congressional additions. Data from Department of the Navy, *Department of Defense Fiscal Year (FY) 2023 Budget Estimates, Weapons Procurement Justification Book, Weapons Procurement, Navy* (Washington, DC: Department of Defense, April 2022), 1-227-1-236, https://www.secnav.navy.mil/fmc/fmb/Documents/23pres/WPN_Book.pdf. Navy inventory of its JASSM version (AGM-158C) in 2026 will be only 31.

318 The Air Force, under the flamboyant Billy Mitchell, sank the captured German battleship Ostfriesland, demonstrating the ability of aircraft to sink warships. In a 1938 exercise, Air Force long-range aircraft located the high-speed passenger liner Rex, 630 nautical miles from New York City, demonstrating the ability of aircraft to intercept ships far at sea. For additional details, see John T. Correll, "Rendezvous with the Rex," *Air and Space Forces Magazine*, Air and Space Force Association, December 1, 2008, <https://www.airandspaceforces.com/article/1208rex/> Air Force Magazine; John T. Correll, "Billy Mitchell and the Battleships," *Air and Space Forces Magazine*, Air and Space Forces Association, July 21, 2021, <https://www.airandspaceforces.com/article/billy-mitchell-ostfriesland/>.

319 For further reading on the history and significance of the maritime strike mission, see David Deptula, "Bombers for Maritime Strike: An Asymmetric Counter to China's Navy," Mitchell Institute Policy Papers (Arlington, VA: Mitchell Institute, February 2019), https://mitchellaerospacepower.org/wp-content/uploads/2021/02/a2dd91_546d5ed9b4424fd780887be1146f9ac2.pdf. For further reading on the Southwest Pacific air campaign, see: George C Kenney, *General Kenney Reports; A Personal History of the Pacific War* (New York: Duell, Sloan and Pearce, 1949).

One way to implement such an effort would be to shift JASSM production to the LRASM. The missiles are built on the same production line and are 70 percent common. The LRASM can strike the greatest threat, the Chinese amphibious fleet, with less risk of escalation. Yet the JASSM inventory is far larger than that of LRASMs, and production plans in FY 2023 continue that imbalance, consisting of 581 JASSMs and 88 LRASMs. This is backward.³²⁰

Powered naval mines are another option that might be highly effective. Mines have the advantage of obviating the requirement for precise targeting of the Chinese fleet; once the Chinese select an invasion beach, any mine dropped there will eventually hit a ship. While current extended-range mines require aircraft to get within 40 km of the target, a powered version of these mines could reach farther and reduce attrition.³²¹

Accelerating CLEAVER, a program to put palletized missiles into the cargo bay of a C-17 or C-130 cargo aircraft, would expand the number of launch platforms. This may sound unnecessary, as the United States has bombers that are specifically designed to deliver such payloads. However, there are not enough bombers to sustain attrition and launch all the strikes that are needed. Being able to include some of the 225 C-17s in these long-range strikes would add flexibility to mission planning and hedge against unexpectedly high losses to the bomber force.³²²

Finally, the project tracked a few key munitions and assumed that the United States had sufficient stockpiles of the rest. This may not be true. The DOD should review the inventories of all relevant munitions.

Continue development and fielding of hypersonic weapons but recognize that they are a niche capability.

Hypersonic weapons, defined as missiles able to travel more than five times the speed of sound, have received considerable attention in recent years. Their high speed makes defense difficult and allows them to strike fleeting targets. The base case includes Chinese DF-17s with hypersonic maneuverable re-entry vehicles.³²³ It is logical for China to pursue hypersonic technologies to defeat the well-developed U.S. missile defense system.

By 2026, the United States will have few equivalent hypersonic systems. The game included 50 U.S. hypersonic weapons (the Air-Launched Rapid Response Weapon, or ARRW), although this was speculative. In 2022, no U.S. hypersonic weapons are yet programs of record although several systems

320 The procurement in the FY 2023 budget proposal, Office of the Under Secretary of Defense (Comptroller)/Chief Financial Officer, *FY 2023 Program Acquisition Cost by Weapon System* (Washington, DC: Department of Defense, April 2022), 5–11, https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2023/FY2023_Weapons.pdf.

321 Tyler Rogoway, “B-52 Tested 2,000lb Quickstrike-ER Winged Standoff Naval Mines During Valiant Shield,” *The Drive*, September 20, 2018, <https://www.thedrive.com/the-war-zone/23705/b-52-tested-2000lb-quickstrike-er-winged-standoff-naval-mines-during-valiant-shield>.

322 Theresa Hitchens, “Air Force Weaponizing Cargo Planes For All-Domain Ops: ‘Bomb Bay In A Box,’” *Breaking Defense*, May 27, 2020, <https://breakingdefense.sites.breakingmedia.com/2020/05/air-force-weaponizing-cargo-planes-for-all-domain-ops-bomb-bay-in-a-box/>.

323 It is likely that other Chinese TBMs have MaRVs that maneuver at more than five times the speed of sound, making them also “hypersonic.”

are emerging from development. Most U.S. hypersonic programs would likely be in testing or initial fielding in 2026 and thus not available in large numbers.³²⁴

Hypersonic weapons would be useful for attacking highly defended and deep targets such as China's over-the-horizon-backscatter radars or satellite uplink stations. Modeling indicated that Chinese defenses could typically shoot down about 25 percent of U.S. land-attack cruise missiles targeting the mainland. This blunted the effect of U.S. attacks. Hypersonic weapons would not suffer this attrition.

However, hypersonic weapons are expensive and no substitute for large numbers of long-range cruise missiles. Picking off a few high-value targets does not solve the central problem of countering a massed invasion. That requires sinking enough amphibious ships such that Chinese forces cannot sustain a lodgment on Taiwan. The strategist Hal Brands made this point in an assessment of contemporary arms races, "The United States doesn't need to emulate every Chinese breakthrough in hypersonic weapons. These weapons can't provide, at a reasonable cost, the volume of fire power Washington would need in the Western Pacific."³²⁵

Prioritize sustainment of the bomber fleet over fighters.

Both bombers and fighter/attack aircraft played important roles. However, the range and high ordnance throughput of bombers presented the Chinese with a particularly daunting challenge. The range of bombers meant that they could be based beyond the range of Chinese ballistic missiles, while their ordnance throughput meant that they could rapidly attrite Chinese forces. When paired with standoff munitions, even unstealthy "bomb trucks" are extremely useful against targets at the edge of the Chinese air defense zone.

The range and high ordnance throughput of bombers presented the Chinese with a particularly daunting challenge. The range of bombers meant that they could be based beyond the range of Chinese ballistic missiles, while their ordnance throughput meant that they could rapidly attrite Chinese forces.

This combination of platforms with long-range precision munitions is viable because this air campaign focuses on a few hundred aiming points comprising ships, air bases, and ports and airfields. It is not a

324 For a general description of U.S. hypersonic weapons programs, see Kelly Saylor, *Hypersonic Weapons: Background and Issues for Congress*, CRS Report No. R45811 (Washington, DC: Congressional Research Service, October 2022), <https://sgp.fas.org/crs/weapons/R45811.pdf>. In the game, ARRW is a placeholder for whatever hypersonic weapons the United States fields by 2026.

325 Hal Brands, "The Art of the Arms Race," *Foreign Policy*, Summer 2022, 39–43, <https://foreignpolicy.com/2022/07/01/arms-control-race-cold-war-geopolitical-rivalry/>

strategic bombing campaign involving tens of thousands of aim points on the Chinese mainland and designed to paralyze the economy, military command structure, and political operations. Long-range precision missiles are too expensive to be procured in the numbers necessary to prosecute such a campaign, as the Russians are finding out in Ukraine. Further, as noted earlier, such a campaign raises questions about escalation.³²⁶

The value of bombers leads to several recommendations for Air Force acquisitions.

1. **Stop retiring bombers.** The Air Force has been retiring legacy bombers in expectation of fielding the B-21 and as part of its “divest to invest” strategy.³²⁷ This creates a gap in capability because the B-21s will not be available in large numbers until the 2030s. If the United States believes there is a significant chance of conflict with China in the 2020s, then the size of the bomber force should be maintained. Thus, the Air Force might retain its B-1 and B-52 fleets even as the B-21 enters the inventory.³²⁸
2. **Re-engine the B-52 fleet.** The program, called the Commercial Engine Replacement Program, is already in Air Force plans. The Air Force will need as many bombers as it can get even when the B-21 has been fielded.
3. **Ensure that all bombers can carry the full range of munitions.** For example, the LRASM is currently certified only for the B-1 bomber and the F/A-18E/F.³²⁹ Given the LRASM’s centrality in destroying Chinese surface forces, it needs to be employable from all aircraft for maximum flexibility.
4. **Consider the implications for aircraft type and mix if most are lost on the ground.** Fifth-generation aircraft were just as vulnerable on the ground as 4.5-generation aircraft.
5. **Think ahead to the next stage of bomber vulnerability.** China likely also appreciates the significance of the threat that the U.S. bomber force poses. China might develop longer-range SAMs or deploy long-range air-to-air missiles on fighters that would fly deep into the Philippine Sea. The United States must develop countermeasures in the same way it thinks about disrupting the anti-ship-missile kill chains.
6. **Harden bomber bases in Australia, Hawaii, and Alaska.** In this game (set in 2026), China had few options for striking these critical bases. Chinese submarines might theoretically operate that

326 One analysis cites the need to hit 100,000 aiming points and therefore recommends a variety of munitions, many of which require aircraft to penetrate deep into adversary airspace. See Mark A. Gunzinger, *Affordable Mass: The Need for a Cost-Effective PGM Mix for Great Power Conflict* (Arlington, VA: Mitchell Institute for Aerospace Studies, November 2021), https://mitchellaerospacepower.org/wp-content/uploads/2021/11/Affordable_Mass_Policy_Paper_31-FINAL.pdf.

327 John Tirpak, “Air Force May Divest 1,468 Aircraft over Five Years,” *Air & Space Forces Magazine*, April 7, 2022, <https://www.airandspaceforces.com/air-force-may-divest-1468-aircraft-over-five-years/>.

328 A recent MITRE study made a similar recommendation, that no bombers be retired until at least 50 B-21s have entered the inventory. “MITRE U.S. Air Force Aircraft Inventory Study,” MITRE Corporation, n.d., <https://aerospace.csis.org/wp-content/uploads/2019/09/MITRE-AF-Summary.pdf>.

329 Office of the Under Secretary of Defense (Comptroller)/Chief Financial Officer, *Program Acquisition Costs by Weapons System* (Washington, DC: Department of Defense, April 2022), 5–11, https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2023/FY2023_Weapons.pdf.

far from port but were generally fully engaged in the Western Pacific. However, future Chinese missiles might have the range to destroy aircraft based there. The DOD should examine the defenses of Alaska and Hawaii since they will increasingly be within the scope of Chinese strikes.

Procure more, cheaper fighters.

With so many aircraft lost early in the conflict, the Air Force risks running out of aircraft and becoming irrelevant to the conflict unless it has a large enough force to sustain the losses. Therefore, the Air Force should be cautious about taking its “divest to invest” strategy too far.³³⁰

Numbers matter. Throughout the campaign, even fourth-generation fighter/attack aircraft had value. For many missions (such as launching standoff weapons), the stealth of fifth-generation aircraft is not needed. This was particularly true later in the conflict when Chinese air defenses weakened. At the same time, losing all fifth-generation aircraft early was a problem. After the long-range LRASMs were gone, fifth-generation aircraft were particularly valuable because they could press in to deliver shorter-range JSMs or JSOWs. There is therefore a strong argument for keeping a balanced mix throughout by withholding fifth-generation aircraft until the Chinese missile inventory is depleted.

Ninety percent of aircraft losses occurred on the ground.

The vulnerability of aircraft on the ground raises questions about U.S. plans to procure relatively small numbers of extremely capable but expensive aircraft. If most are lost on the ground before they can bring their advanced capabilities to bear, then cheaper airframes might be worthwhile. Plans to procure the Next Generation Air Dominance fighter, with a cost per airframe of “‘multiple’ hundreds of millions” of dollars, do not make sense if 90 percent of U.S. and Japanese aircraft losses occurred on the ground.³³¹

330 For a discussion of how the “divest to invest” strategy reduces Air Force structure, see Mark Cancian, “Force Structure in the New National Defense Strategy: More Capable but Smaller and Less Global,” CSIS, *Commentary*, October 31, 2022, <https://www.csis.org/analysis/force-structure-national-defense-strategy-highly-capable-smaller-and-less-global>. For a discussion of the Air Force’s general problem with maintaining inventories and increasing aircraft age, see Mark Cancian, *U.S. Military Forces in FY 2022: Air Force* (Washington, DC: CSIS, November 2021), <https://www.csis.org/analysis/us-military-forces-fy-2022-air-force>.

331 Stephen Losey, “Future NGAD fighter jets could cost ‘hundreds of millions’ apiece,” *Defense News*, April 28, 2022, <https://www.defensenews.com/air/2022/04/28/future-ngad-fighter-jets-could-cost-hundreds-of-millions-apiece/>.

Conclusion—Victory Is Not Everything

The game results showed that the United States and Taiwan could successfully defend the island even under relatively pessimistic assumptions. This is different from many observers' impressions and constitutes an important insight. The analysis also indicates that there is no need for the United States to consider highly risky strategies such as preemptive attacks on Chinese amphibious shipping or the early use of nuclear weapons.

China would take enormous risks in launching such an operation. Chapter 5 describes the heavy losses to Chinese air and naval forces that even a successful invasion would entail. These losses would take many years to replace. Invasion forces on Taiwan would risk destruction if, as happened in many iterations, the Chinese were unable to sustain these forces in the face of heavy maritime losses. This failure would produce tens of thousands of prisoners of war, a highly visible and emotional symbol of defeat. Although the project did not explore what effects these losses might have on the Chinese political system, the CCP would be risking its hold on power.³³²

However, there is no cause for complacency by the United States or Taiwan. First, China could choose other coercive paths, whether it be the seizure of offshore Taiwanese islands, a bombardment without ensuing invasion, or a blockade. These contingencies also warrant consideration. Second, the morale of Taiwan's military and leadership must be strong enough to resist a Chinese attack in the face of high losses. Without the will to resist, the rest is irrelevant.

332 Richard Haass and David Sacks, "American Support for Taiwan Must Be Unambiguous," *Foreign Affairs*, October 30, 2022, <https://www.foreignaffairs.com/articles/united-states/american-support-taiwan-must-be-unambiguous>.

Finally, the human, economic, military, and political costs loom over even a successful defense. These would be enormous. The discussion below lays out a few of these.

- **Taiwan's Economy Debilitated:** Chinese forces, even if defeated, would inflict massive damage on Taiwanese infrastructure and cripple its economy for many years.
- **Cyber Damage:** Although the game included cyber affects at the operational level, it did not examine economic and social impacts. Both Taiwan and the United States might suffer damage to civilian and economic infrastructure.
- **Lost Military Capabilities:** The United States would suffer tremendous damage to its military forces. Rebuilding these capabilities would take many years and would occur at a slower rate than China's rebuild, given the rapid pace of Chinese military modernization.³³³ With only two U.S. shipyards currently building large surface combatants, it would take decades to replace the dozen or more such ships lost while continuing the Navy's build program. Lost carriers could not be replaced because the current shipyard capacity is sufficient only to maintain the current carrier force. Aircraft would be a bit easier to replace. For example, the United States lost an average of 200 to 500 aircraft across the scenarios. At current procurement rates of about 120 such aircraft per year, it would take two to four years to replace those aircraft, assuming no further attrition and no retirement of aging aircraft in the force.³³⁴ Ships and aircraft would take longer to replace if the war went beyond the three or four weeks of game play or if losses from engagements in the South China Sea were calculated and included.
- **Loss of Global Position:** The world would not be standing still during and after a U.S.-China conflict. Other countries—for example, Russia, North Korea, or Iran—might take advantage of U.S. distraction to pursue their agendas. After the war, a weakened U.S. military might not be able to sustain the balance of power in Europe or the Middle East.
- **Risk of Escalation:** Although this project focused on conventional conflict, many analyses of an invasion have nuclear play. The recent novel 2034 concludes with nuclear strikes.³³⁵ The CNAS wargame, *Dangerous Straits*, similarly ends with the use of nuclear weapons. No one knows what those escalation dynamics would be. They depend on an unprecedented event, conventional war between nuclear powers, as well as the opaque decisionmaking process of the CCP. The

333 For example, the Chinese are building enough ships that they are expected to expand their fleet from the current 340 ships to 440 ships by 2030. In contrast, the U.S. Navy builds only enough ships to maintain its current size of 290 ships. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2022* (Washington, DC: Department of Defense, 2022), 50–52, <https://media.defense.gov/2022/Nov/29/2003122279/-1/-1/1/2022-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF>.

334 For discussion of past industrial mobilization and current capabilities, see Mark Cancian and Adam Saxton, *Industrial Mobilization: Assessing Surge Capabilities, System Brittleness, and Wartime Risk* (Washington, DC: CSIS, January 2021), <https://www.csis.org/analysis/industrial-mobilization-assessing-surge-capabilities-wartime-risk-and-system-brittleness>. The analysis shows that for most categories of weapons, replacement of current inventories would take many years. Ships take an especially long time to replace. Conversion of civilian industry to wartime use, though possible, is a long process. In World War II, the industrial mobilization process took about six years, from 1938 to 1944. In World War I, the war ended before U.S. industry fully mobilized, so U.S. forces fought the war with large amounts of French and British equipment.

335 Ackerman and Stavridis, 2034.

recommendations above to focus on anti-ship attacks instead of mainland strikes could reduce the risk of escalation, but that risk will never go away.

- **Protracted or Episodic Conflict:** Finally, the war might not end after this initial phase but drag on for months or even years. Conflict might be episodic, with periodic ceasefires. This project is called *The First Battle of the Next War* for a reason. Opening battles, even if seemingly decisive, generally do not end a conflict. Cathal Nolan makes this argument in his monumental study, *The Allure of Battle*. After looking at the long history of wars, he concludes, “How to win decisively in war is the aspiration of all professional military, and a main subject of concern to those who study war. Yet it is the single hardest thing to do, to translate combat into achievement of an important strategic and political goal that the other side is forced to recognize and accept when the war is over.”³³⁶

These losses might cause strategic disillusionment. The United States would sustain as many personnel casualties in a month of such conflict as in 20 years of wars in Iraq and Afghanistan. The scale and suddenness of such losses would shock a U.S. population unaccustomed to significant military losses.

The effect might be like the attack on Pearl Harbor in 1941, where the combination of surprise, betrayal, and loss solidified public opinion and created a determination to press the conflict to its conclusion. On the other hand, the effect might be like the 1983 bombing of the U.S. barracks in Beirut, where the U.S. population and political establishment decided that the cost was not worth the foreign policy benefit. The result was withdrawal.

Even if the United States prosecuted the war to a successful conclusion, a narrative of disillusionment might emerge. U.S. policymakers and Americans might question whether the sacrifice had been worth preserving Taiwanese independence and democracy. That kind of disillusionment occurred after World War I. Even though the United States was successful, with relatively low casualties (at least compared to the other combatants), there was profound disillusionment after the war. Many argued that “merchants of death” had manipulated the United States into the war.³³⁷ This produced a turn toward isolationism.³³⁸

Even if the United States prosecuted the war to a successful conclusion, a narrative of disillusionment might emerge.

336 Cathal J. Nolan, *The Allure of Battle: A History of How Wars Have Been Won and Lost* (New York: Oxford University Press, 2019), 572.

337 The term “merchants of death” was first used in an article about Greek arms dealer Basil Zaharoff in 1932. See Xavier De Hauteclocque, “Zaharoff Merchant of Death: Translated from *Le Crapouillot* Paris Topical Monthly,” *The Living Age (1897-1941)* 342, no. 4388 (1932): 204. The term was later picked up as a title for a book on the arms industry: Helmuth Carol Engelbrecht and Frank Cleary Hanighen, *Merchants of Death* (Garden City, NY: 1937). It was also a popular term in discussions about the arms industry after World War I. See, for example, “U.S. Senate: ‘Merchants of Death,’” U.S. Senate, n.d., <https://www.senate.gov/about/powers-procedures/investigations/merchants-of-death.htm>.

338 For a description of this shift, see “American Isolationism in the 1930s,” Office of the Historian, n.d., <https://history.state.gov/milestones/1937-1945/american-isolationism>.

The project does not take a position on whether the United States should defend Taiwan. That requires a political and foreign policy assessment of benefits, costs, and values that goes beyond the scope of the current effort. The project does rigorously document the likely outcomes of defending Taiwan in a variety of scenarios and how different assumptions about conditions and capabilities affect those outcomes. The intention is that this analysis will help the public and policy discussion about how the United States should move forward.

Nevertheless, the project recognizes that a succession of Democratic and Republican administrations, a bipartisan consensus in Congress, and a near uniformity of views among strategists identify China as the “pacing” U.S. competitor. U.S. policy needs to be broadly aimed at succeeding in this competition.³³⁹ In the military sphere, it is imperative to deter China from starting any conflict. To be deterred, China must doubt their ability to prevail through force of arms. This requires U.S. military capability to be manifestly sufficient for the task.

Developing that capability will have additional costs but does not require across-the-board increases in U.S. defense spending. The recommendations in the previous chapter target specific capabilities that would be most useful for conflict in the Western Pacific.³⁴⁰ To offset these investments, less effective capabilities might be cut.

To be deterred, China must doubt their ability to prevail through force of arms. This requires U.S. military capability to be manifestly sufficient for the task.

The bottom line from the analysis is that a successful defense is possible, and deterrence is achievable, but it will require planning, some resources, and political will.

339 CSIS outlined such a policy for successful competition in a 2016 study, Michael Green et al., *Asia-Pacific Rebalance 2025* (Washington, DC: CSIS, January 2016), <https://www.csis.org/analysis/asia-pacific-rebalance-2025>.

340 Such a focus does not make a judgment about whether U.S. defense policy should downplay other requirements and regions in favor of a Pacific strategy. Strategists argue both ways, and such a discussion is beyond the scope of this project. One of the authors (Mark Cancian) has argued strongly for a global strategy that builds enough forces to meet global commitments even while still countering China as the pacing threat. Cancian, *U.S. Military Forces in FY 2022*, vi; also, Cancian, “Building Military Forces for the 2020s: Implementing Strategy and Exercising Global Leadership in an Era of Reduced Resources,” CSIS, Transition 46 Series, February 10, 2021, <https://www.csis.org/analysis/building-military-forces-2020s-implementing-strategy-and-exercising-global-leadership-era>.

Appendix A

Scenarios

This appendix gives an overview of the 24 game iterations.

Iteration #	Scenario Description	Characterization
1	Base case	Base
2	Base case	Base
3	Base case	Base
4	No maritime strike JASSM	Pessimistic
5	No maritime strike JASSM	Pessimistic
6	No maritime strike JASSM	Pessimistic
7	No maritime strike JASSM	Pessimistic
8	<ul style="list-style-type: none">▪ No maritime strike JASSM▪ Delayed U.S. entry into conflict because of extended decisionmaking process<ul style="list-style-type: none">◦ U.S. active duty forces delayed two turns◦ U.S. reserve forces delayed four turns▪ No mainland strike because of escalation concerns	Pessimistic

9	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ Delayed U.S. entry into conflict because of extended decisionmaking process <ul style="list-style-type: none"> ○ U.S. active-duty forces delayed two turns ○ U.S. reserve forces delayed four turns ▪ SSN withhold for SSBN trailing and Russia hedge ▪ Taiwan response slowed by sabotage or Chinese information operations; no troop movement outside invaded zone 	Pessimistic
10	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ SSN withhold for SSBN trailing and Russia hedge ▪ Taiwanese ground forces operate at reduced capability because of low prewar readiness ▪ Taiwan response slowed by sabotage or Chinese information operations; no troop movement outside invaded zone in first turn ▪ Taiwan tries to defend its air space day one, is annihilated ▪ No U.S. bomber attacks on Turn 1 as a result of a short delay in U.S. decisionmaking. 	Pessimistic
11	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ SSN withhold for SSBN trailing and Russia hedge ▪ Taiwan response slowed by sabotage or Chinese information operations; no troop movement outside invaded zone in first turn ▪ Taiwanese SAMs try to defend its air space day one, are annihilated ▪ No U.S. bomber attacks on Turn 1 as a result of a short delay in U.S. decisionmaking. ▪ Taiwanese ground forces operate at reduced capability because of low prewar readiness ▪ Long run: <ul style="list-style-type: none"> ○ Taiwan starts with 12 turns of supplies <ul style="list-style-type: none"> ▪ They have 30 days total at high-intensity operations, one-third of units are not engaged (guarding alternate beaches); and their supplies can be moved away ○ Each SAG arriving at Taiwan brings a load equivalent to Chinese amphibious flotilla (10 points) ○ Non-leg infantry out of supply fight at one-half strength ○ China has 82 Houbei missile boats ○ U.S. forces to Singapore go around South China Sea, arrive on map two turns later 	Pessimistic

12	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ United States distracted by another global crisis, for example, in Europe; no prewar deployment; slower U.S. response; greater withhold of U.S. forces ▪ Taiwan response slowed by sabotage or Chinese information operations, no troop movement outside invaded zone in first turn ▪ Taiwanese ground forces operate at reduced capability because of low prewar readiness 	Pessimistic
13	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ United States distracted by another global crisis, for example, in Europe; no prewar deployment; slower U.S. response; greater withhold of U.S. forces ▪ Taiwan response slowed by sabotage or Chinese information operations; no troop movement outside invaded zone in first turn ▪ Taiwanese ground forces operate with reduced capability because of low prewar readiness 	Pessimistic
14	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ The Philippines allows U.S. access but its forces do not participate; MLR to northern Luzon islands 	Pessimistic
15	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ United States distracted by another global crisis, for example, in Europe; no prewar deployment; slower U.S. response; Greater withhold of U.S. forces ▪ Taiwan response slowed by sabotage or Chinese information operations; no troop movement outside invaded zone in first turn ▪ Taiwanese ground forces operate at reduced capability because of low prewar readiness 	Pessimistic
16	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ United States distracted by another global crisis, for example, in Europe; no prewar deployment; slower U.S. response; greater withhold of U.S. forces ▪ Taiwan response slowed by Chinese information operations and sabotage; no troop movement outside invaded zone in first turn ▪ Taiwanese ground forces operate at reduced capability because of low prewar readiness ▪ Prewar deployment of one MLR to Taiwan; desire to enhance deterrence and defense overcome concerns about escalation 	Pessimistic

17	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ United States distracted by another global crisis, for example, in Europe; no prewar deployment; slower U.S. response; greater withhold of U.S. forces ▪ Taiwan response slowed by sabotage or Chinese information operations; no troop movement outside invaded zone in first turn ▪ Taiwanese ground forces operate at reduced capability because of low prewar readiness ▪ Prewar deployment of one MLR to Taiwan; desire to enhance deterrence and defense overcome concerns about escalation 	Pessimistic
18	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ United States distracted by another global crisis, for example, in Europe; no prewar deployment; slower U.S. response; greater withhold of U.S. forces ▪ Taiwan reaction slowed by sabotage or Chinese information operations; no troop movement outside invaded zone in first turn ▪ Additional HASs in Japan and Guam 	Pessimistic
19	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ United States distracted by another global crisis, for example, in Europe; no prewar deployment; slower U.S. response; greater withhold of U.S. forces ▪ Taiwan response slowed by sabotage or Chinese information operations; no troop movement outside invaded zone in first turn ▪ Philippines allows basing but Philippine forces do not participate ▪ MLR deploys prewar to end of the Ryukyus island chain 	Pessimistic
20	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ Taiwan response slowed by Chinese information operations and sabotage; no troop movement outside invaded zone in first turn ▪ Taiwanese ground forces operate at reduced capability because of low prewar readiness ▪ SSN withhold for SSBN trailing and Russia hedge 	Pessimistic
21	<p>Taiwan stands alone</p> <ul style="list-style-type: none"> ▪ No delayed Taiwan response ▪ Taiwan combat power on par—all same as in the base case except no United States. Average losses for amphibious ships from Taiwanese ASCMs used ▪ China has 14 ground support air points; other aircraft are held back to deter United States and Japan 	Taiwan Alone

22	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ 50 percent increase in Chinese DF-17 and DF-26 inventory because of uncertainty about production rates ▪ Taiwan response slowed by Chinese information operations and sabotage; no troop movement outside invaded zone in first turn ▪ No U.S. strikes on Chinese mainland because of escalation concerns ▪ If the Chinese strike U.S. territory, including Guam, the United States can strike Chinese homeland 	Pessimistic
23	<ul style="list-style-type: none"> ▪ Chinese suboptimum TBM warhead types ▪ JSDF fully committed from start ▪ Shipborne missile defense less effective: 0.25 total Pk per ASM ▪ PLA lower amphibious competence: minus 30 percent amphibious lift ▪ Poor PLA pilot training: United States inflicts 50 percent more attrition on similarly capable Chinese airframes ▪ United States able to use large civilian airfields in Japan ▪ Extra HASs in Japan 	Optimistic
24	<ul style="list-style-type: none"> ▪ No maritime strike JASSM ▪ Japan neutral, United States cannot use bases in Japan 	Ragnarök

Appendix B

Wargaming Lexicon

This appendix lays out the specific lexicon used in the project.

Base case: The most likely assumption about each individual variable.

Base scenario: The scenario in which all assumptions are set to the base case.

Campaign analysis: A method involving the use of a model and techniques for managing uncertainty to answer questions about military operations.

Descriptive data: Data on the occurrences of a given iteration, for example, who won and how many missiles were fired.

Excursion case: Any alternate assumption wherein one or more of the variables is set to be different than the base case.

Excursion scenario: Any scenario wherein one or more variables are set to an excursion case

Iteration: One specific play through of the game under any scenario.

Game: The overall project rather than a particular iteration or playthrough.

Model: A mathematical or otherwise logically rigorous representation of a system or a system's behavior.

Net assessment: The comparative analysis of military, technological, political, economic, and other factors governing the relative military capability of nations.

Operations research: The analytical study of military problems undertaken to provide a scientific basis for decision on action to improve military operations.

Simulation: A method for implementing a model over time.

Structured judgment: Any analysis that lays out assumptions in a logical, evidence-based argument that leads to a clear conclusion.

Scenario: A set of assumptions about each variable that provides the basis for playing one iteration of the game.

Systems analysis: The process of studying a procedure or business to identify its goal and purposes and create systems and procedures that will efficiently achieve them.

Unstructured judgment: Any analysis that lacks evidence, logical structure, or transparency.

Variable: A condition likely to have an impact on the analysis about which the project team must make an informed assumption.

Wargame: A simulation, by whatever means, of military operations involving two or more opposing forces, using rules, data, and procedures designed to depict an actual or assumed real life situation.

Appendix C

Abbreviations and Acronyms

A2/AD - Anti-access/area denial

ACE - Agile Combat Employment

AESA - Active Electronically Scanned Array radar

AEW - Airborne early warning

AKA - Amphibious cargo ship

ALCM - Air-launched cruise missile

AMRAAM - Advanced Medium-Range Air-to-Air Missile

APA - Amphibious attack transport

ARG - Amphibious ready group

ARRW - Air-Launched Rapid Response Weapon

ASAT - Anti-satellite

ASCM - Anti-ship cruise missile

ASBM - Anti-ship ballistic missile

ASW- Anti-submarine warfare

ATACMS – Army Tactical Missile System

ATF – Amphibious task force

ATS – Auxiliary towing and salvage ship

CAP – Combat air patrol

CCD – Camouflage, concealment, and deception

CCP – Chinese Communist Party

CNAS – Center for a New American Security

CSG – Carrier strike group

CSIS – Center for Strategic and International Studies

DOD – U.S. Department of Defense

GLCM – Ground-launched cruise missile

HAS – Hardened aircraft shelter

IADS – Integrated air defense system

IISS – International Institute for Strategic Studies

INDOPACOM – U.S. Indo-Pacific Command

IRBM – Intermediate-range ballistic missile

ISR – Intelligence, surveillance, and reconnaissance

JASSM – Joint Air-to-Surface Standoff Missile

JASSM-ER – Joint Air-to-Surface Standoff Missile-Extended Range

JDAM – Joint Direct Attack Munition

JASDF – Japan Air Self-Defense Force

JDAM – Joint Direct Attack Munition

JMSDF – Japan Maritime Self-Defense Forces

JSDF – Japan Self-Defense Forces

JSM – Joint Strike Missile

JSOW – Joint Standoff Weapon

KMT – Kuomintang Party

LCG – Lightning carrier group

LCI – Landing Craft, Infantry
LCM – Landing Craft, Mechanized
LCT – Landing Craft, Tank
LCV – Landing Craft, Vehicle
LHD – Landing Helicopter Dock
LSM – Landing Ship, Medium
LST – Landing Ship, Tank
LRASM – Long-Range Anti-Ship Missile
MDTF – Multi-Domain Task Force
MLR – Marine Littoral Regiments
MPA – Maritime patrol aircraft
MPS – Maritimes Prepositioning Ships
MRBM – Medium-range ballistic missile
MST – Maritime Strike Tomahawk
MDTF – Multi-domain task force
NSM – Naval Strike Missile
OASuW – Offensive Anti-Surface Warfare
OOB – Order(s) of battle
 P_k – Probability of kill
PLA – People’s Liberation Army
PLAAF – People’s Liberation Army Air Force
PLAN – People’s Liberation Army Navy
PLANAF – People’s Liberation Army Naval Air Force
PLARF – People’s Liberation Army Rocket Force
PME – Professional military education
PRC – People’s Republic of China
PrSM – Precision Strike Missile
ROE – Rules of engagement

SAG – Surface action group
SAM – Surface-to-air missile
SDB – Small Diameter Bomb
SSBN – Ballistic missile submarine
SSN – Nuclear-powered submarine
SUBRON – Submarine squadron
STUFT – Ships taken up from trade
TBM – Tactical ballistic missile
TC – Theater Command
TOW – Taiwan Operational Wargame
USAF – U.S. Air Force
UUUV – Unmanned underwater vehicle
VFA – Visiting Forces Agreement

About the Authors

Mark Cancian (Colonel, USMCR, ret.) is a senior adviser with the International Security Program at the Center for Strategic and International Studies (CSIS) in Washington, D.C. He joined CSIS in April 2015 from the Office of Management and Budget, where he spent more than seven years as chief of the Force Structure and Investment Division, working on issues such as Department of Defense budget strategy, war funding, and procurement programs, as well as nuclear weapons development and nonproliferation activities in the Department of Energy. Previously, he worked on force structure and acquisition issues in the Office of the Secretary of Defense and ran research and executive programs at Harvard University's Kennedy School of Government. In the military, Colonel Cancian spent over three decades in the U.S. Marine Corps, active and reserve, serving as an infantry, artillery, and civil affairs officer and on overseas tours in Vietnam, Desert Storm, and Iraq (twice). Since 2000, he has been an adjunct faculty member at the Johns Hopkins School of Advanced International Studies, where he teaches a course on the connection between policy and analysis. A prolific author, he has published over 40 articles on military operations, acquisition, budgets, and strategy and received numerous writing awards. He graduated with high honors (*magna cum laude*) from Harvard College and with highest honors (Baker scholar) from Harvard Business School.

Matthew Cancian currently conducts classified wargaming at the U.S. Naval War College as a senior researcher for Saalex Solutions. He holds a PhD in political science from MIT, where he concentrated in security studies and comparative politics. His thesis was about the motivations of combatants and the effects of training, based on a survey of 2,301 Kurdish fighters (Peshmerga) during their war against the Islamic State. Before attending MIT, he earned an MA in law and diplomacy from the Fletcher School and a BA in history from the University of Virginia. Between those educational experiences, he served as a captain in the U.S. Marine Corps, deploying to Sangin, Afghanistan, as a forward observer in 2011 in

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Eric Heginbotham is a principal research scientist at the Massachusetts Institute of Technology's Center for International Studies and a specialist in Asian security issues. Before joining MIT, he was a senior political scientist at the RAND Corporation, where he was the lead author of the *RAND US-China Military Scorecard* and a RAND study on *China's Evolving Nuclear Deterrent*. He is the co-author (with George Gilboy) of *Chinese and Indian Strategic Behavior: Growing Power and Alarm*, published by Cambridge University Press in 2012, and is an editor of *China Steps Out: Beijing's Major Power Engagement with the Developing World* (Routledge, 2018). Prior to that, he was a senior fellow of Asian studies at the Council on Foreign Relations. After graduating from Swarthmore College, Heginbotham earned his PhD in political science from MIT. He is fluent in Chinese and Japanese and was a captain in the U.S. Army Reserve.

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