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Closing the Deterrence Gap in the Taiwan Strait

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Edited by Jared M. McKinney and Robert S. Hinck

Air University Press
Maxwell Air Force Base, Alabama

Published by Air University Press in August 2025
600 Chennault Circle, Building 1405
Maxwell AFB, AL 36112-6010

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AIR UNIVERSITY PRESS

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Library of Congress Cataloging-in-Publication Data

Names: McKinney, Jared Morgan, editor. | Hinck, Robert S., editor. | Air University (U.S.). Press, issuing body.

Title: Closing the deterrence gap in the Taiwan Strait / edited by Jared M. McKinney and Robert S. Hinck.

Description: Maxwell Air Force Base, Alabama: Air University Press, 2025. | In scope of the U.S. Government Publishing Office Cataloging and Indexing Program (C&I); Federal Depository Library Program (FDLP) distribution status to be determined upon publication. | Includes bibliographical references. | Summary: "Taken together, this volume of essays not only demonstrates how integrated deterrence can be made practical with respect to Chinese aggression toward Taiwan but also offers a model for approaching integrated deterrence across levels of strategy. A comprehensive-or integrated-approach to deterrence would require military, defense, and national implementation in both Taiwan and the U.S. While there is no "one" right answer, there are — we believe — "right answers" and they should be pursued simultaneously. At the end of the day, the situation in the Taiwan Strait is different today because the military balance of power is more unequal now than it has been at any time over the last 70 years. This has created a deterrence gap in which PRC hostile action is possible (though not inevitable). The way to stabilize the situation is to close the deterrence gap. This volume has outlined various methods to do this. Implementing these proposals, we believe, will contribute to peace and stability, and reduce the risk that the present globalized international order will be shattered by the ravages of war"— Provided by publisher.

Identifiers: LCCN 2025014256 | ISBN 9781585663354 (paperback)

Subjects: LCSH: Deterrence (Strategy) | National security—Taiwan. | Chinese reunification question, 1949- | Taiwan—Foreign relations—China. | China—Foreign relations—Taiwan. | Taiwan—Military relations—United States. | United States—Military relations—Taiwan.

Classification: LCC U162.6 | DDC 355.030951249—dc23/eng/20250527 | SUDOC D301.26/6:D 48/4 LC record available at https://lccn.loc.gov/2025014256

Published by Air University Press in August 2025

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Acknowledgments

This project received intellectual and practical support from many individuals. Margaret Sankey, at Air University, provided extensive institutional support. David “Rock” Bottomlee, at Air War College, and Jared Donnelly, at Air Command and Staff College, intervened when obstacles arose. Mark Jacobsen (Blue Horizons) and Todd Robinson (Air Command and Staff College) helped lead the task force’s seminars throughout the year. Galen Ojala, at Air War College, advised on space matters. Kameron “Smooth” McAdams and Brittany Oxley organized the effort at Squadron Officer School. Mark F. Cancian and Matthew Cancian briefed the task force about the CSIS wargaming report that inspired part of the current research project. For extensive feedback, we are indebted to Jared Paslay, Jon Varoli, David Golden, Andrew DuBois, John Wright, Sze Miller, Spencer Schardein, Nicholas Welch, Jordan Schneider, and numerous others.

Introduction

The Case for Closing the Deterrence Gap

Dr. Jared M. McKinney

Abstract

This introductory chapter categorizes the two predominant camps in American discourse on a potential People's Republic of China (PRC) invasion of Taiwan as the "Catastrophizers" and the "Experts." It argues that the Experts have underestimated how quickly the status quo is changing. In contrast, the Catastrophizers have diagnosed the problem correctly but so far have failed to propose solutions that are actually strategic. Attempts to stabilize Taiwan deterrence must make sense according to a framework that incorporates ends, ways, resources, risks, and time. The chapters in this volume conform with such criteria. They show that there are numerous ways for Taiwan and the United States to strengthen deterrence within this decade without demanding extraordinary resources or needlessly provoking the PRC. The deterrence gap in the Taiwan Strait can be closed.

Chinese Language Abstract

本文將美國有關中國入侵臺灣的討論分為兩個主要陣營，即「災難論者」和「專家」。它主張，「專家」論者低估了現狀改變的速度；相反地，災難論者們對問題的診斷是正確的，但到目前為止他們仍未能提出真正具有戰略意義的解決方案。試圖穩定臺灣嚇阻能力的努力必須根據一個包含目標(ends)、能力(means)、資源、風險和時間的框架來進行。本文顯示，在這個十年內臺灣和美國有許多方法可以加強嚇阻，而不需要過多的資源或無謂地激怒中國。臺灣海峽的嚇阻鴻溝是可以彌補的。

What is the probability that China will invade Taiwan within the next decade? Two sets of answers dominate public discourse.

The first answer, given by what we might label the "Taiwan Catastrophizers," is that the probability is high.[1] Exponents of this position argue that the United States must undertake previously unthinkable actions to stop a prospective Chinese invasion:

- formally bringing Taiwan back into the US defensive umbrella[2]
- doubling the defense budget[3]
- adding Taiwan to the US nuclear umbrella[4]
- deploying nuclear weapons in Taiwan[5]
- or even threatening preemptive nuclear war.[6]

Members of this intellectual camp imagine the Taiwan issue in apocalyptic Cold War terms, with the island functioning, once again, as the "cork" in the bottle of Communist expansion in Asia.[7] Ensuring the cork stays lodged in the bottle's neck is the defining issue of our era, according to this view, and nothing short of a fundamental rethinking of America's policy and approach will suffice to assure success. This must be done before, depending on the "gut" feeling of the proponent,[8] 2025 or 2027 or thereabouts.[9]

The second answer, given by what we might label the "Taiwan Experts," is that the risk of an invasion is not zero but low. Fewer than 10 percent of sixty-four experts surveyed in 2022 thought that China would use force by 2027.[10] This general expert perspective was confirmed in a survey of forecasts from 2013 to 2023.[11] Top Experts warn against "panic"[12] and "hype"[13] when it comes to the prospects for a Chinese invasion. These Experts believe that Beijing remains patient when it comes to unification, and they see continuity with China's current policies toward Taiwan.[14] A 2024 survey also showed that some US experts see a "prolonged downturn" in China's economy—something that very well could emerge this decade—as reducing the likelihood of China reverting to force to resolve the Taiwan dispute.[15] The Experts also prefer to talk about a coercive Chinese blockade of Taiwan, as opposed to an all-out invasion,[16] and to emphasize "gray zone" challenges over the prospect of direct military action.[17] In contrast with the Catastrophizers, the Experts almost to a person caution against radical changes to the status quo and encourage a judicious use of both sticks and carrots to maintain peace and stability.[18]

In the absence of "smoking gun" evidence regarding the PRC's strategic intentions—and to be clear, no such evidence exists[19]—how should US and Taiwanese military and political leaders go about formulating policy? Do they need to be alarmed and seek immediate, radical changes in policy? Or should they seek to maintain the status quo, adjusting on the margins as necessary?

In a previous monograph co-authored with Peter Harris, I developed an objective framework intended to adjudicate the disagreement over interpretations of risk.[20] The framework took the PRC's desire to "reunify" with Taiwan as a constant, though one now contextualized by an explicit deadline of 2049 or before.[21] Given the outstanding unification objective, why has the PRC failed to achieve reunification so far, for more than seventy years (1949–present)? The answer is that a powerful set of external *constraints* bound the PRC, preventing it from acting successfully. At the same time, a series of internal *restraints* suggested that given the gamut of PRC domestic and international interests, later was better than now, and peaceful unification was better than armed reunification.

Examples of external constraints from this period include the US-ROC Mutual Defense Treaty (1955–1979); US nuclear deterrence (1955–1974); US maritime dominance (1949–2014); and Taiwan Air Force air superiority (1958–2003). Examples of key restraints from this period include revolutionary chaos in China (1965–1975); deepening positive trade relations between China and Taiwan (1990–2016) and China and the United States (2000–2016); and Taiwan's Silicon Shield (2000–2022). Until recently, the constraints on a Chinese invasion of Taiwan were so high that the PRC could not have acted successfully even if it wanted to. And the restraints were such that, regardless, it likely did not want to (all things considered).

Since 2016, however, the situation has fundamentally changed. Few constraints positively bind the PRC anymore. At the same time, many of the restraints that incentivized the peaceful continuation of the status quo have also deflated. In this context, the explicit objective of reunification by 2049 becomes problematic, as the Chinese Communist Party will have to determine when, between now and then, the least bad time to forcefully reunify is. And the emerging balance of power—something that includes US modernization programs, the eventual effects of Japan doubling defense spending and investing in counterstrike capabilities, and the potential for tighter alliance groupings such as AUKUS and the Quad going forward—suggests that sooner may be better than later from China's perspective. That is where there is a "deterrence gap in the Taiwan Strait." The existence of a gap does not mean that the PRC is locked into a certain path, but it does mean the Experts are wrong, and the next ten years are fundamentally different from the previous seventy.

The risk of a PRC move on Taiwan is increasingly high within the next decade. The Catastrophizers are not wrong in this regard, even if their comments are often too deterministic and simplistic. At the same time, radical ideas (reproducing the national mobilization and rhetoric of the Cold War, threatening nuclear war, or making Taiwan once again a US ally) would, in net, do more harm than good. The Experts are right in this regard. It is not "deterrence" to undertake actions that provoke an adversary to conflict.[22]

The problem with the Catastrophizers is not, per se, in the ends they desire—continuing peace and stability in the Taiwan Strait—but in the ways they envision securing this peace, the massive resources they seek to justify, and the genuine risks associated with their recommended ways, such as threatening nuclear war. In contrast, the problem with the Experts is they tend not to perceive how significantly the military balance of power has shifted and how the future balance of power (in the 2030s and 2040s) may create incentives for the PRC to act sooner as opposed to later. In short, while Catastrophizers are more clear-eyed in assessing the probability of conflict, they are less useful when it comes to preventing it. What this means is that American and Taiwanese strategists need to carefully examine the *ways* to achieve the desired *ends* using realistic *means* while mitigating *risks*.

Given this context, can the US strengthen deterrence through smaller actions that do not require breaking existing national policy frameworks (such as America's "One China" policy)? This book shows that the deterrence gap that has been growing wider in the Taiwan Strait can be reduced in size. With persistence, it may be closed. Closing the deterrence gap will require national strategy, defense strategy, and military strategy to be integrated.[23] According to Joint Doctrine, strategy should answer four questions:

- What are the desired ends?
- What are the ways to get there?
- What means or resources are available?
- What are the risks associated with the strategy?[24]

A review of the literature that meets these specifications by seriously seeking to link ends, ways, means, and risk management yields the following conclusions: There is a consensus that Taiwan needs to become a "porcupine" to better defend itself from the PRC,[25] and the US needs to better position itself for conflict in a theater dominated by large spaces and PRC antiaccess/area denial (A2/AD) capabilities.[26] This consensus has failed to close the deterrence gap in the Taiwan Strait because of "porcupine" capabilities coming to be defined up to include virtually anything, including Abrams tanks and MQ-9 drones. Meanwhile US countermodernization efforts to China's A2/AD capabilities will begin to be implemented broadly only in the 2030s, which does not help the situation in the 2020s (and actually increases short-term risk). The result is that the deterrence gap remains, and this is why Catastrophizers are increasingly pressing for more radical ways and gargantuan means.

Much of the deterrence problem as it exists today is a result of the failure of military strategy. Taiwan's military is essentially a twentieth-century force, centered on F-16s, frigates, and tanks, while the PRC's is increasingly a twenty-first century force able to utilize sophisticated kill chains. An example that illustrates Taiwan's predicament is how it has centered its navy not on small missile boats—as Admiral Lee Hsi-ming argued it should[27]—but instead on the *Yushan*-class landing platform dock, a massive amphibious assault ship. The Taiwan Navy intends to build four such ships, at the cost of approximately $162 million each.[28] To put this in perspective, for this price Taiwan could build fifty or so smaller missile boats or 2,000 unmanned surface vehicles of the sort Ukraine is effectively utilizing in its war with Russia.[29] Developing ships that will be targets instead of developing weapons that will sink ships is the antithesis of military strategy. Over the past two decades, US arms sales have largely sustained Taiwan's existing force structure instead of forcing it to specialize in asymmetric, distributed, and attritable capabilities that could counter the PRC's advantages in technology and mass. And many useful systems the US has sold Taiwan have not been delivered and remain delayed (with some taking eleven years from announcement to delivery).[30]

So what is to be done? To answer this question, an Air University research group was formed, composed of Air Command and Staff College and Air War College students and faculty tasked with thinking practically about the *ways* and *means* question over the course of an academic year. Twenty-one captains at Maxwell AFB for Squadron Officer School also joined to provide support on specific aspects of military modernization. The task was to come up with practical ways to close the deterrence gap in the Taiwan Strait that accounted for *time* (next decade is too late) and *risk* (actions that make a conflict more likely, like garrisoning US Soldiers on Taiwan, should be looked at with skepticism).

The Taiwan Deterrence Warfighting Advantage Research team (TDWAR) spoke with subject matter experts, surveyed Chinese language publications in both Taiwan and the PRC, dug up seldom used historical documents at the Air Force Historical Research Agency, brainstormed ideas, relentlessly war-gamed different scenarios, traveled to the East Asian region, and competitively developed options for Taiwan Air Force (TAF) modernization. As projects developed, their authors repeatedly briefed their findings to relevant stakeholders for feedback. As ideas were formalized into essays, these were circulated extensively for rigorous peer review.

The TDWAR's single most important finding is that there are numerous practical, reasonably inexpensive, and low-risk actions that would increase the likely costs to the PRC of an invasion and decrease the benefits. The team calls these ideas the "low-hanging fruit" of the deterrence tree. To be productive, the deterrence debate needs to be redirected to identifying, cultivating and picking these. There is no reason to climb to the top of the metaphorical tree and venture far out on its branches—debating ideas such as including Taiwan in the US nuclear umbrella or building a 500-ship navy[31]—when "low -hanging fruits" remain available. Nor is there need for a complete rethinking of US grand strategy.[32]

Robust deterrence in the Taiwan Strait involves five principal questions:

- How much does the PRC benefit from the status quo?
- What are the PRC's expected costs were it to break the status quo?
- Could Taiwan stop an invasion?
- Could the US stop an invasion?
- Would the US stop an invasion?

Each of these questions also represents levers that can be manipulated to maximize deterrence. All things being equal—as the 2022 *US National Defense Strategy* recognizes—a state's assessment of the benefits of restraint (not going to war/preserving the status quo) anchors deterrence calculations.[33] This means that were the PRC to increasingly interpret the trajectory of international relations as inimical to its own vital interests, deterrence will be harder. States, naturally, also assess the likely costs of going to war, which include the military consequences, the economic relationships destroyed and forgone, the political reactions of adversarial and otherwise neutral states, and the extent to which all strategic goals would be achieved. In the context of Taiwan, these costs can be categorized as "deterrence by punishment" in the event of an invasion.[34] The ability of Taiwan and the US to militarily stop an invasion is "deterrence by denial": the People's Liberation Army (PLA) would be prevented from landing and occupying Taiwan, and so its military actions would be thwarted.

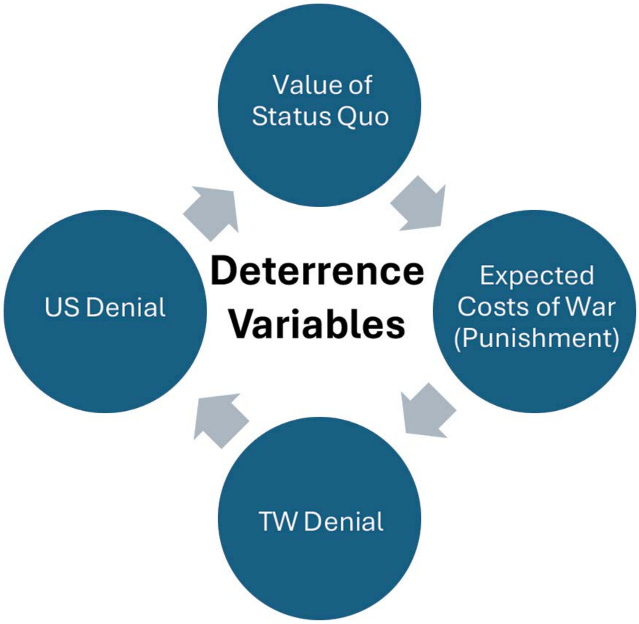

Figure I.1 Deterrence variables

What is surprising about these major deterrence levers is that, considered holistically, the aperture on manipulating deterrence in a favorable direction is wide: there are many different potential ways to bolster the benefits of restraint, expand deterrence by punishment, and amplify deterrence by denial (and the newer but related concept of deterrence by resilience). There is no need to isolate just one element of deterrence while minimizing the others, as sometimes is done in debates between hawks and doves that promote the false dichotomies that deterrence is essentially about sticks or essentially about carrots or must necessarily be centered on either denial or punishment. The proposals in this volume run the gamut of options and cross different strategic levels (national strategy, defense strategy, and military strategy). The proposals do not cover each category or level comprehensively, but their contributions are representative of where discourse on deterrence should go.

The volume's essays flow logically from the broad understanding of deterrence outlined above as well as that elaborated in the following theoretical chapter by Robert Hinck, which situates the volume's approach in both classical deterrence theory and China's distinctive strategic culture. Before exploring specific systems and ideas, the book looks first to the past and then to the future. Chapter 2, "A Long and Costly Fight," investigates why the US chose not to invade Taiwan (Formosa) during World War II and why the PRC should study this case as a notable "dog that didn't bark." Good history might mean more such dogs. Unfortunately, PRC analysts appear to have exerted most of their efforts studying successful amphibious invasions, resulting in likely selection bias and perhaps overconfidence.[35] The history of Operation Causeway, which is based on declassified primary sources, shows how the US military determined that adequate logistical support and required force ratios were unavailable in 1944, so Taiwan was not invaded as part of the island-hopping campaign. Notably, careful analysis from the only real experts on amphibious invasions then or now—the US military of the mid 1940s—determined that force ratios of at least 2.5:1 and perhaps as high as 5:1 would be required to successfully occupy Taiwan. Equivalent PRC force ratios today, assuming Taiwan could successfully mobilize even part of its reserve force, could be over 1 million soldiers. Given the PRC's limited amphibious lift capacity, transporting and sustaining soldiers in such numbers on Taiwan would be prohibitively difficult even without military reform on the island. In short, the past suggests that even if the changing military balance suggests a PLA invasion is barely possible, victory assumes many questions are consistently resolved in the favor of the mainland. PRC leaders would be wise not to wager their nation's future on a proposition so uncertain.

With this historical foundation, the book moves to the future via wargaming. Chapter 3, "Fortress Taiwan," reports the findings of nine structured, focused war games played over the course of the academic year. Deterring a Chinese invasion of Taiwan requires understanding what it might look like. No one can predict the future, but by using the state-of-the-art gaming system, carefully constructed orders of battle, and a team of subject matter experts, the war-game report gives a good sense for why the status quo is increasingly precarious from a capabilities perspective and what might be done to change this.

Unlike most Taiwan wargames—including the excellent report from the Center for Strategic and International Studies[36]—the Air University war-gaming team focused on a PRC-Taiwan fight in which a third-party (the US) is not actively a belligerent in the conflict. This is important because it allows the team to isolate strategies, force structures, and acquisition ideas Taiwan could—and should—pursue to better deny or punish an invading force. For an estimated $14 billion in investment over the next five years (or less than $3 billion per year), the Taiwan Armed Forces could acquire the capabilities needed to operate as a resilient and lethal porcupine, or as "fortress Taiwan," as the war game team names its approach. The systems Taiwan is recommended to acquire, which vary from short takeoff and vertical landing drones to unmanned surface vessels to increased missile defense and many more antiship missiles, would create an extraordinarily complicated problem for PLA planners. Beyond verification in war game simulation, such systems are already operating effectively in Ukraine today. Given the increasing sophistication of the PLA and the likelihood of peak geopolitical risk this decade and shortly thereafter, nothing short of radical reorganization and prioritization are required to stabilize the military balance and close the deterrence gap. Fortress Taiwan is where such discussions should begin.

Taiwan must lead its own defense, but it need not do so alone. The Taiwan Relations Act of 1979 (TRA) requires the United States "to make available to Taiwan such defense articles and defense services in such quantity as may be necessary to enable Taiwan to maintain *a sufficient self-defense capability*" (emphasis added). These articles and services, per the law, are to be determined by the President and the Congress, "based solely upon *their judgment of the needs of Taiwan*" (emphasis added).[37] If helping Taiwan maintain a "sufficient self-defense capability" is a key tenet of America's Taiwan policy—and it is—it obviously is not fully succeeding if there is, in fact, increasing risk of the PRC not being deterred and launching an invasion of Taiwan. At this conjunction, strategists are quick to default to the role the US plays in deterring such an invasion. US deterrence is real enough, and maintaining a national capacity to resist a PRC invasion is also part of the TRA. But it is imperative that US military authorities and strategic analysts refocus on supplying Taiwan the right weapons, services, and ideas it needs to bolster deterrence, not just selling or transferring systems for symbolic gains.[38] Deterrence works best when it is constructed in the plural as deterrents: concurrent and layered incentives and disincentives that together produce sufficient reason to avoid or defer war. Taiwan's autonomous capability to deny and punish an invading PLA force must be the central deterrent in deterrence.

Part 2 of the book focuses on ways to strengthen such deterrence. Mark Jacobsen, a leading expert in military innovation, presents the argument for the rapid acquisition in Taiwan of the type of drones that have become omnipresent in Russia and Ukraine today: small unmanned aerial vehicles (SUAV). If there could be consensus on anything, one would think it would be here, but Jacobsen explains how current US efforts to adapt to the current revolution in military affairs are falling short. Next, Reiss Oltman shows that a larger type of drone—Group 5 Short Takeoff and Vertical Landing UAVs—could be the key to modernizing the Taiwan Air Force for the twenty-first century, offering potentially both the firepower needed for intense conflict and the persistent sensing, intercept, and surveillance capabilities needed for peacetime. Finally, Tiffany Basham explains how Taiwan's reserve force could be reorganized to be a more operational force in peacetime and a more robust fighting force in war.

While drones and reorganized reserves could enable Taiwan to potentially deny a Chinese invasion or at least to inflict tremendous punishment upon such forces, the third part of the book embraces the concept of "deterrence by resilience," showing how resilient space communications, more robust logistics networks, and a civil guard could provide Taiwan with the ability to fight a prolonged war. The assumption here is that every day a PRC invasion is denied success, the costs for the PRC increase, as do its chances of failure (due to external intervention or internal turmoil).

"Linking Up," by Nicholas Stockdale, shows that Taiwan could diversify its current space-based communication capabilities by working with both Amazon's Kuiper and SpaceX's Starlink. Unfortunately, Taiwan has so far contracted with Eutelsat's OneWeb, a less resilient system that will likely suffer network degradation in a war, limiting effective communication coverage in Taiwan. Good strategy can change this.

"Current Deterrence" by Austin Whelan analyzes Taiwan's energy infrastructure. Whelan shows that dependencies on imported fuels (coal and natural gas), the limited availability of renewables, and the vulnerability of pipeline and transmission infrastructure mean that in a war, Taiwan's ability to generate electricity for both civilian and military uses would likely be very limited. Given the example of Russia intentionally attacking Ukrainian energy infrastructure in a manner reminiscent of the "total war" of the Second World War, such vulnerability could undermine both morale and Taiwan's ability to defend itself in wartime if it were attacked in an equivalent manner. Although this is a hard problem for Taiwan to fully solve, resilience can be built by acquiring mobile systems, exercising wartime scenarios, and communicating across the whole of society.

Societal resilience is also the theme of the final chapter in this section, "Taiwan Civil Guard." In this innovative essay, Wang and Shin make the case for the creation of a new organization in Taiwan aimed at responding to crises, natural disasters, and wars and strengthening civil society. This would be done through non-military community volunteers working underneath the Ministry of the Interior, who would prepare ahead of time to operate in dangerous environments with the goal of saving lives. In peacetime, this would mean responding to natural disasters. In wartime, this would mean helping to provide the civil services needed to sustain a society under attack and, if required, even resisting occupation. The key transmission mechanism for the new Civil Guard should be the existing community of nongovernmental organizations (NGO) operating in Taiwan aiming to prepare individuals for just such a mission. Taiwan's foreign minister has recently praised these organizations.[39] Taiwan should go a step further and give graduates of NGO training courses a formal role in civil defense. In combination with a formalized structure from the Taiwan authorities, the mentoring of former Taiwanese special forces, and local leadership from Taiwanese communities or neighborhoods, Taiwan could start embracing the sort of "total defense" model modeled by the Nordic states. Although on its own such a Civil Guard may not prove decisive for deterrence, in combination with other proposals, it adds to deterrence by resilience and represents to the mainland something Mao would have understood: a people united is the ultimate form of deterrence.

The next part of the volume includes a bold proposal for renewed US deterrence by denial this decade. Although this volume has argued that Taiwan's military must be at the center of a resilient deterrence equation, the US military of course plays a role in success on this front as well. In "First Strike Deterrence," Glen Gibson argues that the possibility of a highly disciplined US first strike on Chinese amphibious forces would force PRC decision-makers to think twice before initiating a conquest of Taiwan. Gibson argues that the US should consider taking an "active defense" approach to deterrence that reserves the right to strike preemptively were intel to suggest the PRC was about to launch an attack. Given that there is a very real risk that the PRC's Joint Firepower Strike Campaign would include simultaneous attacks against forward deployed US assets,[40] acting before US personnel were struck is, Gibson argues, both ethically warranted and potentially strategically reasonable.

The book's final section features three essays collectively coauthored by twenty-one US Air Force captains. Operating in independent teams of seven, each team was tasked with spending $2 billion on a three-year timeline to significantly improve the TAF's ability to deter or deny a PRC invasion. This exercise sought to optimize for creativity with the assumption that there are potentially good military options to rebalance the deterrence equation that are not currently being explored. Given that Congress authorized $2 billion in foreign military financing for the Indo-Pacific in fiscal year 2024—with Taiwan as the obvious intended recipient—and that the Taiwan Enhanced Resilience Act, passed by Congress in 2022, authorized up to $1 billion annually in presidential drawdown authority funds, funds at this scale will likely be available in future years.[41] What could the prudent allocation of these funds accomplish?

Lee Hsi-ming, Taiwan's former chief of the general staff, has contended that Taiwan can close the deterrence gap by moving from a force based on "concentration, fixed-defenses, and control" "(集中、固守、控制)" to one relying on "dispersal, mobility, and denial" "(分散、機動、拒止)."[42] These three essays illustrate how US equipment, in combination with prioritized production of some indigenously produced systems, can help enable this transformation. All three essays highlight the imperative of air and missile defense for the TAF. Limiting the damage for China's Joint Firepower Strike Campaign and challenging a PLA attempt at air dominance are key objectives for successfully resisting a PRC victory. Layered air defense systems are key to these objectives, as are concealment, mobility, dispersion, decoys, electronic warfare defenses, and reliable communication technologies. Focused investments by the US in these areas and redoubled Taiwanese investment in its own TK-3 missile batteries—which the TAF operates—could ideally position Taiwan to asymmetrically resist PRC aggression.[43] Furthermore, recent US experience and investments in Agile Combat Employment, which in the US context is focused on fighter jets, can be applied to the air and missile defense mission. In short, there is tremendous space here for progress, and were it to be achieved, PRC air dominance could be made prohibitively costly or even impossible to achieve. Taiwan's Air Force can be made into an Anti-Air Force.

Going forward, other essays beyond those contained in this volume can and should be written across elements of deterrence and levels of strategy. The overall strategy of the TAF is overdue for rethinking. A detailed analysis of sea mine deployment, utilization, and deterrence optimization is desperately needed.[44] Taiwanese integrated air defense options are overdue for an updated look. Air defense, as opposed to strike, may actually be the TAF's most important role. Taiwanese drone employment—as opposed to mere acquisition—needs further analysis. Taiwanese urban and irregular warfare are wide open for study. A rigorous examination of weaponizing, distributing, and maintaining Conex boxes would also be useful.[45] As these and future essays survive the marketplace of ideas, they must be transformed into focused strategic efforts that make their insights a reality.

Would a Taiwan military equipped with both SUAVs and larger Type 5 drones coordinating kill chains with resilient space communications, empowered by more robust logistics and civil society networks, backed by a more competent reserve core, and protected by a dense, agile air defense network be sufficient to deter a Chinese invasion either by plausibly denying the PRC's objectives or exacting such costs that action becomes seemingly irrational? No one can know for sure. But such a force would be much more likely to achieve this goal than the force that exists today. And when combined with a US more attentive to avoiding deterrent costs in a quest to gain competition successes, more focused on modernizing Taiwan's military into a twenty-first century fighting force, and potentially attuned to the deterrent value of first strike signaling (in response to an imminent attack on US forward-deployed forces), much of the current deterrence gap can be closed. Of course, international affairs are dynamic, and the PRC will respond to such initiatives with its own counters. But at that point, Taiwan and the US would be at least setting the agenda.

Notes

1. The term is derived from Andrew S. Erickson, Gabriel B. Collins, and Matt Pottinger, "The Taiwan Catastrophe," *Foreign Affairs*, February 16, 2024, https://www.foreignaffairs.com/.

2. Richard Haass and David Sacks, "American Support for Taiwan Must Be Unambiguous," *Foreign Affairs*, September 2, 2020, https://www.foreignaffairs.com/.

3. Matt Pottinger and Mike Gallagher, "No Substitute for Victory: America's Competition With China Must Be Won, Not Managed," *Foreign Affairs*, April 10, 2024, https://www.foreignaffairs.com/.

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PART 1

THEORY, HISTORY, AND WAR GAMES

Chapter 1

Western and Chinese Approaches to Deterrence

Dr. Robert S. Hinck

Abstract

Deterrence in the Taiwan Strait has succeeded for over 70 years. Whether it will continue to do so is in doubt. Although conflict is not preordained, factors on both sides of the Strait point to a weakening deterrence regime. In considering how best to revitalize deterrence in the Taiwan Strait, strategists should avail themselves of the multitude of approaches and variables that contribute to successful—and unsuccessful—deterrence outcomes. This chapter summarizes four approaches to deterrence in addition to synthesizing how Chinese strategists understand the concept. Seemingly simple ideas to deter Chinese aggression may risk conflict more than mitigate it. Instead, actions are needed to contest China's deterrence calculus in marginal ways and across multiple fronts to buy sufficient time to persuade Chinese decision-makers that China's national interests are best met without armed conflict.

Chinese Language Abstract

美國在臺灣海峽的嚇阻能力已經成功維持超過70年，但能否維持下去尚有疑問，儘管兩岸衝突並非一定發生，但兩岸的各種因素都顯示出嚇阻能力的衰弱，導致發生衝突的機率升高。考慮到如何最好地重振美國在臺灣海峽的嚇阻能力，戰略家應參考涉及成功嚇阻與失敗嚇阻的各種方法與變數。本文總結四種嚇阻方式，並加入中國戰略家對此概念的理解。看似簡單的嚇阻中國侵略的想法在表面上是減輕衝突，但結論卻是更容易引發衝突；相反地，我們需要用小規模、多面向的方式挑戰中國對於嚇阻能力的評估計算，爭取足夠的時間說服中國決策者，使其相信中國可以透過非武裝衝突的方式來實現最佳的國家利益。

Introduction

Since 1949, deterrence has succeeded in the Taiwan Strait. While tested at times, both the People's Republic of China (PRC) and Taiwan have refrained from substantively changing the territorial status quo. The US has played a role too, signaling its resolve to defend Taiwan against PRC aggression through congressional acts and displays of force. While military strategists may point to the balance of forces as the crucial variable for this success, as the historical record shows, wars rarely occur simply because one side sees itself as holding a military advantage.[1] This is not to say that military capabilities are unimportant; the ability to deny an aggressor from achieving its objective typically forms the foundation of any deterrent strategy.[2] Nonetheless, focusing solely on the balance of forces hazards a narrow, and strategically incomplete, view of deterrence, one that can risk raising the likelihood of conflict rather than preventing it.

While China's rise and recent rhetoric toward Taiwan is cause for concern, closing the deterrence gap in the Taiwan Strait is possible. Room for persuasion still exists in that, despite signaling the intent for "reunification" and the development of capabilities to do so, Chinese leaders have not yet decided upon how or when such actions would occur, with peaceful measures still on the table—although less prominently stated than before.[3] Within this context, policymakers and strategists are left with a tightrope to walk. Credibly signaling to China that the costs of forceful reunification outweigh the potential benefits, without alienating Beijing such that it comes to see the status quo as no longer serving its interests or pushing the Chinese Communist Party (CCP) to perceive reunification as best achieved now rather than later, requires a nuanced understanding of deterrence from which creative, actionable policies can emerge.

At its core, deterrence is a communicative activity. As a practice, it seeks to discourage an actor from taking unwanted action. However, as a strategy, it can take a variety of forms, including classical approaches, like threats of punishment or denying potential aggressors the likelihood of success, to more recent and broader views, like integrated or tailored deterrence, among others. Regardless of the form they take, the success of deterrent strategies hinges on one crucial variable: perception. As Michael Mazaar explains, the cumulative body of research on deterrence emphasizes one crucial fact: "It is the perceptions of the potential aggressor that matter, not the actual prospects for victory or the objectively measured consequences of an attack. Perceptions are the dominant variable in deterrence success or failure."[4]

This chapter serves two goals. First, it provides a broad overview of deterrence strategies to aid readers' evaluations of the benefits—and potential risks—of the policies, proposals, and ideas presented in this collection of essays. Second, it summarizes thoughts on deterrence from the PRC view; after all, the perceptions of PRC decision-makers will largely determine whether an attempt at forceful unification occurs or not, regardless of the best intentions from Taiwan, the US, or others in preventing such action. Taken together, it demonstrates to readers the necessity for creative solutions that chip away at the current deterrence gap in the Taiwan Strait across multiple fronts without raising undue risk and opening avenues for Beijing to see its interests best met within, not outside, the current global order.

Deterrence

In the broadest sense, deterrence is persuading one's opponent that the costs or risks (or both) of a course of action may outweigh its benefits.[5] While seemingly simple, a multitude of factors affects how and why (or why not) political actors are deterred. Accounting for these variables is crucial for formulating effective strategy. Sound deterrent strategies should both include clear theories of victory with ways and means coherently aligned to one's ends and also accurately reflect the empirical record regarding how states and political leaders actually respond to deterrence posturing.[6] In the case of the latter, research on deterrence suggests strategists array themselves with four different approaches: (1) classical conceptions of denial and punishment, (2) geographical considerations regarding what is being deterred, (3) the applied time frame by which deterrence imparts its effect, and (4) the scope of instruments conceived to be in play.[7]

Classical Approaches to Deterrence

The two fundamental approaches to deterrence include strategies of denial and punishment. Deterrence by *denial* aims to prevent an action by making it infeasible or unlikely to succeed. It functions by augmenting local defensive capabilities to deny a potential aggressor's confidence in its ability to attain its objectives while also raising the perception of the costs to do so. Deterrence by *punishment* uses a different logic. Punishment strategies operate through threats of severe penalties if an attack occurs. Here, discouragement comes not from the direct defense of the contested environment but by connecting the local fight to repercussions within the larger world to raise the costs of an attack.[8]

Research suggests that denial strategies are inherently more reliable than punishment strategies. The former speaks louder and clearer while the latter leaves room for doubt regarding the willingness of a defender to enact promised punishments when the time actually arises.[9] Still, reliance on a local balance of forces is often insufficient on its own.[10] History is replete with examples when a country ought not to have attacked, as well as numerous cases where smaller forces overcame larger ones. As Clausewitz notes, war is human endeavor; questions of will, motive, chance, and perception all shape the confrontation between material forces and human agency in determining the course of war.[11]

Geographical Considerations

Another consideration is the geographical circumstance in which deterrence occurs. *Direct* deterrence concerns itself with preventing attacks on one's own territory while *extended* deterrence concerns itself with discouraging attacks on third parties, whether they be allies or partners. Two factors make extended deterrence significantly more challenging than direct deterrence. The first is operational. The distance between the deterring party and the defender in relation to the potential aggressor creates logistical issues. Moreover, projecting force requires capabilities at the ready or sufficient time to mobilize and send them into theater, time that may not be present when conflict begins, especially for those attempting a fait accompli. The second issue is credibility. Just as potential aggressors weigh the cost, benefits, and risks associated with a course of action, so too do the deterring parties. Coming to the defense of a third party can be costly, even more so when the aggressor is a peer or near-peer power.[12]

Potential aggressors, then, may be susceptible to discounting the likelihood of a distant defender fulfilling its deterrence pledge, thereby eroding the deterrent effect. For extended deterrence to work, additional communicative steps are necessary. Distant defenders may pass laws, station tripwire forces, or increase their military presence in the contested region to convince potential aggressors of their commitment to act. Such actions, however, may be viewed as escalatory and deepen tensions with potential foes that may or may not have intended to attack.[13] Consequently, strengthening extended deterrence is difficult;

actions to bolster it hold the potential to increase risk while decreasing room for maneuverability.

Applied Time Frame

A third factor in deterrence strategy is timing. *Immediate* deterrence refers to "more short-term, urgent attempts to prevent a specific, imminent attack."[14] It is most often at work in crisis situations to prevent escalation. *General* deterrence, on the other hand, operates over the long term through ongoing, persistent efforts to prevent unwanted actions.[15] Within US doctrine, general deterrence can be understood as "deterrence by dissuasion," which consists of actions to prevent potential adversaries from developing or embarking on programs or activities that can threaten US vital interests.[16] The goal of general deterrence is to reduce the need for immediate deterrence by limiting the available military forces in play and the number of circumstances by which immediate deterrence may be needed; it therefore aims to regulate relationships between actors to ensure that neither party is anywhere near mounting an attack.[17]

General deterrence tends to be more easily done than immediate deterrence. In crisis situations, deterrence is most at risk as the speed of decision-making and perceptions of urgency to act become heightened. In these instances, aggressors may perceive backing down as untenable or become committed to a course of action, at which point deterrence no longer functions.[18] The success of general deterrence, on the other hand, is evident whenever the status quo holds. At any given time, a multitude of nations holds grudges or expansionist aims. Yet regional orders supply sufficient general deterrence effects such that conflict is largely avoided.[19] Regional stability, however, is not a given. It requires consistent routinization, adaption, and legitimacy. Changes in the global balance of power and beliefs in one's future economic growth (or lack thereof) often motivate challenges to contest or revise regional and global orders.[20] In this sense, negative perceptions of one's future, especially from rising powers, supply disruptive forces that challenge self-interested beliefs of ongoing stability in the current global system, reducing the effect of general deterrence.[21]

Scope of Instruments

A final way to understand deterrence comes from the instruments of power one perceives to be in play. Here, three views emerge. In the *narrowest* view, deterrence takes the form of threats intended to raise the costs and risks of aggression through denial or punishment with a focus solely on military tools of statecraft.[22] A broader view incorporates nonmilitary means as additional sources of threats, like economic sanctions or diplomatic exclusion.[23] Broader yet are strategies that go beyond threats to include offers of reassurance. In this approach, a potential aggressor is persuaded not only of the costs of aggression but also the benefits of maintaining the status quo. Such assurances operate by convincing potential aggressors that aggressive acts are either unnecessary or that a world absent of aggression is more attractive to their national interests.[24] In this regard, the goal is to induce a potential aggressor to perceive its long-term prospects positively while reducing negative perceptions of its security environment, thereby circumventing the impetus for aggression.[25] Taken together, potential aggressors are furnished with internal motivation (restraints) in addition to external motivation in the form of costs (constraints) to deter aggression action.[26]

While military strategists may find themselves most at home in the narrow view of deterrence, rarely can one subdue another through threats alone.[27] Pairing reassurances with threats is particularly important when dealing with peer or near-peer adversaries, as the parity in forces constitutes relatively equal bargaining power; this is especially true for major powers who possess additional, emotional needs like status, prestige, or respect.[28] Approaching deterrence through this broadest view can contribute to a more lasting deterrence regime with a focus on not just power over others but also power with them by establishing a system of relations whereby both parties' national interests are met, even if minimally so.

Deterrence in the Taiwan Strait

Over the last five decades, the success of deterrence in the Taiwan Strait is largely attributable to the broadest view of deterrence.[29] Both the PRC and Taiwan viewed cooperative relations with the US and the wider global order as more attractive to their national interests than conflict. Such views restrained both parties, restricting the mainland from forcefully reunifying Taiwan while preventing the Taiwanese government from declaring formal independence.[30] Unfortunately, this deterrence regime in the Taiwan Strait is unraveling. China's economic growth and military development substantially alter perceptions of the local balance of power. Meanwhile, the viability of the one-China idea is increasingly in doubt owing to the Taiwanese increasingly seeing their national identity as distinct from the mainland Chinese in conjunction with the PRC's political crackdowns in Hong Kong undermining the feasibility of its "one-China, two systems" proposal.[31] Furthermore, security cooperation and economic development—the historical linchpin of US-China cooperation—no longer possess the hold on relations as before as both nations increasingly see the other as their primary challenger with economic decoupling on the rise.[32] In other words, all four of the elements of deterrence reviewed above are weakening and contribute to a widening deterrence gap, a gap that poses significant risk of conflict if actions to narrow it are ignored.

Deterrence in the Taiwan Strait must be revitalized now. Doing so requires multiple overlapping efforts applied to the specific context of US-Taiwan-PRC relations in addition to engagement with other nations in the Asia-Pacific. In this regard, the 2022 *National Defense Strategy*'s call for integrated deterrence is both necessary and prudent.[33] As the literature on deterrence shows, deterrence strategies universally applied are likely to fail; deterrence works not in general application but in specific ways against specific potential aggressors.[34] In applying deterrence strategies specifically, one must take seriously a potential aggressor's motivations and perceptions of the future battlespace and use that understanding to design strategies sufficiently suasive that the adversary perceives the alternatives to aggression as more attractive than war. Strategists must bear in mind then that deterrence achieves its ends not through "objective" or "rational" considerations in the minds of those involved but through the subjective perceptions of those within the targeted state.[35] Toward this goal, understanding how PRC strategists approach deterrence is important.[36]

China Deterrence

Chinese theories of warfare are heavily influenced by China's long history and classical writings, as well as by modern Maoist-Marxist views on struggle.[37] Consequently, Chinese strategists tend to conceptualize deterrence in ways different than Western strategists. Although overlap exists, recognizing these differences is essential for reducing risk, regarding both miscommunication and miscalculations, and offers an entry point for influencing Chinese decision-makers within their own cognitive schema.[38] In doing so, it is important not to essentialize or "other" Chinese military strategy while also avoiding overly "Western-centric" views on strategy. Strategists should therefore apprise themselves of the PRC's conceptualization of deterrence, its key components, and its usages throughout differing phases of conflict not only to anticipate how one's deterrence rhetoric and actions may play out in Chinese decision-makers' mindsets but also to enhance the credibility of deterrent threats, prevent misinterpretation of deterrence signals, and facilitate international dialogue on these issues through a common terminology.[39]

Chinese Views of Deterrence

At a conceptual level, Chinese views of deterrence take a broader form than the West's. In the Western tradition, deterrence is tied to dissuasion (convincing opponents *not* to do something), which is distinct from coercive strategies (the compelling of others *to do* something).[40] The available literature on PRC thinking suggests that Chinese strategists make no such distinction, with the term for deterrence (*weishe*) including elements of both coercion and dissuasion.[41] Foundationally, then, there exist differing strategic logics when it comes to deterrence: for the US, deterrence tends to represent the ends, or the objective, of a policy/strategy; for PRC strategists, deterrence is but a means for achieving broader political goals.[42] In more concrete terms, the objective of US deterrence appears to be stopping potential actions in specific domains through possession of a capability that rationally conveys to others the cost and willingness to deny or punish. In contrast, for China, deterrence is not about stopping a specific action in a specific domain. It is an instrument of political activity used in support of securing a larger strategic objective by psychologically influencing others. In the case of Taiwan, Chinese deterrence activities aim not merely at preventing it from declaring formal independence but also at compelling Taiwan to abandon such efforts while also leaving it with no other option other than accepting China's objective of unification.[43]

First, the blending of dissuasion and compellence is evident throughout People's Liberation Army (PLA) writings.[44] The 2011 *PLA Dictionary of Military Terminology* defines deterrence strategy (*zhanlue weishe*) as "displaying or threatening the use of armed power, in order to compel an opponent to submit."[45] Likewise, the 2015 edition of *The Science of Strategy* defines deterrence as a form of military combat whereby adversaries are coerced to "give way, compromise, or submit."[46] The purpose of deterrence therefore includes two components: "one is to dissuade the opponent from doing something through deterrence, the other is to persuade the opponent what ought to be done through deterrence, and both demand the opponent to submit to the deterrer's volition."[47] Deterrence, then, operates both defensively and offensively, as it aims "to halt, or prevent, the other side from starting a conflict, and thus protect one's own interests from aggression. Or, it is to shake the other side's will to resist, and thus seize those interests or benefits that originally would have required conflict to obtain them."[48] In this regard, Chinese concepts of deterrence are more active than Western approaches, emphasize coercion as much as dissuasion, and highlight the use of force as a key part of deterrence.[49]

Second, the PRC's broader conceptualization of deterrence results in a whole-of-government approach that links Chinese deterrence behavior to the nation's broader foreign policy goals.[50] As a former deputy commander of the China's Second Artillery (now the People's Liberation Army Rocket Force), playing off Clausewitz, stated, "Like war, deterrence is a continuation of politics."[51] As Dean Cheng states, "for Chinese decision-makers, successful deterrence is ultimately a form of political activity . . . whereby an adversary is constrained in his actions, allowing China to achieve its goals." The tools to accomplish this include military and nonmilitary means, to which both are applied to deter and compel others, demonstrate Chinese resolve, control and manage conflict escalation, and operate across domains of space, cyber, information, conventional, and nuclear capabilities.[52]

Third, although the PRC relates deterrence to cost-benefit calculations—like Western thoughts on the subject—the Chinese approach differs in its emphasis on influencing the psychology of an adversary. In this regard, "the crux of military deterrence is to influence the other side's thinking" and that influencing is a "psychological process."[53] Concealment, surprise, and offensive activities are crucial.[54] As the PLA's 2001 Academy of Military Science (AMS) edition of *Science of Military Strategy* explains, "only when the implementation of strategic deterrence brings about psychological shock on the opponent . . . can he be forced to submit and compromise."[55] The intent then is "to incite psychological fear in the deterred side" and supply "pressure within the enemy."[56] Such efforts extend throughout phases of peace and conflict and may be brewed in advance "to highlight the potential of future strikes . . . subduing the enemy without going to battle" or during war as an effort to maximize "psychological shock and awe."[57]

Core Components of Chinese Deterrence

According to PLA writings, there are three core components of deterrence: capability, resolve, and communication. The first component, *capabilities*, is derived from a nation's "deterrence strength" (*weishe shili*). The 2013 AMS *Science of Military Strategy* states: "The more powerful the deterrence strength is, the greater the possibility for deterrence activities to succeed."[58] Capabilities include offensive and defensive aspects, with the former tending to focus primarily on military strength. Other elements of national power, however, such as a country's territorial size, population, economic strength, levels of science and technology, and geographic conditions play a role.[59] Although nonmilitary instruments function as part of China's broader spectrum of deterrence messaging—frequently employed in China's whole-of-government approach to coercive deterrence activities—military capabilities remain the central element of deterrence strength. Whereas perceptions of capabilities can be "manipulated by bluffing or exaggerating, this is successful only when there is an element of true capability to deter the adversary."[60]

The second component is demonstrating credible *resolve*. The 2013 AMS *Science of Military Strategy* explains that strength without resolve makes deterrence difficult: one must possess the "courage to hang the sword of deterrence strength high above the opponent's head."[61] Resolve includes two components: interest and willpower. *Interest* is "the degree of national security interest at stake for each side" while *willpower* includes "the deterring side's subjective factors, including the will, intelligence, and psychological qualities."[62] The ability to influence both is largely the purview of "psychological deterrence," which focuses on undermining enemies' will to fight and thereby improving China's relative deterrence.[63] Targets of psychological deterrence extend to military personnel and the general public. When applied to military leaders and personnel, psychological warfare aims to confuse the enemy, reduce their combat effectiveness, and "amplify their anxiety of hostile warfare, fear of death and injury, aversion to hardships, and the thought of the hometown of loved ones."[64] As for the general public, the 2015 National Defense University *Science of Military Strategy* calls for application of China's three warfares—public opinion warfare, psychological warfare, and legal warfare—to be used.[65]

The third component is *communication*. Chinese military thought sees the "essence" of deterrence as psychological, with opponents needing to receive and believe messages conveyed for psychological effect to occur.[66] Therefore, "Successful deterrence must make the deterred side be aware of the exact meaning expressed by the deterrence strength and the deterrence resolution."[67] This is done through "deterrence information transmission" (*weishe xinxi chaundi*), which is composed of information content and its transmission mode.[68] *Information content* refers to the message, including what one wants the other side to do and actions one might take otherwise, and showcasing one's commitment to fulfill these threats.[69] The *transmission mode* represents the medium by which the deterrence message is sent and can be direct or indirect and comprise statements or actions.[70] The selection of both message and medium should "mainly be determined according to the [intended] effect of the information,"[71] including the use of "multiple channels to clearly transmit capability and resolve to use force in a timely, fast, and accurate manner."[72] Of note, some evidence suggests that PRC strategists recognize the limitations of effectively communicating deterrence. Operationally, deterrence messages may not be transmitted as seamlessly as PRC military theory intends.[73] Additionally, cognitive challenges emerge as reception of messaging requires two parties to share "an identical or close cognitive logic . . . to avoid war, reduce casualties and uphold stability."[74] In the case of US-China deterrence signaling, the countries' differing conceptualization of the purpose and usage of deterrence activities may lead to misunderstandings that escalate, rather than de-escalate, conflict.

Phases

In the PRC view, deterrence can be applied, and operates differently, in three distinct phases: peacetime, crisis, and wartime. *Peacetime* activities combine elements of general deterrence and take the broadest view of deterrence. In this regard, China's three warfare activities (legal, public opinion, psychological) aim to shape the security environment and regulate relationships with other strategic actors in ways supportive of broad Chinese political interests.[75] Drawing from its "static deterrence capability," the PLA is to rely upon China's comprehensive national power to ensure "sustainable long-term deterrence through a balance of power with the adversary."[76] In doing so, China's "peacetime deterrence posture" uses "low-intensity military activities" that "display the existence of the military, express security concerns, and declare the strategic bottom line."[77] These efforts are viewed as "preventative deterrence activities"[78] that target "potential sources of threat."[79] They are a means to "form normalized deterrence posture" in which an opponent is forced "to not dare to act lightly or rashly."[80] In the context of PRC-Taiwan relations, examples of nonmilitarized peacetime deterrent activities include strategies of persuasion (convincing key actors, both in Taiwan and the international community, of the benefits of reunification and the costs of the alternative), united front work (CCP engagement with Taiwanese politicians, parties, and civil society groups to support groups in support of unification and undermine those against), and leverage (efforts to isolate Taiwan diplomatically, economically, and militarily such that Taiwan becomes wholly dependent on China).[81]

Greater nuance exists between Western and Chinese views of deterrence during *crises*. In the Western case, deterrence activities aim to stabilize crises and prevent conflict from spiraling out of control.[82] Deterrence posturing, then, is about balancing actions that secure one's interests without needless provocation. Chinese thinking, in contrast, adopts a more proactive and often—in the eyes of others—provocative approach. For instance, Chinese gray zone operations operate within its concept of active deterrence activities. Such actions serve to contest Taiwan and its allies' readiness to respond to crises, measure their adversaries level of will, and determine the boundaries of acceptable coercive behavior below Western thresholds of confrontation. These efforts do so by also interweaving legal and cognitive warfare to create favorable conditions for China's goal of reunification, like usage of its China Coast Guard in disputed waters, which amplify Beijing's political narratives and strategic agendas across multiple domains before possible kinetic warfare.[83]

China's deterrent approach to crises can engender miscommunication and miscalculation. As Allen Whiting observed, a core principle of Chinese deterrence is that "the best deterrence is belligerence," by which one achieves credibility through movement of military forces as "words do not suffice."[84] The risk here is that mobilization of PLA forces, while intended to signal credible resolve, can be misinterpreted as actual preparation for war, thereby unintentionally escalating a crisis deeper into conflict.[85] Indeed, as the 2013 AMS *Science of Military*

Strategy states, when necessary, the PLA should "adopt appropriate amount of activities that borderline on warfare to force an opponent to acknowledge the difficulties and retreat and terminate when seeing danger."[86] This includes small-scale warning strikes that are offensive in nature, not intended to degrade an adversary's war-fighting ability but rather to simply signal China's capability and resolve.[87] Taken together, the logic of China's crisis deterrence activities is to "persuade the adversary to back down while preparing for war" by showcasing China's core deterrence abilities to signal its capability and resolve. This logic moves from "deterring the adversary via balance of power" during peacetime to that of "a threat by revenge" during crisis.[88]

In *wartime*, Chinese deterrence strategies focus on controlling the course of war and limiting its costs.[89] While some may argue that deterrence fails once conflict breaks out, such a view is inconsistent with Chinese approaches to *weishe,* which takes deterrence and war-fighting as complements, not opposites.[90] In this sense, PLA strategy sees deterrence activities and war-fighting abilities as going hand in hand: "close cooperation between deterrence activities and actual combat activities" both signals China's resolve and capabilities and contributes to "favorable conditions for going from deterrence to war."[91] Operationally, Chinese deterrence activities during wartime continue to influence adversaries' decision-making calculus, cause hesitation, and reduce the will to continue fighting. Nonetheless, some evidence suggests that a further strategic goal of wartime deterrence is limiting the scale of conflict by preventing others from joining in conflict against China. For instance, in a Taiwan scenario, the 2013 AMS *Science of Military Strategy* notes that wartime deterrence is important to avoid US intervention as well as ensure other potential opponents refrain from taking advantage of China's distraction to seize the initiative on another front.[92]

Finally, the concept of war control (*zhanzheng kongzhi*) describes how the PLA transitions between phases of conflict. Because of China's more proactive view of deterrence, *escalation management* serves a key aim in its deterrence strategy. In doing so, China is to use all instruments of national power throughout the phases of conflict, reflecting its integrated approach to deterrence.[93] The idea of war control begins when China is confronted with a security threat. In this case, the first step is to address the threat to "shape the situation" and prevent it from escalating by using both military and diplomatic means. If this fails, the second step is to manage the crisis. Here the PLA is to be ready for war to break out but refrain from starting the war itself. Third, if the crisis continues to escalate, moving closer to outright war, war must be deterred—again through military and diplomatic actions, but also through the mobilization of "public opinion forces." Finally, if war does occur, the PLA "must win the war . . . through constant vigilance against an adversary's surprise first move."[94]

Despite this public attention to escalation, Western analysts fear that China may not appropriately appreciate the risks of conflict escalation. This is due to China's limited recent experience with high-stakes crisis situations and concerns over PRC decision-makers' overconfidence in their ability to manage war control.[95] Additional concerns emerge from the potential misinterpretation of Chinese deterrence activities given the Chinese linkage of deterrent actions and preparations for actual war. Taken together, these concerns suggest that the PLA may unintentionally stumble into hostilities during a crisis.

Implications for Deterrence Strategy

In summary, the PRC's approach to deterrence centers around perceptions of will, capability, and persuasion and is applied throughout the spectrum of competition through a whole-of-government approach. Strategies or policies to bolster deterrence in the Taiwan Strait must first factor in Chinese perceptions not only of the local balance of forces but also PRC decision-makers' confidence in the likelihood of success against the potential costs, and second, grapple with the risks of escalation given the potential of miscommunication.

Applying Chinese thinking on deterrence to the four deterrence approaches described in the first part of this chapter suggests the following lessons: first, China will likely test strategies of extended deterrence, designed in ways to both assess and undermine Taiwanese, US, ally, and partner nations' resolve. Furthermore, Chinese decision-makers will likely assume their will to be greater than the US's, given Taiwan's status as one of China's core national interests. Therefore, seemingly "easy" solutions to enhance US extended deterrence, like strategic clarity or positioning of trip wire forces, will likely result in greater coercive responses by China, responses that can spiral out of hand and make immediate deterrence more difficult given the differences in Chinese and Western perspectives of escalation management. Additional changes in US or Taiwanese positions or security policies will likely be viewed as acts of aggression that, from the Chinese perspective, necessitate a response in return to demonstrate their resolve and capabilities, potentially making conflict more likely despite what Western analysts may consider rational.

Second, relying primarily on strategies of cost imposition, whether through threats of economic sanctions or military retribution, has limits. As the 2022 Russia-Ukraine war illustrates, countries may sacrifice economic development for political objectives by transitioning themselves to a war-fighting economy to sustain a conflict and wear down enemy will. Indeed, some evidence of this is already present as Xi Jinping directs government officials to pursue economic development activities to make China more self-sufficient and resilient to external conditions.[96] Moreover, cost imposition may have little strategic effect on PRC will. Channeling Marxist-Maoist beliefs of struggle, efforts to curtail Chinese economic capacity or raise the destructive costs of war may be used as further justification of the value of struggle and the historical inevitability of conflict, thereby legitimizing resistance to outside forces.[97] Such interpretation would legitimize CCP ideology and evoke a rally-around-the-flag effect that hardens the will of Chinese and increases China's commitment to conflict, thereby reducing the space for deterrence.

Third, denial strategies, too, have limits, albeit they remain perhaps the most useful in shaping Chinese perceptions of deterrence in the short term. The emphasis of deterrence strength as falling upon one's deterrent capabilities demonstrates the value Chinese strategists place on the local balance of power. Sharpening the quills of the Taiwanese porcupine is therefore necessary and can reduce PRC confidence in its ability to unify Taiwan with the mainland, but only in the short term. The size of China's economy combined with its continued military modernization will progressively outpace Taiwan's capabilities, barring some radical change in Taiwanese defense spending. Taiwan will unlikely be able to go toe-to-toe with the PRC and must turn its attention to asymmetric capabilities. Still, such efforts require not only the political will but also strategic policymaking to do so; such efforts can be countered in kind by Chinese manufacturing and political directives at a much faster pace. Ultimately, denial strategies do little to shape the will of either nation and leave unaddressed the coercive tactics employed by China through economic, political, and military means, especially in the gray zone.

Fourth, general deterrence will continue to crumble without some form of meaningful intervention. China already engages in the broadest form of deterrence through its whole-of-government approach and broader take on deterrence as political warfare. Moreover, the question of Taiwan will remain one of its core national interests, which—when combined with its geographical proximity to Taiwan vis-à-vis the US, continued modernization and integration of PLA operational abilities, and willingness to engage in coercive activities—will allow it to, over time, dictate the operational space to its advantage.

The solution then, at least in the short to medium term, is to contest China's deterrence calculus in marginal ways across all fronts. Every additional step to make Taiwan more resilient to a Chinese attack, confuse or complexify how conflict may unfold, and employ novel, cheap, and disposable systems among other actions, can collectively reduce Chinese confidence. This serves to buy further time for the US and its allies to "change the prevailing winds" such that Chinese perceptions of its strategic environment and the timing by which reunification should occur can be forestalled. As these actions chip away at the deterrence gap, raising the overall costs and reducing confidence in the likelihood of a successful attack, they can help reframe China's strategic calculus such that assurances may gain relative attractiveness, thereby persuading PRC decision-makers that China's national interests are better met within a stable status quo while limiting the opportunity for actions that unintentionally engender conflict.

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Chapter 2

"A Long and Costly Fight"

How Historical Insight from Operation Causeway Can Still Deter Aggression Today

Col J. Kevin McKittrick, USA

Abstract

In 1944, the US military planned an amphibious invasion of the Japanese-ruled island of Formosa (Taiwan), known as Operation Causeway. Despite the perceived necessity and potential benefits that control of Formosa would provide US forces in the eventual defeat of Japan, the Joint Chiefs selected alternative options, choosing to bypass the island. Through several weeks of debate, these senior military leaders concluded that because of a lack of adequate resources, the risk of executing Operation Causeway was too high, even if it still could potentially shorten the duration of the war. Understanding these logistical constraints and the decision-making process of an experienced fighting force well versed in the complexities of amphibious warfare could suggest to the People's Republic of China (PRC) that the probability of success of an invasion of Taiwan today would be extremely low. Additionally, a keen understanding of the factors surrounding Operation Causeway, and in general other historical examples of amphibious assaults, can provide the Taiwanese government with potential actions to consider in improving its doctrinal approach to repelling an invasion by the PRC or to potentially deter it from even happening.

Chinese Language Abstract

1944年，美國軍方計劃對日本統治下的臺灣島（即福爾摩沙）進行入侵，該計畫稱為鋪道行動（Operation Causeway）。儘管控制臺灣被認為對美軍最終戰勝日本具有必要性和潛在的利益，但參謀長聯席會議在經過數週的辯論後，高階軍事領導人得出結論。儘管鋪道行動可能會縮短戰爭時間，但由於缺乏適當的資源且風險過高，最後選擇替代方案，決定繞過臺灣。透過了解後勤限制以及熟悉具有在複雜兩棲作戰環境中的部隊決策過程，可以向中國表明入侵臺灣的成功概率極低。此外，深入了解贊成或反

對鋪道行動的因素以及其他歷史上兩棲作戰的例子可以為臺灣政府改進現今教條式的反制中國入侵理論或者阻止入侵發生。

Introduction

On August 30, 1944, during a meeting of the Joint Planning Staff (JPS), US Army Brig Gen Frank N. Roberts, then the Chief of the Strategy and Policy Group on the War Department General Staff, participated in a discussion on the next major objective in the Pacific Theater. He expressed that he had long thought this objective should be the Japanese-ruled island of Formosa (Taiwan), but if US forces were to execute such an operation without decisive force, it would be "a long and costly fight."[1] Brigadier General Roberts was referring to Operation Causeway, a planned amphibious invasion of Formosa. Despite the potential benefits that control of Formosa would provide US forces in the eventual defeat of Japan, the Joint Chiefs chose to bypass the island. Through several weeks of debate, these senior military leaders concluded that owing to a lack of adequate resources, the risk of executing Operation Causeway was too high, even if it still could potentially shorten the duration of the war. Understanding these logistical constraints and the decision-making process from a fighting force that had the most experience in amphibious operations in history might suggest to the PRC that the probability of success of an invasion of Taiwan today remains extremely low. Additionally, understanding the factors surrounding Operation Causeway offers Taiwan potential actions to consider in not only improving its doctrinal approach to repelling a PRC invasion but also deterring an invasion from ever happening.

To fully appreciate the value that Operation Causeway provides to the present, one must study both the original operational plan as well as the discussions surrounding it. Fortunately, numerous declassified transcripts of the Joint Chiefs of Staff (JCS) and JPS meetings provide invaluable references, cited in the following sections. For Taiwan, analyzing Operation Causeway and other historical amphibious assaults can provide the island with additional ideas to strengthen its Overall Defense Concept. For China, analyzing Operation Causeway should stress the incredibly robust logistical capability required to successfully invade Taiwan—a capability that it likely does not have at the present.

Why Formosa?

The overall objective in the Pacific Theater during World War II was the unconditional surrender of Imperial Japan. Short of a direct assault on the Japanese homeland, the capture and use of Formosa as a forward base would provide the best option to end the war. Aside from the main islands of Japan, Formosa—a territory controlled by Japan since 1895—was its most well-defended and best-developed military stronghold. Formosa guarded Imperial Japan's vital lines of communication to its overseas possessions, controlled the southeastern coast of China, and provided an important fortification for its naval and air bases.[2] It also provided a "protective screen for military shipping routed through the Straits of Formosa," itself a vital sea line of communication for Japan.[3] As it is today, Formosa was a key part of the first island chain and vital to commerce and security in East Asia. Analysts thus expected that Japan would "defend this island to the fullest extent of her capabilities."[4]

Despite this expected resistance, US planners saw the inherent value that Formosa could provide. It would sever lines of communication, help keep the Republic of China in the war, and provide basing and access to bomb the main islands of Japan.[5] No other individual location could accomplish all three objectives as thoroughly as Formosa could alone. Planners initially assessed it was likely worth the perceived cost.

Significant discussion of Formosa serving as an intermediary objective on an advance toward the main islands of Japan emerged in July of 1943.[6] Formosa's prominence in war plans grew so much that the JPS treated its capture as an inevitability: the JPS even began to refer to planned subsequent actions as "operations against Japan subsequent to Formosa." The last known recorded use of this phrase was within a week of the decision to postpone Operation Causeway, demonstrating the centrality of this mindset.[7]

The Initial Plan for Operation Causeway and its Limited Objectives

The initial draft of Operation Causeway emerged by June 1944; subsequent revisions, including an annex on logistics, arrived in August 1944. According to the original version of the war plan, the operation's main objective was to "capture, occupy, defend, and develop southern

Formosa and the port of Amoy [modern-day Xiamen]," allowing US forces to bomb Japan, support further advance into China, sever Japanese sea and air communications, and deprive Japan of resources from Formosa—all of which would subsequently provide "unremitting military pressure against Japan."[8]

Notably, Operation Causeway was concerned with the occupation of southern Formosa only, not the entire island. After an amphibious assault at the southern end of the island, invading forces would establish lodgments on beaches between the Shitmotamsui River and Tairimpo (known today as the Gaoping River and the area to its immediate northwest). Maneuver forces would advance north along the western coastal plain and secure terrain "to the maximum extent permitted by the means available,"[9] but the perimeter of the expected limit of advance would secure only a small southern portion of the island, as displayed in figure 2.1.

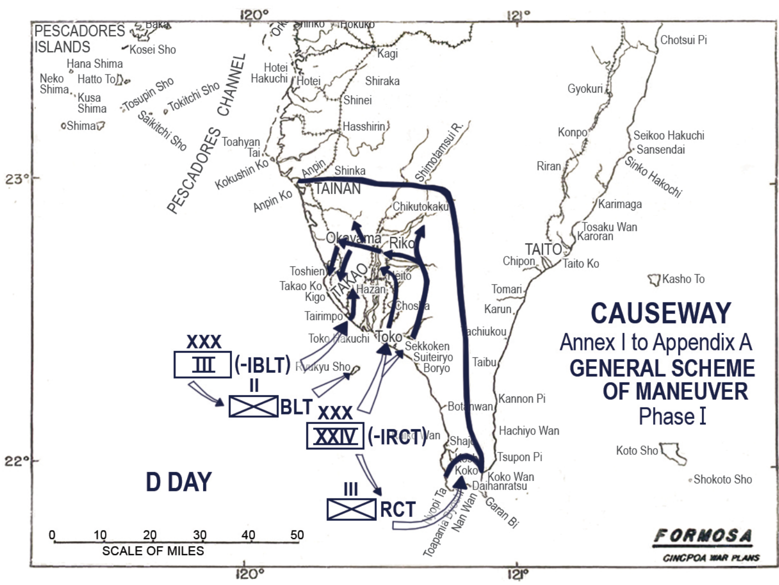

Figure 2.1. Operation Causeway—general scheme of maneuver[10]

The geographic limitations of Operation Causeway's initial plan mark an important distinction from the Chinese Communist Party's (CCP) current desire to unite all Taiwan and its outlying islands with mainland China. An additional distinction is that Operation Causeway also included a plan to seize the port of Amoy on the mainland. These two key distinctions are important: differentiating the forces arrayed against *part* of the island of Formosa from those arrayed against capture of Amoy on the *mainland* provides more clarity and more accurately allows a comparison to the present day. Further discussion contained within will focus primarily on Phase I of Operation Causeway, the portion of the plan that primarily concerns itself with the capture of Formosa, and not Phase II, which concerns itself with capture of Amoy approximately twenty days after the initiation of Phase I. It will also include later discussions on the value and necessity of seizing the entire island of Formosa and the subsequent resources required for that revised end state. By making these distinctions, one can better make a comparison to the pronounced objectives of the PRC today.

According to Phase I of the initial draft of Operation Causeway, the invasion force would consist of two corps, or six total Army and Marine divisions,[11] divided into 304,565 total assault and garrison echelon personnel.[12] Ensuring that just the 163,000 assault forces could land simultaneously would require 92 amphibious assault ships[13]—each with a carrying capacity of approximately 1,000 to 1,500 troops[14]—and 29 attack cargo ships.[15] This force would also require a total of 1,669,050 ship tons of material over the first 30 days, including 326,000 ship tons carried on the initial assault. Supplies carried on the initial assault equated to roughly two ship tons per man, a number that planners derived from analysis of previous amphibious assaults.[16] These forces would potentially contend with approximately 98,000 Japanese forces on the island, 32,000 of which were ground troops.[17] Compared to the 304,565 total US forces dedicated to the Formosa invasion, a standard 3:1 attack-to-defend ratio would have been achieved when taken holistically.

The Required Resources Grow

In early September 1944, Gen George C. Marshall, the Chief of Staff of the United States Army, stated that based on his assessment, the requirement for Operation Causeway's objective had changed from capturing just the southern portion of Formosa to capturing the whole island. As a result, he asked his peers on the JCS and the JPS whether the occupation of all of Formosa was necessary—and if it were necessary, the additional resources required and the impact on the feasibility and timing of an assault to seize Luzon in the Philippines, among several other related matters.[18] By the end of September, the JPS provided answers to many of General Marshall's questions. In their September 23 report, the JPS confirmed earlier suspicions on resource limitations for Operation Causeway. First, sufficient manpower was not available for Operation Causeway until February 1945 at the earliest, and then only if operating on the assumption that a major cessation of hostilities in Europe would allow the redeployment of forces from there to the Pacific by November 1944.[19] Second, intelligence estimates concluded Japan would reinforce Formosa with the equivalent of five to six divisions by March 1945—which was around the earliest timeframe that personnel and resources would be available for execution.[20] Assuming a modified or standard Japanese division consisted of approximately 15,000 to 18,000 personnel,[21] then the number of defenders could increase by anywhere from 75,000 to 108,000, placing total strength somewhere in the range of 173,000 to 206,000, doubling the total number of Japanese forces on the ground.

Based on the estimation that Operation Causeway could not feasibly occur until February 1945 at the earliest, planners recommended that Gen Douglas MacArthur, Commander of the Southwest Pacific Area, execute his operation to liberate the island of Luzon in the Philippines by December 1944. This action, they argued, would keep pressure on Imperial Japan without negatively impacting preparations for Operation Causeway. This recommendation, however, was not that Luzon should be liberated in lieu of Formosa, as the JPS still believed that an occupied Formosa provided significant advantages that an occupied Luzon could not replicate. These advantages—largely consistent with those previously mentioned in the original operational plan for Operation Causeway—included the best option for very-long-range bombers against the Japanese main island, an opportunity to better support US and allied Chinese forces on the mainland, and the best means to sever Japanese sea and air lines of communications.[22]

Though Luzon was not a substitute for Formosa, planners provided their first indication that they had begun to question the inevitability of capturing Formosa. In the same report from September 23, the JPS provided recommended criteria for potentially bypassing Formosa and approaching the main islands of Japan from elsewhere. The criteria weighted most heavily were estimations of required resources by early 1945 and increased defensive strength on the island.[23] Essentially, resourcing became the predominant issue on the final disposition of Operation Causeway.

On September 26, 1944, the Joint Logistics Committee weighed in and further increased the burden that resourcing would play in the debate. The Committee recommended that the US occupy all the island of Formosa—not just the southern portion proposed by the Operation Causeway base plan—primarily to allow the US to generate more future basing capability. If only a portion of the island were seized, Formosa could provide basing to house only eight very long-range bomber groups and no more than three divisions for later assaults on Japan—both of which were deemed inadequate to accomplish subsequent objectives. If, on the other hand, the US were to seize the whole island, mounting capacity would increase to eighteen bomber groups and up to seven divisions.[24]

Alongside its recommendation to occupy all of Formosa, the Joint Logistics Committee Report also referred to previous numbers provided by Rear Adm Forrest P. Sherman—then the Deputy Chief of Staff to the Pacific Fleet Commander, Adm Chester W. Nimitz—that three additional divisions would be required for the complete occupation of Formosa, amounting to an increase of 207,383 required personnel.[25] When added to the original troop requirement in Operation Causeway, the required number of forces to seize Formosa in its entirety would total approximately 511,948. This assessment echoed previous estimates made by Admiral Nimitz and Lieutenant General Buckner—the presumptive commander for Operation Causeway—who placed the required number at approximately 505,000 Army Soldiers and 154,000 Marines.[26] These troop estimates presume the initial estimate of defenders remains the same.

One week after the completion of the Joint Logistics Committee Report, the JCS issued the order to General MacArthur to seize and occupy Luzon, with a target date of December 20. The order also included a message to Admiral Nimitz that directions on operations against Formosa would be issued later.[27] That order, however, never came. Instead, the Battle of Iwo Jima (beginning in February) and the Battle of Okinawa (beginning in April) would serve as the new avenue of approach to Japan. Operation Causeway, once seen as essential to victory in the Pacific, never saw either its D-Day or official cancelation.

Operation Causeway and Chinese Interest in Historical Cases of Amphibious Warfare

Operation Causeway provides important lessons on resource analysis in preparation for a major operation on the very piece of terrain that the CCP seeks to control today. For that reason alone, the People's Liberation Army (PLA) should find the operation highly relevant. To be sure, Chinese authors and strategists have conducted extensive analysis on numerous amphibious invasions from the twentieth century.[28] According to Dr. Lyle Goldstein, their analysis provides less of a focus on the Pacific War and more so on other campaigns—chief among them Operation Overlord, the allied invasion of Normandy.[29] Among Pacific battles Chinese scholars have analyzed, recurring themes of joint operations, shore-based airpower, intelligence, and—most relevant to this case—logistics all stand out.[30] In fact, Chinese strategists' frequent praise of American superiority in logistics as well as existing Chinese doctrine emphasizing the importance of preemptive strikes against an enemy's logistical vulnerabilities may indicate a self-perceived weakness in PLA sustainment functions required for amphibious operations.[31]

Even so, there is scant evidence that the PLA or other related agencies have done any significant analysis on Operation Causeway and its logistical concerns. According to Ian Easton, Chinese professional literature on the topic tends to examine highly successful examples of amphibious assaults and ignores or censors costly or controversial examples due to political acceptability.[32] Operation Causeway is an obscure example of a never-executed amphibious invasion planned for what is today the most politically sensitive issue for the CCP. While these three caveats do not mean that Chinese scholars are not familiar with Operation Causeway, they indicate that a case study on this war plan does not fit the model of what typically draws the attention of the PLA despite its immense applicability and relatable lessons.

Force Ratios and Operational Pause: Predictors for Amphibious Warfare Success

One simple takeaway that the PLA could glean from Operation Causeway is the force-ratio comparisons between US and Japanese forces in 1944 and the PRC and Taiwanese forces today. According to US Army doctrine, defenders historically have had over a 51 percent probability of successfully prevailing against an attacker that is three times as large. Therefore, an attacker should consider a force ratio of at least 3:1 to have a moderate chance at success.[33] Average force sizes across twenty amphibious assaults during World War II confirm this generally accepted axiom of a 3:1 ratio.[34] When comparing this historical average of executed amphibious assaults with the potential courses of action for Operation Causeway, these numbers are rather consistent with a high range of roughly a 5:1 ratio to a low range of a 2.5:1 ratio (see table 2.1).

Table 2.1. Operation Causeway force ratios of various scenarios

Operation Causeway scenarios	*Total assault force*	*Total defense force*	*Force-on-force ratio*
Phase I Initial Estimate—Southern Area Only	304,565	98,000	3.1:1.0
Phase I Refined Estimate—Whole of Island	511,948	98,000	5.2:1.0
Intel Assessment for March 1945 (Low End)	511,948	173,000	3.0:1.0
Intel Assessment for March 1945 (High End)	511,948	206,000	2.5:1.0

Carrying these ratios forward, a 2023 assessment estimated Taiwan has an active component force of approximately 164,000 personnel—including an army of 94,000—and a total reserve force of 1,657,000, including an army reserve of 1,500,000.[35] By comparison, China in 2023 had an active force of 2,035,000, including a ground force of 965,000[36] and an estimated reserve force of 510,000.[37] Operation Causeway would have seen a ratio as high as 5:1. Assuming an effective ground defense from only the active component of the Taiwanese Army (94,000 troops), the PLA would require an assault force between 282,000 and 470,000 to achieve a 3:1 or 5:1 ratio, respectively. If Taiwan could effectively mobilize its reserves on short notice, and if they could effectively fight at full strength, their forces would surpass the numbers for the entire PLA ground force.

Another consideration to ponder would be the effectiveness of these reserves. Accounts vary, but a recent and very thorough wargame estimated their strength as half that of an active-duty unit. This assessment was based on a lack of training, older equipment usage, and the compilation of various sources.[38] In 2022, a leading lawmaker from Taiwan stated that only about 300,000 of this massive Taiwanese reserve force could immediately join the fight.[39] Taking a conservative estimate, an effective fighting reserve strength of 150,000—half of what would be immediately available—augmenting a 94,000 active army force would provide a total fighting strength of 244,000. In keeping with a 3:1 or 5:1 force ratio, this would then require the PLA to invade with anywhere between 732,000 and 1,220,000 troops if it sought a moderate chance of success.

Even when considering the lower end of an estimated size of a Chinese force, one immediately questions the lift capacity required to effectively conduct such an invasion. In short, various scholarly sources conclude that the PRC does not currently have the organic capacity to move the required force, even if augmented by civilian resources. Of note, the PLA has demonstrated the capability to launch small-scale amphibious assaults but lacks the overall numbers to do so at echelon, with only six out of a total of eighty-three combined arms brigades primarily focused on this mission. In fact, the PLA does not even have the organic amphibious lift capacity to move the approximately 30,000 personnel and over 2,400 vehicles belonging to these specially trained six brigades, requiring outside support from civilian vessels to do so.[40] Further, J. Michael Dahm of the China Maritime Studies Institute also assesses that, "at least through 2030, the PLA's reserve civilian merchant fleet is probably unable to provide significant amphibious landing capabilities or the maritime logistics in austere or challenging environments necessary to support a large-scale, cross-strait invasion of Taiwan."[41]

After analyzing force ratios, it is evident that the PLA now lacks the lift and the array of forces to execute an amphibious assault at conventionally accepted force ratios. Therefore, one may begin to doubt the inevitability of the PLA's success; an analysis based solely on reported numbers, however, does not completely provide a picture of success or failure for either side. Force ratios are effective planning tools, but history also shows that they are not the complete or convenient predictors of success for amphibious assaults that strategists would like them to be. A 2002 study conducted by the Center for Naval Analyses (CNA) on the US Marine Corps amphibious warfare concept known as "operational maneuver from the sea" extensively examines historical data from amphibious invasions, beginning in 1941 and ending with Grenada in 1983. One portion of the study examined thirty-one amphibious assaults from this period and concluded that high force ratios alone did not necessarily dictate a higher success rate for the attacker, because they do not take into account "operational pause."[42] Operational pause—a term defined by the CNA study as the period between the assault force's initial landing and significant advancement beyond the beachhead—is impacted by the level of ground resistance from the defender as well as the buildup of supplies ashore.[43]

Historically, an operational pause for most amphibious assaults took, on average, three days.[44] A PLA invasion of Taiwan would see an operational pause much longer than three days, because of its limited amphibious lift capabilities. According to Thomas Shugart, Chinese roll-on, roll-off ferries could more than double sealift tonnage of the PLA (assuming port access on island) but would deliver only approximately 300,000 troops and their vehicles over a period of about ten days.[45] This troop number is estimated at the lower end required for a successful invasion force, as it does not account for resistance or destruction of these civilian landing craft. An operational pause, then, would likely be at least ten days, which is greater than three times the average historical precedent. This longer period would provide greater exposure to fragile PLA sustainment lines of communication, increased casualties, and more time for Taiwan to activate additional reserves or appeal for outside intervention by a third party to come to its defense.

The Importance of Military Decision-Making During Operation Causeway

Operation Causeway offers the PRC lessons in more than just logistics. In particular, the deliberations of the JCS and JPS offer valuable insight into the importance of the decision-making required to reach the best possible military choice. Robert Ross Smith, a longtime historian with the Office of the Chief of Military History, concurred that while "logistical considerations alone" would have been enough to bypass Formosa, Smith erroneously placed too great an emphasis on how politics, particularly those played by General MacArthur, ultimately affected the outcome of the decision.[46] Dr. Benjamin Jensen, in his own article on Operation Causeway, also reiterates the weight of General MacArthur's efforts.[47] Even though several accounts make this assessment based on recollections from General MacArthur—a proponent of liberating the Philippines above all else—this line of reasoning is refuted by numerous original source documents in JCS and JPS meeting notes from the era.

On Oahu in late July 1944, President Roosevelt met with his chief of staff (Adm William D. Leahy), Admiral Nimitz, and General MacArthur to discuss the next phase of the Pacific War. MacArthur believed he had sold the President on his approach over a requirement for Formosa, at least in part because he made an impassioned plea during an election year that the United States had a moral imperative to liberate one of its territories.[48] His recollection contrasts with that of Admiral Leahy: on September 1, 1944, only a few weeks after the meeting, he stated to the JCS that both senior officers (Nimitz and MacArthur) had "expressed willingness to await further developments before a decision was taken."[49]

Unlike General MacArthur, Adm Ernest J. King, Chief of Naval Operations, was easily the biggest proponent for a Formosa approach and remained the last one to defend Operation Causeway before acquiescing to its postponement. Despite his advocacy to the Joint Chiefs, he does not appear to have utilized politics to champion his view, and there is little evidence that others did to the extent that General MacArthur had. Though King based his justifications for the execution of Operation Causeway solely on military merit, he may have later expressed misgivings after the war. Upon conclusion of the Chinese Civil War in 1949, Admiral King regretted that no one countered General MacArthur's political attempts (which were seemingly inconsequential to the ultimate outcome) with similar arguments for the political future of China.[50] Ironically, in 1950, less than six years from his attempt to derail Operation Causeway, General MacArthur would state that "the domination of Formosa by an unfriendly power would be a disaster of the utmost importance to the United States."[51]

The importance of the above debate leads to two conclusions important for further study. First, it demonstrates that General Marshall had full control of the deliberations, and he guided the rest of the Joint Chiefs to a decision based on sound military advice. Second, the discussion over Operation Causeway was deliberative among very experienced senior personnel who looked at the problem set through an extremely detailed and objective lens. Notes from the Joint Chiefs of Staff meetings give the impression that General Marshall was encouraging this discussion over Operation Causeway. During these discussions, members of the JPS asked several times for an immediate decision on whether to execute Operation Causeway or pursue another option. Despite these frequent requests, Marshall appeared quite comfortable in exercising strategic patience to ensure that the Joint Chiefs would arrive at the right decision based on objective information. In one exchange, Marshall stated that he was not yet ready to decide because "he was considering the operations in the Pacific and the operations in the European Theater as a whole. He felt it unwise to be committed until the entire picture became clearer."[52]

When considering the focus that the JPS provided to Operation Causeway—as well as the general sense of inevitability it seemed to have gained at the highest levels—the dialogue leading to its postponement provides a remarkable example of leaders altering a plan they once saw as essential. It also shows how these leaders understood the critical issue behind the decision as a question of time versus resources. During debates, Admiral King felt that Formosa might be a greater cost up front than other options such as Luzon but that it would cost less in blood and treasure over the long run. Although Leahy favored Luzon by this stage, he nevertheless agreed that this question—namely the cost in the long run—was the most important factor to consider.[53]

It is unlikely that an objective debate like the example above would happen at the highest levels of the PLA or CCP today. A sense of political justification and visceral need, like that provided by MacArthur in his argument for Luzon over Formosa or the sense of inevitability that members of the JPS felt at one point over a Formosa approach, would almost certainly influence any decision for the PLA to launch an invasion for Taiwan today. Not only does the PRC desire to rule Taiwan, but it also sees this fact as essential for the realization of China's complete rejuvenation.[54]

The deliberative nature of the American military decision-making process regarding Operation Causeway could serve as a reminder to the CCP to look at any potential plans for invading Taiwan more objectively, like its leaders have done in the past. Mao Zedong was willing to exercise patience toward Taiwan after it was clear that the Americans were willing to defend it. Later, Deng Xiaoping, when referring to Taiwan, remarked that "reunification of the motherland is the aspiration of the whole nation. If it cannot be accomplished in 100 years, it will be in 1,000 years."[55] Under the rule of Xi Jinping, however, the CCP has adopted a faster, more demanding timeline.

Xi believes that the "national security imperatives of 'complete security' are more important than any foreign policy or wider reputational cost to the regime."[56] Examples such as Tiananmen Square and, in even more recent memory, Hong Kong in 2019 show that the international community did very little, presumably based on their self-perceived dependence on the Chinese economy. Xi may see an invasion of Taiwan similarly.[57] Taken together—and with the assumption that Xi is a rational actor—it is in the realm of possibility that he would decide to proceed with a forced unification of Taiwan, despite the inherent military difficulties. It would have been difficult under any period of CCP rule for the PLA to have the same level of discussion that the Joint Staff had over Operation Causeway in 1944, but today it nears the level of impossibility. China runs the risk of making a grave miscalculation to begin a war it has little chance of winning unscathed. It may assume that, as in the past, the international community will express outrage at its actions but in practice do very little to assist Taiwan militarily for fear of repercussions or escalation. Following this logic, the weight of deterrence must therefore come principally from Taiwan itself: it must show the CCP that it can increase the cost on the PLA well beyond a perceived level of acceptance.

What Can Taiwan Do?

The fact that China may not look at an invasion of Taiwan objectively should serve as a significant warning to Taipei. Fortunately, lessons from Operation Causeway and, more generally, other examples of amphibious assaults can better help prepare Taiwan for a potential PLA invasion. Taiwan must send a strong-enough deterrence signal to make the CCP question its sense of destiny. Further, Taiwan must be willing to fight the "long and costly fight," adopt a modified mobile defense, and target the logistical system of the PLA, a likely candidate for its operational Center of Gravity (COG).

According to Adm Lee Hsi-min, retired, former Chief of the General Staff of Taiwan's Armed Forces, Taiwan's Overall Defense Concept has four major components to its concept of operations. The first is force protection to ensure survivability in an initial PLA air or missile attack. The second is the littoral battle as landing craft approach the shoreline. The third is the beachhead battle. Finally, the fourth phase is homeland defense.[58] Although this overall plan provides good depth, one area it overlooks is the transition between the beachhead battle and homeland defense. This transition would align with earlier discussion on the operational pause—an area previously shown as a critical vulnerability for the PLA due to its lack of adequate amphibious lift. This unloading and landing stage would prove the most difficult portion of the operation for the PLA. Current inefficiencies would prolong this period, increasing casualties. Further, the PLA itself assesses that this first echelon and the majority of the second would need to land and unload supplies without ports, proving even more difficult.[59]

This critical juncture could provide the Taiwanese a greater opportunity to destroy an invading PLA force over destruction in the littoral environment or on the beachhead. The Second Nagorno-Karabakh War in 2020 provides an example of how a defending Taiwanese force could best take advantage of the situation:

> The PLA, like the Armenians, would be fixed in place while desperately bringing up enough logistical capability to go on the offensive—which would then be on predictable lines of advance to Taipei. This would actually be a worse scenario than having the initial invasion armada destroyed at sea, because a partial but inadequate landing force would not be able to easily retreat, would continue to be a massive resource sink for the PLA, and would essentially be a marooned hostage if the US Air Force and Navy destroyed resupply capability.[60]

Such a plan does not have to be an either-or situation; Taiwan should have an extremely robust plan to destroy an invading Chinese force in the littorals and on the beachhead, but it should also have an equal, if not greater, plan for destroying them during their critical transition phase. In other words, the current four-part Overall Defense Concept should change to a five-part plan (see figure 2.2).

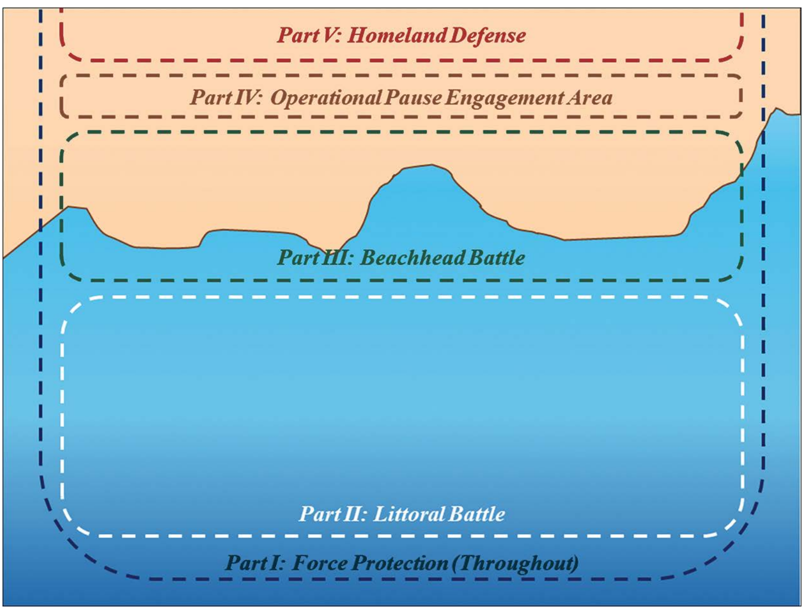

Figure 2.2. Proposed Five-Part Defense Concept with addition of operational pause engagement area

The CNA study also examined the defensive doctrines of invaded forces, dividing each into four categories: forward defense, mobile defense, in-depth defense, and guerrilla warfare/insurgency. The analysis found that of the four, a forward or mobile defense far outperformed an in-depth or counterinsurgency-style defense when measuring the length of operational pause.[61] Of the two successful defensive tactics that have historically prolonged operational pause (forward defense or mobile defense), Taiwan should consider the mobile defense. A mobile defense focuses on defeating an attacking enemy force by conducting a decisive counterattack at an exposed point.[62] The location near the beachhead is a natural decisive point for such an attack to occur. Since the exact beach or beaches that PLA forces would invade would be unknown, this approach gives Taiwan's defenders more flexibility with their combat power. Additionally, a mobile defense may be more survivable to preassault fires that would inevitably target fixed forces already located at assessed landing sites.

Taiwan would also be wise to consider the Chinese sustainment function as its operational COG during an amphibious invasion. The lessons from Operation Causeway demonstrate that required resourcing was the biggest limitation to the war plan for Formosa. Historical analysis of numerous amphibious assaults has also shown that operational pauses are decisive points in these kinds of operations. If these two statements are true, then an invading force would draw its source of power and freedom of action from its logistics. Additionally, the logistics system in an amphibious scenario over Taiwan also expresses many other characteristics of an operational COG, such as its dependence on factors of space and time, its mostly physical nature, its ability to allow freedom of action, and the location of where the enemy's force will be most densely concentrated (in the operational pause).[63]

The sustainment function of the Chinese military is also a self-assessed weakness in large-scale combat operations. As previously discussed, its lack of organic amphibious lift capacity is inadequate to meet force requirements. Augmentation from civilian roll-on, roll-off ferries may increase this capacity, but they are extremely vulnerable. Taiwan can also exploit sea lines of communication through mining and surface-to-ship munitions. Additionally, it can damage key pieces of infrastructure, such as ports and airfields, if the PLA is successful with an advance beyond the beachhead. Interestingly, US planners expected the Japanese to use the same technique in an invasion of Formosa, estimating that it could take ninety days or more after the initial landing to utilize an actual harbor, as opposed to unloading supplies over a beach, if key infrastructure were destroyed.[64] It may at first seem counterintuitive to primarily refocus Taiwan's military from the destruction of lethal systems in favor of logistical assets and functions, but Taiwan cannot match the PLA toe-to-toe. Therefore, despite the clear sense of inevitability that the CCP holds regarding Taiwan, the Taiwanese military could potentially deter the PRC from even launching an invasion by demonstrating the will and capability to target the PRC's already suspect logistical system.

Conclusion

Much like the American military in 1944, the PLA of today is not positioned for success in its capture of Taiwan. The logistical capacity required for a high probability of success simply does not exist within the PLA. Although Chinese scholars have extensively studied historical examples of amphibious assaults and have even recognized the importance of sustainment in these endeavors, it is not clear that they genuinely appreciate the concept of operational pause. Their logistics system is rife with vulnerabilities and inadequacies that they currently attempt to address by less-than-adequate civilian substitutions. Operation Causeway helps show the CCP that an invasion of Taiwan remains infeasible, or at least too costly, for their political aims.

Despite these shortfalls, the CCP seems more determined than ever to forcibly unify Taiwan with the mainland. Even if Chinese scholars have paid cursory attention to US plans to invade Formosa during the Pacific War,[65] it is very unlikely that they have focused any attention on the deliberations and the decision-making process that permitted senior leaders to make the right judgment call to not invade Formosa in 1944 or 1945. China, for all its strengths and scholarly efforts, has not demonstrated the same understanding or given the required value to deliberative military decision-making. Instead, it potentially shows a bias toward confirming already-held beliefs.[66] Therefore, it runs the risk of a miscalculation by not fully appreciating the challenges that the Joint Chiefs saw in Operation Causeway. In 1944, sound military judgment prevented an invasion of Taiwan. If taken objectively, sound military judgment may lead to the same conclusion for the near future. Will the CCP reason emotionally, like McArthur, or objectively, like the Joint Staff?

Taipei cannot assume that the PLA will not invade Taiwan just because it is counter to sound military judgment. One can hope that the CCP will learn from the deliberations surrounding Operation Causeway, but in its current political environment, this seems unlikely. What is clear is that China's path to victory relies on its logistical capability, while Taiwan's relies on its ability to target this critical function. For Taiwan, there is not just one weapon system, targeting focus, or doctrinal approach that will win the war; rather, it will require a multitude of factors, some of which are more obscure and marginal. These factors require redundancy, more guesswork, and a less predictable outcome for China. Much to the chagrin of the PRC, any fight over Taiwan today has the same potential to be "a long and costly fight," as an improperly resourced Operation Causeway would have been for US forces.

Taiwan must be willing to accept this fact. The defense of its freedoms may come with significant sacrifice, but its efforts have a high likelihood of success if it can identify and enact lessons from the past that the PRC chooses to ignore.

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Chapter 3

Fortress Taiwan

Mapping Defense Strategies Through War Gaming

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Abstract

This chapter investigates Taiwan's potential resilience against a full-scale Chinese invasion through war-gaming simulations. Nine iterations of the Assassin's Mace war game were played based on a 2026 to 2027 timeframe. Scenarios included comparisons between US levels of intervention and multiple iterations whereby Taiwan stands alone. The primary objective was to assess the effectiveness of various defense enhancements for Taiwan's military and identify strategic opportunities to maximize resistance. Adjustments to Taiwan's navy, air force, and joint force were tested to determine ways to increase deterrence absent US intervention. Results demonstrated that strategically planned enhancements to Taiwan's military, specifically those focusing on asymmetric tactics and active defense strategies, can significantly bolster Taiwan's resistance against a Chinese invasion.

Chinese Language Abstract

本文通過兵棋推演探討臺灣在中國全面入侵下的潛在抵抗能力。在2026至2027年的時間架構下進行九次兵棋推演。場景設定包含臺灣單獨面對中國入侵和比較美國在不同干預程度下的結果。主要目的是評估各種對臺灣軍方的防禦強化措施的有效性，以及發掘能夠最大化臺灣抵抗中國入侵能力的戰略機會。透過單獨調整臺灣的飛彈部隊、海軍、空軍或直接調整三軍聯合部隊，探討在美國沒有干預的情況下臺灣如何增加對中國的嚇阻能力。結果顯示，通過從戰略層級上強化臺灣軍隊能力，特別是集中於不對稱戰術和主動防禦策略可以顯著提高臺灣抵抗中國入侵的能力。

Introduction

According to the *2022 National Security Strategy*, the People's Republic of China (PRC) presents the "most consequential geopolitical challenge" to American national interests.[1] While this challenge will be faced on multiple fronts, a conflict over Taiwan is widely regarded as the most dangerous flashpoint between the US and the PRC.[2] Although the conflict between the two nations is not preordained, rising tensions and a decaying deterrence regime in the Taiwan Strait have worsened the situation. Consequently, conflict in the Taiwan Strait is a real possibility, viewed by some as likely.[3] Preventing the catastrophic consequences that an armed conflict in the Taiwan Strait would bring is critical not only to US and Taiwanese interests but also those in the Asia-Pacific more broadly.[4] Doing so, however, requires renewed efforts to strengthen deterrence by identifying specific ways and means by which Taiwan can raise the potential costs of aggression and deny the likelihood of a quick PRC victory.

Supporting this endeavor, this chapter presents results from nine iterations of the Assassin's Mace war game played to a hypothetical PRC invasion of Taiwan within the 2026 to 2027 timeframe. Because successful deterrence depends on how a potential aggressor weighs the likely costs and benefits of pursuing aggressive actions, assessing how a conflict over Taiwan may unfold provides a crucial starting point for identifying ways to strengthen deterrence.

Results from the war gaming demonstrate the viability of increased self-reliance in an invasion scenario and challenge the notion of a quick PRC victory. Taiwan already possesses a certain degree of geographic advantage, as there are only a small number of beaches suitable for amphibious landing. The proposed enhancements to the Taiwan Armed Forces, which entail a myriad of agile and resilient asymmetric warfighting systems and long-range fires, prove crucial to further enhance Taiwan's survivability and resilience against a potential Chinese invasion. In addition to identifying specific ways in which Taiwan can bolster its own deterrent effects, this chapter also consolidates the main ideas and insights from currently available war-game models and assessments, including a brief summary of past analyses. Taken together, the goal is to offer readers a source of unclassified analysis of likely military operational outcomes in the event of the PRC invasion of Taiwan and near-term, actionable recommendations for Taiwan to enhance its deterrence against a comprehensive Chinese invasion.

Context

Maintaining peace and stability across the Taiwan Strait is paramount. The Chinese Communist Party (CCP) has recently engaged in several military incursions into Taiwan's airspace and marine zones, raising tensions to a level last seen in the 1950s.[5] If these tensions were to intensify and lead to a military confrontation, the United States may become involved in a war with the PRC, causing significant economic, political, and physical destruction in the region and beyond.[6]

While the PRC continues to view Taiwanese unification as the "core of its core interests" and the "first red line" that must not be crossed in US-PRC relations,[7] Washington has responded to coercive Chinese activities in the Taiwan Strait by adopting an increasingly supportive stance toward Taipei. Not only has the tempo of high-level US visits to Taiwan increased, but in the Biden administration, the US rhetorical commitment was also expanded.[8] The PRC views these actions, including Congress's consideration of the Taiwan Policy Act's designation of Taiwan as a "major non-NATO ally," as a serious erosion of US support of the One China policy.[9] Consequently, observant Chinese citizens, including a well-connected, influential Chinese commentator known by his pseudonym "Chairman Rabbit 兔主席," now refer to the Taiwan Strait issue as a "gray rhino event": a high-probability, high-consequence event that analysts continue to disregard despite its apparent proximity, highlighting the very real risk of conflict.[10]

Beyond the deteriorating political and public perceptions of a conflict, deterrence in the Taiwan Strait has diminished because of a variety of factors. Dwindling CCP legitimacy; silicon decoupling between China, the US, and Taiwan; and changes in the military balance of power have all widened the deterrence gap in the Taiwan Strait.[11] Perhaps most importantly, the PRC's multidecade military modernization efforts have not only grown the capability gap vis-à-vis Taiwan's military but also circumvented many of Taiwan's ways of militarily deterring China. Such actions require commensurate actions and reactions from Taipei, but so far decay has been the principal pattern over the past two years. Whereas the PRC's coercive behavior and the pattern of wider and deeper strategic interactions between the US and Taiwan may result in inadvertent escalation, the most direct and effective form of deterrence for Taiwan remains reducing the PRC's perception of a relatively "easy" invasion of Taiwan due to an imbalance of military power between the PRC and Taiwan.

The Current Balance of Force

The PRC holds a significant advantage in both personnel and materiel relative to Taiwan. According to the *US Department of Defense's 2023 Report on Military and Security Developments Involving the People's Republic of China*, the PRC could easily deploy its total ground force of 420,000 personnel from both Eastern Theater Command and Southern Theater Command for military operations against Taiwan. This level of personnel projection is compared with Taiwan's 89,000 total ground force personnel.[12] On paper, Taiwan could also muster as many as 1.6 million reservists. However, most reservists are not combat-ready, with the perceived number of reservists presenting little deterrent effect to the PRC.[13] Furthermore, if required, the PRC could mobilize its remaining 600,000 ground force personnel from other theater commands for an all-out war against Taiwan to ensure military victory.[14]

The PRC also holds a distinct advantage in military armaments relative to Taiwan. The PRC has a total of 7,250 tanks versus 800 for Taiwan and 9,550 total artillery pieces compared with Taiwan's 1,300.[15] These ratios average more than 3:1, the traditional formula for succeeding in an offensive operation.[16] Furthermore the PRC has a clear naval superiority. The PRC has the largest navy in the world numerically, with an overall battle force of over 370 ships and submarines, including more than 140 major surface combatants.[17] In addition, the PLA's aircraft quantity advantage is overwhelming. The PLA has a total of 2,650 combat aircraft as compared to a mere total of 320 for Taiwan (including fighters, bombers/attack, and special-mission aircraft).[18] Taken together, the PRC has an overwhelming numerical advantage in terms of its conventional military capabilities vis-à-vis Taiwan.

Most Dangerous COA by the PRC: Amphibious Invasion of Taiwan

PRC writings describe multiple operational concepts for Chinese leaders to credibly deter Taiwan's independence or compel unification through force or both. The three primary campaign options include: (1) a Joint Firepower Strike Campaign (JFSC), intended to punish Taiwan or support a blockade or invasion; (2) a Joint Blockade Campaign, intended to coerce Taipei or lay the ground for an invasion; and (3) a Joint Island Landing Campaign (JILC), intended to seize the entire island.[19]

The most prominent and dangerous PLA COA is the JILC. Under the JILC, the PRC's objectives are to break through or circumvent Taiwan's shore defenses, establish a beachhead, build up combat power along Taiwan's western coastline, and seize critical targets or the entire island. This would be a complex operation relying on coordinated, interlocking, electronic warfare, logistics, air, and naval support campaigns.[20] Moreover, it would include a large-scale amphibious invasion. In addition to straining PLA resources and provoking a robust international response, the JILC would require PLA air and maritime superiority and the rapid buildup and sustainment of supplies onshore. These factors, combined with the inevitable and significant force attrition resulting from the complexity of urban warfare, have likely led PLA decision-makers to recognize the necessity of speed for such a campaign to succeed, including the need to limit response mobilization from the US and its allies by planning for a rapid offensive operation aimed at creating a fait accompli.[21]

In sum, an amphibious invasion of Taiwan would incur significant political and military risk for President Xi and the CCP. Nonetheless, if the CCP makes the decision to pursue "forceful unification," it will likely resort to the JILC to secure the quick capitulation of Taiwan's political and military leadership and create favorable reunification conditions for Beijing. For this reason, the Air University Taiwan Deterrence Warfighting Advantage Research team (TDWAR) focused on the JILC as the most-dangerous COA in its war gaming.

Mapping Strategies Through War Gaming

For centuries, military strategists have used war games for training, tactics analysis, and mission preparation. Modern war games were ushered in by the Prussian Army officer Herr Georg von Reisswitz.[22] In 1811, Reisswitz invented an innovative war game, *Kriegspiel*.[23] Prussian officers were organized into opposing teams to simulate a particular conflict with actual terrain, with actions determined according to a predefined set of rules. To determine casualties, umpires consulted complex tables indicating likely attrition based on range, terrain, and other factors with exact attrition rates determined by a die roll to depict the uncertainties of the battlefield.

War gaming played a central role in US doctrine development during the twentieth century. For instance, in the lead-up to WWII, Naval

War College war games showed the importance of forward bases in any war with Japan. However, amphibious assaults proved problematic. The Marines decided to solve this wicked problem via war gaming and used the results to develop their doctrine of amphibious operations.[24] Without the work done by the USMC during the 1930s, D-Day and victory in Europe would have been much more challenging.

The importance of war gaming continues today. The *Joint Dictionary of Military Terms* defines a war game as "a simulation, by whatever means, of a military operation involving two or more opposing forces, using rules, data, and procedures designed to depict an actual or assumed real-life situation."[25] This broad definition reflects the diverse characteristics of war games and results in significant variations in their appearance. For instance, actors can be characterized by comprehensive role descriptions or the players' imagination; environments can be depicted through explicit cartographic representations or concise written descriptions; rules might be enforced by strict mechanisms or straightforward reminders of established capabilities and authorities; and models can encompass elaborate computer simulations or the implicit conceptual frameworks of specialists, such as those used in board games. As such, war gaming provides a systematic approach for military practitioners to comprehensively evaluate a military strategy but leaves the art and science of game design as involving the careful selection of a mix of elements to effectively serve the game's objective.

War Gaming a Taiwan Scenario

Leveraging best practices and historical lessons, the US DOD has conducted a robust set of internal war gaming addressing a potential US-PRC conflict. The results, however, are classified with only a few details emerging publicly. These details typically hint at heavy casualties and unfavorable outcomes.[26] Although classification restrictions are understandable, as they are intended to prevent sensitive data from leaking to potential adversaries, restrictions on information regarding US DOD war games make it difficult for outsiders to provide critical analyses and alternative views of the outcomes and assumptions of these games, thereby limiting the generation of novel solutions.

The Center for Strategic and International Studies (CSIS) report *The First Battle of the Next War: Wargaming a Chinese Invasion of Taiwan* broke from this pattern and developed a meticulously crafted war-game scenario that envisioned a Chinese amphibious assault on

Taiwan in 2026. Not only did the CSIS report provide details into the mechanics of gameplay, including die rolls, combat outcomes, and computer-generated assessments, but it also gained significant attention across media, academic circles, and even in the PRC.[27] Anchored in historical data and operations research, including drawing parallels from significant military campaigns such as Normandy, Okinawa, and the Falklands, the CSIS war-gaming report scrutinized potential outcomes of a potential PRC invasion of Taiwan with rigorous predefined rules and proven capabilities to gauge the PLA's amphibious capacity.[28]

Results from the CSIS report found that the PRC would be unlikely to succeed in an invasion of Taiwan if the Taiwanese were willing to fight and the US went "all in" with support.[29] As depicted in figure 3.1, when Taiwan stood alone, a "Chinese victory" occurred. The CSIS report also highlighted that most of Taiwan's infrastructure was expected to be destroyed, and that the US and its allies (e.g., Japan) would face significant losses, damaging their global position for many years. These conclusions succeeded in spurring debate over the US's readiness and capabilities, such as the need for the prioritization of sustainment of the bomber fleet over fighters and the procurement of smaller and more survivable ships, submarines, and stockpiles of standoff antiship weapons.

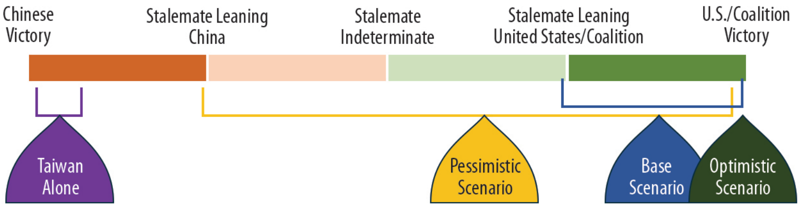

Figure 3.1. CSIS war-gaming operational results (Source: reprinted from CSIS)

While helping inform strategists and policy makers of the costs and limitations of deterring a PRC invasion of Taiwan, the CSIS report leaves open opportunities for further analysis. Most notably, the CSIS report focused primarily on scenarios with US intervention, with only one iteration of a "Taiwan Alone" scenario played out. The CSIS report analyzed the progress and outcome of US-PRC combat operations rather than the question of Taiwanese resistance.[30] Consequently, the CSIS report refrained from diving deeper into how Taiwan can mitigate risk to its force and mission at the operational level without US intervention.

While an assumption of US support is not unreasonable, there remains no guarantee that the US would intervene in the event of a PRC invasion of Taiwan. Indeed, Washington has traditionally adopted the policy of strategic ambiguity, leaving the US security assurance to defend Taiwan open to interpretation.[31] Within this context, some even doubt whether the US will intervene or if doing so is in the US's national interest, especially given the costs shown by the CSIS war-game report.[32] As the literature on deterrence demonstrates, extended deterrence is difficult not only because of operational issues but also because potential aggressors often convince themselves that the distant defender lacks the will to respond.[33] Hence, as the US's commitment to intervene and defend Taiwan against a Chinese invasion remains undetermined, it is paramount for Taiwan to continue to invest in capabilities that will enable it to deter and deny a Chinese invasion with or without US intervention.

TDWAR War-Gaming Approach and Method

Whereas current war-gaming reports approach the potential invasion from the perspective of the US as the main actor, this study explored scenarios in which Taiwan would play the prominent role in deterring and denying a potential Chinese invasion. In this regard, the objective of the "Fortress Taiwan" study was to identify near-term recommendations for the Taiwan military that would increase the deterrence factor and enable Taiwan to shift the needle further to the "right" (see figure 3.2).

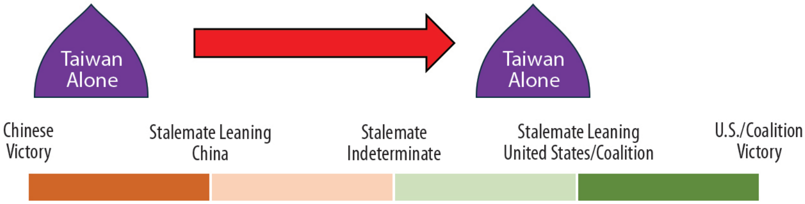

Figure 3.2. TDWAR's desired outcome: Shifting "Taiwan Alone" to stalemate leaning toward Taiwan

There are significant advantages to having US allies and partners lead the efforts against a potential adversarial attack or invasion. First, shifting the perspective to allies or partners as the main actors in countering potential threats encourages these nations to genuinely prioritize and address the issues related to potential invasions. Such a shift in perspective enhances regional security and fosters a collaborative approach to addressing shared concerns, resulting in a strengthened defense posture. Second, entrusting allies or partners with the primary responsibility for countering potential threats prompts careful consideration of strategic decisions within the constraints of limited defense budgets. This, in turn, encourages efficient resource allocation and innovative solutions as nations strive to maximize the impact of their contributions.

Third, reducing the US burden for defending Taiwan serves both US national interests and promotes a more realistic deterrence posture. Examining ways for Taiwan to lead in its defense would not only reduce financial demands on the US but also decrease the risk exposure to casualties of US military personnel. Moreover, empowering allies to take the lead in a conflict would promote collaborative defense strategies that could soften perceptions of an overly imperial posture concerning American foreign policy, thereby contributing to greater stability and cooperation among allied nations. This may also strengthen US deterrence by incentivizing the allocation of resources by the nation on the line of conflict, as opposed to the US thousands of miles away.

For these reasons, this study focused on identifying ways to reduce the deterrence gap in the Taiwan Strait through the following research questions:

- Can Taiwan deny an amphibious invasion if the US refrains from direct intervention?
- If more than two-thirds of the PLA's amphibious capabilities are lost, can the PRC still succeed?
- What are possible military enhancements to Taiwan that will allow it to reduce the deterrence gap and deny a Chinese invasion even without US intervention?

Game Dynamics

The TDWAR team utilized the *Assassin's Mace* and *Taiwan* modules within the Operational Wargame System (OWS), which focuses on the Indo-Pacific and covers a hypothetical conflict in the Western Pacific versus China in the 2025 to 2027 timeframe. OWS is a tabletop, hex-and-counter game that allows players to simulate combat between 2025 and 2050.[34] The game focuses on the operational level of warfare and ties in the effects of military capabilities across all domains, with OWS adjudication based on transparent quantitative models.

Each turn of the OWS game represents a twenty-four-hour day. The opposing sides alternate, taking actions through the sequence of play. The TDWAR team utilized two sets of game maps: the operational map with a hex scale of 200 nm per hex and the tactical map with a hex scale of 50 nm per hex. To add a degree of human judgment to the interaction of these quantitative models, the TDWAR team also incorporated players' decision-making, allowing for plausible sequences of events to be explored. In this regard, players were required to plan their turn, usually by an informal huddle. This gathering, although informal, simulated and captured some aspects of adversarial planning and cognition. The players moved their units simultaneously once the huddle was completed and decisions were made. After these steps, combat was adjudicated with air combat first, followed by naval and ground combat.

Assumptions

The military capabilities of the PLA and Taiwan Armed Forces were based on publicly available information, with the order of battle for both sides as a foundational element. All war-game scenarios were based on the anticipated order of battle in the 2025 timeframe. Within this timeframe, Taiwan is assumed to have 100 out of 400 projected ground-launched AGM-84 Harpoon missiles from the US before the invasion.[35] Additional assumptions of the war game are listed below.

- The PRC would conduct a JFSC on the first day of its military campaign and take the initiative to launch an invasion.
- The PLA Eastern and Southern Theater Commands and the People's Liberation Army Rocket Force (PLARF) units would conduct long-range strikes on Taiwan's air bases, communication networks (e.g., radar and air operations centers), and other key targets such as Integrated Air Defense Systems (IADS).[36]
- The PLA Eastern Theater Command and 50 percent of the Southern Theater Command assets were used in all scenarios that did not include US intervention.
- The PRC would only employ the full Southern Theater Command if the US intervened. The PRC would refrain from using nuclear weapons and conventional intercontinental ballistic missiles (ICBM) (which are preserved as a deterrent to a US intervention).
- Taiwanese citizens have the will to fight against the Chinese invasion.

- Once the PRC decided to invade, there would be no diplomatic resolution.

Scenario Design and Variables

To determine Taiwan's capabilities to deny an amphibious invasion by the PRC without direct US intervention, two primary sets of scenarios were played out: Taiwan Stands Alone and US Intervention. The purpose of the first scenario, Taiwan Stands Alone, was to determine the effect of modifications to Taiwan's force structure and PRC success or failure. In this scenario, variables tested included: (1) the PRC's risk tolerance level and its associated Indications and Warnings (I&W) from Taiwan's perspective; and (2) the effect of potential changes to Taiwan's armed forces determined by the TDWAR team based on Taiwan's defense budget for the next five to six years.[37]

PRC risk tolerance was operationalized in three ways: the PRC's willingness to accept human casualties, loss of high-value assets (HVA), and total asset loss. Baseline assessments assumed low to medium levels of PRC risk tolerance over thirty days of I&W. Further variations of the scenario were played out at high levels of acceptable risk and an element of surprise at fewer than seven days of I&W and high acceptable levels of risk with at least thirty days of I&W.

For measures of I&W, the team relied on research from Taiwanese military scholars. Baseline indicators included large-scale exercises by the PLA along the southeastern coast, missile deployments that put Taiwan within striking range, significant air asset deployments, and long-range air defense missile deployments to the east, as well as evacuations of nationals from various countries.[38] To determine the effect of potential changes to Taiwan's armed forces, the TDWAR team played out games including changes to Taiwan's rocket force, navy, air force, and joint forces. In total, seven iterations of the "Taiwan Stands Alone" scenario were played out.

The purpose of the second scenario, US Intervention, was to determine how the US could avoid a pyrrhic victory (e.g., avoiding massive number of casualties) should it decide to intervene militarily to defend Taiwan against the Chinese invasion. In this scenario, the team tested two variables: (1) minimal kinetic support from the US and (2) full kinetic support. The ongoing US support for Ukraine has shown that it is palatable for the US to provide nonkinetic support to Taiwan in the form of intelligence, surveillance, and reconnaissance (ISR) and sustainment support, enabling Taiwan to deny the PRC from achieving a fait accompli. To this end, both iterations of the "US Intervention" scenario were played out to determine the causal effect of different levels of US intervention.

Table 3.1. Variables across the war game iterations

Scenario	*Variable*	*Specific variables*	*Research questions*
Taiwan Stands Alone	PRC's risk tolerance level and its associated I&W	PRC has a moderate acceptable level of risk with at least 30 days of I&W	If more than two-thirds of the PLA's amphibious capabilities are lost, can the PRC still succeed? What are possible military enhancements to Taiwan that will allow it to reduce the deterrence gap and deny the Chinese invasion even without US intervention?
		PRC has a high acceptable risk level and an element of surprise (less than 7 days of I&W)	
		PRC has a high acceptable level of risk with at least 30 days of I&W	
	Type of reconfiguration to Taiwan Armed Forces	Missile Command[39] Navy Air Force Joint Force	
US Intervention	Level of US support	Minimal kinetic support from the US	If the US refrains from direct intervention, can Taiwan deny an amphibious invasion? If more than two-thirds of the PLA's amphibious capabilities are lost, can the PRC still succeed?
		Full kinetic support from the US	

Chinese Victory Conditions

Victory conditions used for the war games included what side possessed numerical advantages on the island at the end of the game as well as the PLA's ability to secure at least one major sea- or airport.[40] The first condition follows the victory conditions in the CSIS report. The second condition was set on the basis of further analyses of the critical objectives the PLA would need to achieve if an invasion occurred. In both cases, a PRC victory depends on amassing large numbers of soldiers on Taiwan. Ian Easton, for instance, estimated that the PRC would likely need to deploy a minimum of 570,000 ground force personnel to Taiwan to ensure a three-to-one advantage over Taiwan's ground force troop strength of 190,000.[41]

The second condition added further specificity to the challenges associated with an amphibious landing. Amphibious landings are widely known for their difficulty and complexity; they also constitute a central aspect of the PLA's strategy in a Taiwan invasion scenario. Therefore, halting or reducing landing craft capacity is a critical center of gravity for thwarting a Taiwan invasion. In this regard, a maritime subcondition of victory was included; achievement of the estimated 570,000 PLA troops necessary for an invasion requires the PLA to have greater than 33 percent of total landing ships available and a secured seaport (see table 3.2 for the overview of PRC's landing ship and civilian roll on/roll off [RO-RO] ferry capacity).[42]

Table 3.2. Landing ship and civilian RO-RO ferry capacity[43]

Type	*Quantity*[44]	*Capacity*
Type-075 LHA	3	1,200 troops, ~50–60 ZTD-05s, 30 helicopters, 3 Type-726 LCACs
Type-071 LPD	8	730 troops, 24 ZTD-05s, 2–4 helicopters, 4 Type-726 LCACs
Type-072 LST	7	260 troops, 10 ZTD-05s
Type-072A LST	15	250 troops, 10 ZTD-05s
Type-072II LST	9	200 troops, 10–11 ZTD-05s
Type-073A LSM	10	180 troops, 8–10 ZTD-05s
Type-073-III LSM	1	500 troops, 5 ZTD-05s
Type-074 LSM	3	250 troops or 2–3 ZTD-05s
RO-RO ferry	31[45]	1,000 troops, 150 vehicles (only in conjunction with a port)
Total	87	50,860 troops

Key: LCAC: landing craft air cushion; LHA: landing helicopter assault; LPD: landing platform dock; LSM: landing ship medium; LST: landing ship tank. Note: ZTD-05 amphibious assault vehicle is used as a reference due to its large and common assignment to both PLA Navy Marine Corps and PLA Army Amphibious units. For the war game, the quantity of landing craft is not accounted for, as these landing craft are usually deployed together with or onboard the larger landing ships such as LHAs or LPDs.

War Gaming Results

War games simulating a conflict between Taiwan and the PRC identified key challenges for both sides. Taiwan's strategy of dispersing forces to undermine the initial attack effectively bought time but resulted in accumulating losses. The PRC's amphibious invasion plans face inherent difficulties due to the distance across the Taiwan Strait, limited surprise options, and well-defended Taiwanese beaches.

The war games explored how Taiwan could improve its defenses. Bolstering its rocket forces, navy, and air force all showed promise. A combined approach that strengthened all three areas appeared most effective. US intervention scenarios offered mixed results. Full US military intervention could significantly hinder a Chinese invasion but provoked a harsh response. Limited US support could help Taiwan disrupt the invasion through intelligence gathering and nonkinetic warfare.

Overall, the war games highlight the significant challenges the PRC would face in attempting to invade Taiwan. They also emphasize the importance of Taiwan's ability to enhance its defenses and leverage its geographical position to maximum advantage.

Common Themes Across Scenarios

Six common themes emerged from the war-gaming analysis. First, Taiwan's strategic responses and operational maneuvers were crucial in shaping outcomes in all the iterations. The gameplay revealed a common thread regarding Taiwan's strategies, marked by a proactive dispersal of assets to thwart the PLA initial JFSC. Though this dispersion bought precious time (twenty-four to forty-eight hours), subsequent engagements often laid bare Taiwan's vulnerabilities, leading to devastating losses advantageous to the PLA.

Second, the PLA faced the herculean task of ferrying troops, vehicles, and supplies across the Taiwan Strait. Despite moments of localized superiority, attrition took its toll, with vulnerabilities in landing ships and civilian vessels laying bare the PLA's logistical challenges. Meanwhile, Taiwan's fortified beaches served as formidable barriers, amplifying the PLA's inherent limitations in mounting a large-scale amphibious assault on Taiwan.[46]

Third, as each war game unfolded, the PLA consistently focused on Taiwan's northern shores, aiming for swift occupation in virtually every iteration. Additionally, the PLARF reserved mid- and long-range missiles, especially when positioning, navigation, and timing capabilities were degraded. In response, Taiwan marshaled its resources, coordinating joint fire strikes, leveraging surveillance radar and a centralized command-and-control structure. Antiship fires emerged as a linchpin in disrupting PLA troop movements, slowing their advance, and buying critical time for Taiwan's defense.

Fourth, when targeting data was compromised, nonkinetic effects and Special Operations Forces (SOF) interventions proved useful in impeding PLA landing craft. However, as observed in every scenario, Taiwan incurred substantial losses, including the entirety of its navy. At the same time, the People's Liberation Army Navy (PLAN) also suffered significant casualties. Naval mines consistently tilt the advantage toward Taiwan, largely because of the cumbersome demining process faced by the PRC. This recognition has already prompted Taiwan to bolster its capabilities, which is evident in the addition of two naval mine layers in 2022.[47] These mines are critical to close defense for ports and beaches. When mine strategy has been seamlessly integrated into other defensive measures, it yields significant effectiveness in safeguarding Taiwan's ports.

Fifth, despite facing unexpected PLA assaults that initially overwhelmed Taiwan's response, the island nation still managed to delay PLA amphibious landings by twenty-four to forty-eight hours. Furthermore, port mines emerged as significant hindrances in scenarios with a thirty-day I&W timeline, showcasing Taiwan's capacity to impede PLA advancements.

Sixth, employing asymmetric tactics across multiple domains, Taiwan effectively neutralized the majority of the first PLA wave within a mere forty-eight hours. Such tactics, characteristic of a weaker force facing a conventionally stronger opponent, proved instrumental in exploiting vulnerabilities and thwarting invasion attempts. However, in head-to-head confrontations, the PLA's overwhelming force prevailed, securing air and sea superiority within a scant seventy-two hours including the JFSC.

PRC's Amphibious Invasion Vulnerabilities

In all nine iterations of the war games, significant vulnerabilities in the PLA's amphibious invasion emerged. These challenges included difficulties in achieving a surprise attack, crossing the Taiwan Strait, landing, and overcoming difficult terrain (See table 3.3).

Table 3.3. Critical vulnerabilities observed for the PRC across all the war-game iterations

Vulnerability	*Description*
Limited surprise	Large-scale military preparations on China's eastern coast would be difficult to hide, allowing Taiwan and its allies to detect an impending invasion.
Crossing the Strait	Transporting hundreds of thousands of troops across the Taiwan Strait would be a slow and risky process. It would take weeks, with each crossing vulnerable to Taiwanese attacks for hours. This allows Taiwan to target ships and mass troops on potential landing sites and to erect defenses.
Landing challenges	Even if troops reach Taiwan, few deep-water ports and beaches can accommodate a large force. Taiwan could also destroy its major ports to prevent their use, making it difficult to land heavy equipment and offload RO-ROs.
Difficult terrain	Shallow waters off most western beaches make landing difficult. The east coast has cliffs, and movement inland is restricted by narrow passes and tunnels that Taiwan can defend. Shallow waters provide plenty of opportunities for the Taiwan Armed Forces to lay mines and fortify the beaches.[48]

Specific Observations Across Scenarios

In baseline scenarios, the PLA quickly gained air and sea superiority due to its large order of battle and advanced technology, which gave it an overwhelming advantage in head-to-head engagements. However, air and sea superiority alone did not lead to full control of Taiwan. What it did provide the PLA was a strategic advantage, allowing it to respond swiftly to any offensive attempts by the remaining Taiwanese forces. This prolonged control of air and sea domains would starve Taiwan of resources, enabling the PLA to maintain its superiority indefinitely.

In baseline scenarios with US intervention, head-to-head air and sea engagements were more balanced, making it difficult for either side to achieve clear superiority. US involvement also bolstered logistics and resupply for Taiwan, enabling it to reconstitute its forces and making significant advancements challenging for the PLA.

Further iterations with Taiwanese strategic redesign demonstrated that applying an economy of force to specific PLA vulnerabilities could disrupt PLA objectives. When these efforts were coordinated across air, sea, and land domains, they effectively rendered the PLA's landing operations, necessary for occupying and controlling Taiwan, infeasible.

Taiwan Stands Alone

Risk Tolerance of PLA Is Moderate

In this baseline scenario, games were played out with the PRC assuming moderate and low risk. There was sufficient I&W for Taiwan. While the PLA succeeded in attaining localized air and naval superiority over the Taiwan Strait, the PLA faced the herculean task of ferrying troops, vehicles, and supplies across the Taiwan Strait. One key underlying assumption in this scenario was that the PLA would be undertaking large-scale military preparations on its eastern coast that would be difficult to hide, allowing Taiwan and its allies to detect an impending invasion and be more prepared to mount a more aggressive defensive posture. As a result, despite the PLA's efforts to minimize its risk to its force, attrition for the PLA remains high, especially its landing ships and civilian vessels. Specifically, port mines emerged as significant hindrances when Taiwan was presented with a thirty-day I&W, enabling it to fortify its beaches, which served as an additional barrier to limit the PLA's ability to mount a large-scale amphibious assault on Taiwan.

Risk Tolerance of PLA Is High, with an Element of Surprise

In scenarios marked by a high-risk tolerance, the PLA successfully executed a landing operation in Taiwan. However, this achievement came at a significant cost, necessitating the mobilization of 40 percent of the South Sea Fleet to support the invasion. With an I&W timeline of ninety-six hours or less, Taiwan's ability to defend itself was hindered, leading to a significant degree of success for the PLA in landing troops on the island. In other words, the PLA's degree of success can be understood as positively correlated with the reduced time available for Taiwan to prepare its defenses. Through this scenario, three key enhancements were identified that would mitigate the effects of the reduced I&W (see table 3.4).

Table 3.4. Enhancements required for Taiwan to mitigate the reduced I&W

Enhancement	*Description*
Early warning & mobilization systems	Strengthening Taiwan's early warning systems to reduce the time between detection of PLA mobilization and response initiation, thereby providing more time for defense preparation
Infrastructure protection	Implementing measures to enhance the protection of critical infrastructure, such as power plants, communication networks, and transportation hubs to impede PLA efforts to provoke a societal collapse
International communication strategies	Developing robust communication strategies aimed at countering PLA narratives and garnering international support in the event of occupation, thereby mitigating the risk of gradual control establishment by the PLA over Taiwan

Redesigned Taiwan Armed Forces Enable Taiwan to Stand Alone

Taiwan can improve its defense against a Chinese invasion using a multilayered strategy combining traditional military forces with unconventional tactics. This approach would exploit PRC military weaknesses while leveraging Taiwan's strengths. The report examines different improvements, such as adding more long-range missiles to damage PLA's landing craft, expanding the navy with untraditional vessels to counter Chinese naval attacks, and fortifying the air force with drones and missile defense systems. The most promising approach combines these advancements into a joint force. However, fully stopping a Chinese invasion will be difficult even with these upgrades. The PRC still has advantages, and Taiwan's air defenses might not be foolproof. The report concludes by stressing the importance of ongoing planning and resource allocation to adapt to future threats.

Taiwan has clear opportunities to enhance its resistance against a PLA invasion. These opportunities necessitate a coordinated approach that refines the employment of Taiwan's conventional forces and amplifies its unconventional asymmetric capabilities through a proactive defensive strategy.

As the PLA intensified its invasion effort, Taiwan responded by entangling the PLA in defensive layers, thereby impeding the PLA's mobility and thwarting its ability to establish control. The aim was to capitalize on the PLA's vulnerabilities while leveraging Taiwan's strengths.

Redesigned missile command. In this iteration, Taiwan's long-range fires were substantially bolstered, achieving a threefold increase in the *Hsiung Feng*-III and *Hsiung Feng*-IIE capabilities. The integration of missiles with a pulsed operational strategy indicated a potential to diminish the PLA's landing craft force to 30 percent within a forty-eight-hour window. However, this strategy is not impervious to weaknesses. Despite advancements in missile capabilities, Taiwan's navy and air force remain vulnerable. The PLA continued to achieve air and naval superiority. Additionally, the PRC continued to retain a significant capacity for strategic adaptation and innovation, potentially shifting toward a punitive approach through massive bombardment of the island or imposing a blockade. In such scenarios, Taiwan may find itself with limited means of defense against these aggressive efforts, highlighting the need for continued strategic planning and resource allocation to address evolving threats effectively.

Redesigned navy. During the redesigned Taiwan navy iteration, the focus was ensuring that the Taiwan navy would possess sufficient capability to conduct antinavy operations. See table 3.5 for the enhancements to the Taiwan navy. It was demonstrated that within twenty-four hours, the planned landing fleet could be reduced to 50 percent, coupled with several significant attacks on PLA Navy surface action groups (SAGs) that destroyed several other high-value assets. By the seventy-two-hour mark, China's amphibious force was reduced to 30 percent, and the entire East fleet was diminished to 20 percent, effectively denying PLA naval superiority in the region. However, this achievement came at a cost, depleting a significant portion of Taiwan's resources. Despite these gains, the Taiwan navy and air force remained vulnerable to further attacks. Additionally, China retains substantial capabilities to bombard the island and enforce a blockade, posing ongoing challenges to Taiwan.

Table 3.5. Enhancements to Taiwan navy

Capabilities	*Additional quantity*
Kuang Hua missile boats	30
Tuo Chiang corvette	18
"Sea Baby" unmanned surface vessels (USV)	100
Marichka One-Way unmanned underwater vessels (USV)	60
"Jet Ski" One-Way USVs	200

Redesigned air force. The redesigned Taiwan Air Force iterations aimed to bolster Taiwan's air denial capabilities through the procurement of National Chung Shan Institute of Science and Technology (NCSIST) drones, unmanned aerial vehicles (UAV), and additional

IADS capabilities from the US. Refer to table 3.6 for more details. The additional Patriot and *Tien Kung* III launchers and interceptors provided additional missile defense coverage during the PLA's JFSC so that HVAs (e.g., *Hsiung Feng* launchers) could survive to provide more firepower for Taiwan to counter the amphibious forces in the subsequent rounds during the war game. The PLA was observed to have a lower probability of success and had to dispense more rockets/missiles to destroy the Taiwanese HVAs. In one engagement, the PLA launched 556 cruise missiles and ninety-six short range ballistic missiles to destroy six battalions of IADS and four battalions of *Hsiung Feng* launchers. The introduction of *Chien Hsiangs* and one-way attack drones also degraded the antimissile capabilities of S-400s, Renhais, and Luyangs by acting as "missile sponge." This helped Taiwan to manage to strike the PLA's naval and amphibious capabilities with more ease. However, the outcome remained the same, as the Taiwan navy was entirely destroyed by the PLAN even though two PLAN SAGs were destroyed by Taiwan. Lastly, introducing the XQ-58 seemed useful in striking PLA airbases as they could penetrate the airspace and destroy about 20 percent of the PLAAF's airlift capabilities (e.g., Y-20).

The iterative analysis of the war gaming further supported the efficacy of employing pulsed tactics where a second wave swiftly engages targets before they can fully recover from the initial assault. Specifically, the fighters were not tasked with contesting the PLA in an air superiority fight. Instead, they were preserved to counter the PLA's amphibious capabilities as the PLA invasion forces approached Taiwan during the war game. However, the results of the redesigned Taiwan Air Force iteration failed to prove decisive for Taiwan, as the PLA continued to possess sufficient amphibious capabilities and was able to proceed with its planned invasion.

Table 3.6. Enhancements to Taiwan Air Force

Capabilities	*Additional quantity*
XQ-58 drones	5 squadrons
NCSIST *Chien Hsiang* anti-radiation drones	8 squadrons
NCSIST *Chien Hsiang* one-way UAV	6 squadrons
Commericial off-the-shelf one-way attack drones	6 squadrons
PAC-3	2 batteries
PAC-2	3 batteries
TK-2	3 batteries
TK-3	3 batteries

Two primary challenges were identified with the air force redesign: First, the limited payload capacity of one-way drones posed a considerable constraint, as they must expend energy between sustaining flight and navigating to their targets. This constraint starkly contrasted with naval drones, which can allocate their energy more efficiently due to their neutral buoyancy, thereby enabling higher payloads. Second, the PRC's formidable and extensive IADS network rendered air drones easy to defend against.

Redesigned joint force. The team leveraged the insights from the above three iterations and developed a cross-domain joint force based on the current Taiwan defense budget. Refer to table 3.7 for the proposed enhancements to the Taiwan joint force.

Table 3.7. Enhancements to Taiwan joint force

Domain	*Capabilities*	*Additional quantity*
Air	XQ-58	7 squadrons
Air	NCSIST *Chien Hsiang*	20 squadrons
Air	Patriot Systems	2
Sea	*Kuang Hua*	30
Sea	Sea Baby USV	300
Sea	Jet Ski USV	400
Sea	unmanned underwater vessels (UUV)	200
Missile	HF-III	200
Missile	HF-IIE	200

The joint iteration exhibits comparable advantages to those observed in the sea and missile expeditionary iterations. Within ninety-six hours, PLA landing craft were depleted to a mere 25 percent, while Taiwan maintained sufficient capacity to repel any subsequent attempts from the PLA. Achieving this effect took an additional twenty-four hours compared to the baseline case. This suggests that with a major—but not fantastical—force redesign Taiwan could stop a PRC invasion in its tracks.

Similar to the observations from the redesigned Taiwan Air Force, the additional missile defense systems offered better protection for Taiwanese HVAs (e.g., *Hsiung Feng* launchers). Deploying *Chien Hsiang* drones as "missile sponges" continued to help Taiwan to saturate PLA air defense systems (S-400s, HQ-9, and HQ-15), allowing Taiwan to strike back at PLAN surface and amphibious forces with greater success. The XQ-58 drones also proved to be useful in attacking mainland Chinese airbases, penetrating defenses, and destroying some of the PLA's airlift capabilities and disrupting its air assault capacity.

In sum, the proposed enhancement to the Taiwan Joint Force structure offers a compelling balance between early defense and offensive capabilities, effectively hindering the PLA's amphibious assault and inflicting substantial losses on the PLAN while minimizing Taiwan's aerial losses. The enhanced Taiwan Joint Force iteration demonstrates effective resistance against a PLA invasion with a combination of missile, naval, and air capabilities.

US Intervention

In the following two scenarios, the game was played out by assuming that the US would intervene and support the defense of Taiwan. There were two possible modalities of the US intervention: (1) full kinetic support and (2) minimal kinetic support. For the full-kinetic support modality, the US was envisaged to forward deploy all its offensive assets from United States Indo-Pacific Command and undertake a more aggressive posture toward the PRC (e.g., conducting a preemptive first strike). For the minimal kinetic support from the US, the team referenced how the US has supported Ukraine in its fight against Russian aggression.

Full-Kinetic Support from the US

Having received clear I&W of an invasion and potential preemptive attack against forward deployed US assets, the US launched a focused preemptive first strike against the PLAN's eastern fleet landing craft, significantly damaging PRC's invasion capabilities. However, this prompted a retaliatory strike by the PRC, which sank the Ronald Reagan Carrier Strike Group (CSG) near Guam and resulted in massive casualties for the US. A second iteration of this variation resulted in 50 percent destruction of all landing craft between both fleets, and a similar retaliatory strike. The US and Taiwan achieved an operational victory, similar to the observations from the CSIS war games, but at high cost.

Minimal Kinetic Support from the US

In scenarios with limited support from the US, Taiwan's baseline operational capabilities and resources were enhanced by additional ISR assets, SOF, cyber forces, and sustainment. The PLA continued to attain air superiority over Taiwan, a feat it had achieved in previous iterations. Even limited support from the US undermined the effectiveness of the PLA's JFSC campaign. Taiwan was able to enhance its defense and improve its targeting of PLA forces. While there was minimal kinetic support from the US, the ISR, sustainment, and nonkinetic support enabled Taiwan to disrupt and destroy the PLA's amphibious assault operations more effectively. The disruption of the PLA's amphibious assault created a strategic dilemma for the PRC, as the PLA had limited ability to invade and capture the whole island. This allowed Taiwan to resist the PLA's invasion attempts and maintain a stalemate, which is still a desired outcome for Taiwan as the goal is to deny the PRC from achieving a fait accompli via the full-scale invasion of Taiwan.

Insights and Recommendations

Our recommendations are organized into three categories: (1) strategic-level recommendations for the US, (2) strategic-level recommendations for Taiwan, and (3) operational-level recommendations for Taiwan.

Strategic-level Recommendations for the US

Strategic-level recommendations for the US involve several key points. First, maintaining comprehensive ISR coverage on the PLA mobilization is crucial for detecting any early potential invasion of Taiwan. Second, the US could consider adopting an indirect intervention strategy akin to the "Ukraine model" to support Taiwan, with unconditional military support in all dimensions except direct or kinetic intervention. While the Ukraine model offers valuable insights into contemporary conflicts, the distinct conditions present in Taiwan necessitate developing a more tailored approach to address its unique characteristics. Some examples include the provision of equipment and spares, providing ISR, denying and deterring the use of the electromagnetic spectrum and space to the PLAs employing asymmetric weapons and strategies that afford nonattributability to the USs coercion; subverting Chinese interests elsewhere in the world, and even potentially using clandestine forces like Special Forces and private military contractors.

Indirect intervention is akin to US support to Ukraine in the ongoing Russia-Ukraine war. The significant difference, however, is the absence of other NATO allies. That absence can be offset by assistance from like-minded nations like Japan, South Korea, and even the Philippines, as well as the activation of the AUKUS group (Australia, UK, and US) and the Five Eyes (Australia, United Kingdom, US, Canada, and New Zealand). This multifaceted support will likely complicate the PRC's decision-making process regarding engagement with the US via kinetic means. On the other hand, the US could also assist Taiwan's defense industrial base in technology in building up its ability to produce missiles, drones, and military assets.

By doing so, Taiwan can build a shield for itself without direct military aid from the US. Given the presence of a nuclear arsenal, the US must strive to keep any conflict limited. This involves exercising deliberate restraint and potentially imposing limits on the geography, weapons, or targets to prevent catastrophic escalation. However, there is a caveat that perceptions of restraint may differ between parties, highlighting the need to consider how Beijing might interpret the US actions during wartime.

Strategic-level Recommendations for Taiwan

Strategic-level recommendations for Taiwan encompass various measures to bolster its defense capabilities and resilience. There are a total of three strategic-level recommendations for Taiwan to consider.

1. Adopt a more proactive porcupine strategy. Taiwan should allocate more resources to national defense and prioritize investments that enhance its ability to resist invasion, aiming to achieve a "Taiwan victory" or deny a Chinese victory without US intervention. Taiwan's Ministry of National Defense should fully embrace the Overall Defense Concept (ODC) [*zheng ti fang wei gou xiang,* 整體防衛構想] as the cornerstone of its military strategy.[49] The ODC strategy is an asymmetric active defense approach in which Taiwan maximizes its defensive advantages and targets an invading force at its weakest: in Taiwan's littoral.[50] Some US and Taiwanese analysts also have called this strategy the porcupine defense strategy.[51] The ODC concept divides Taiwan's defense operations into four phases: force preservation, a decisive battle in the littoral zone, destruction of the enemy at the landing beach, and defense in depth.[52] Each successive phase takes place closer to Taiwan's territory, where the lines of communication are short. Taiwan's forces can benefit from land-based air denial and more effective surveillance and reconnaissance. However, since the Russian invasion of

Ukraine, it is noteworthy that Ukraine has effectively used smaller weapons to fight back and humiliate Russia's larger military force.

However, the current Taiwan defense procurement and strategy may still not be sufficient to resist the Chinese invasion. The existing porcupine metaphor has been used by small states such as Singapore, but this metaphor may suggest a passive force posture.[53] To this end, Taiwan must adopt a more proactive *porcupine* strategy instead, to deter and deny the Chinese invasion more effectively. This entails Taiwan procuring more long-range capabilities that will enable it to conduct large-scale strikes on the PLA's critical amphibious assault capabilities. Denying an amphibious assault is a more realistic and consequential objective than attempting to secure or maintain air and naval superiority.

2. Maintain close nonkinetic military cooperation with the US. The war-gaming results found that the US's ISR and nonkinetic support could severely degrade the PLA's war-fighting capabilities and enhance Taiwan's military effectiveness. Hence, close military coordination with the US and Taiwan in the ISR and nonkinetic domain is essential to establish a shared understanding and language between the two militaries. Streamlining command-and-control processes can improve operational effectiveness by granting commanders at the squad level and below greater authority when engaging with the US military.

Given the US's extensive intelligence coverage on the PRC's activities, Taiwan must capitalize on these capabilities and work closely with the US to build an accurate, common operating picture that will be essential for Taiwan to deny a Chinese victory. This has been exemplified by the use of intelligence in the Russia-Ukraine war in which the US has captured the initiative in the information war. Although it failed to deter Russia, the US intelligence revelations changed the information environment in which Putin's war has taken place. By disclosing the intelligence before the invasion, the West undermined Russia's ostensible casus belli, removed potential provocations as justifications for invasion, and forced the Kremlin to concoct ever-evolving narratives for both foreign and domestic audiences, the development of which took time and energy and which ultimately achieved little for Russia.

The US should expect to see a combination of cyber and kinetic attacks from the PRC. It is also likely that the PRC will attempt to disrupt, blind, or turn off both military and commercial satellites for reconnaissance, navigation, and communications. For a start, it is encouraging that the US has passed new legislation, the Taiwan

Cybersecurity Resiliency Act, which authorizes the US military to conduct cybersecurity training exercises with Taiwan and support the country's military networks and infrastructure to help stop further attacks from China.[54] Using nonkinetic methods is less intrusive and less escalatory than kinetic attacks. These methods would be an area where Taiwan should establish a joint operating concept with the US to leverage nonkinetic effects at the onset or even before the conflict to regain the initiative.

3. Enhance Taiwan's east coast infrastructure. The war-gaming results demonstrated the importance of enhancing the survivability and resilience of airbases and naval bases, especially on the eastern coast of Taiwan. The Taiwan Armed Forces should focus on strategies to keep eastern ports and air bases operational amid conflict.[55] Taiwan must prioritize enhancing infrastructure along its eastern coast to increase the survivability of its critical war-fighting assets. Based on the war game, it is observed that a PLA campaign would always begin with a JFSC intended to destroy Taiwan's military and demoralize its public. The ability to preserve military power during the initial phases of an invasion proved to be essential for Taiwan to mount a counteroffensive against the Chinese invasion. Taiwan should consider increasing the number of antiexplosion bunkers on its eastern coast to safeguard its critical missile stockpiles. Notwithstanding, it is heartening to know that Taiwan is already upgrading all its airbase runways to increase resilience against any potential PLA missile attacks.[56]

In addition, Taiwan should enhance the interconnectivity between its military branches, particularly on the eastern part of Taiwan. One of the key contributing factors for Taiwan to be able to mount a counteroffensive against the PLA is to be able to transport and maneuver its war-fighting capabilities and logistics around the eastern coast of the island. Hence, this necessitates the enhancement to the land interconnectivity between its airbases, seaports, and its supply facilities to enable a more effective sustainment operations and allow the Taiwan Armed Forces to distribute its war-fighting capabilities to continue to deny the Chinese invasion. To this end, Taiwan should pursue additional investments in key capabilities along its eastern coast that will enhance mobility, deception, camouflage, concealment, redundancy, rapid repair, reconstitution, and logistics capabilities. While militaries often neglect these attributes because they are not visible or prestigious, preserving Taiwan's eastern coast is critical to its credible deterrence, and the defense ministry should prioritize it in the competition for scarce defense dollars.

Operational-level Recommendations for Taiwan

This section provides operational-level recommendations for Taiwan, particularly addressing the vulnerabilities associated with the "Taiwan stands alone" scenario. In August 2023, Taiwan announced a total defense budget of approximately $19.1 billion for 2024, reflecting a 7.7 percent increase from the previous year.[57] This defense budget represents about 2.4 percent of Taiwan's GDP, highlighting its commitment to bolster its defense capabilities.[58] Additionally, in January 2022, Taiwan approved an $8 billion, multiyear supplemental defense budget to strengthen the country's air and sea combat capabilities. However, more radical change in Taiwan's military strategy is still required to deter and deny Chinese invasion.

1. Focus on missiles. Taiwan currently fields truck-mounted *Hsiung Feng* antiship missiles, which can disperse to survive initial strikes and then set up later when PLAN ships, particularly the high-value amphibious vessels carrying an invasion force, are crossing the strait. These land-based mobile antiship systems are expected to survive after Taiwan's capital ships have been destroyed and may be able to further extend their survivability by moving after firing to avoid counterfire strikes. Taiwan's ballistic and cruise missile inventory, varying from 800 to 1,200, has an additional capacity to increase production by 500 missiles a year of all types.[59]

Taiwan should continue to increase its missile stockpile and launchers for the *Hsiung Feng*-II, *Hsiung Feng*-III, and *Hsiung Feng*-IIE missile systems, as they are versatile for land-based, ship-based, and air-based deployment. Mobile vehicle-mounted antiship missiles are inherently survivable, making them effective at critical moments when a PLA amphibious force is approaching Taiwan and preparing to offload troops and armor. The capability to survive an initial bombardment, then "shoot-and-scoot" from concealment, is the hallmark of an asymmetric strategy and a key component of an ODC strategy.

2. Prioritize amphibious assault disruption capabilities. The critical vulnerability for the PLA is its amphibious assault ships. Recent PLA joint exercises suggest that the PLA remains limited in its ability to employ civilian RO-RO ferries as part of a major beach assault against Taiwan despite making significant improvements in its core capabilities for the large-scale lift of PLA troops and equipment in a cross-strait invasion of Taiwan.[60] This limitation is one of the core vulnerabilities that Taiwan must exploit to present a more credible deterrent. As such, Taiwan should prioritize its defense budget, enabling its military force to disrupt and destroy the PLA's critical amphibious assault capabilities. Expecting that Taiwan's large surface ships will be the primary initial targets for the PLA, the team recommends that the Taiwan navy focus on procuring more small, fast attack vessels, such as the *Kuang Hua* fast attack craft. That vessel can mount four *Hsiung Feng* missiles and can be quickly reloaded in austere locations, such as the small fishing ports that dot Taiwan's coastline.

Taiwan also needs to bolster its mine-laying capabilities, which were proven essential in delaying amphibious assaults by the PRC during the war games. By delaying the amphibious assault, Taiwan can leverage a protracted campaign to garner international support. The Ukrainian offensive operations against Russia have also proved that Taiwan should invest in more cost-effective, one-way drones or loitering munitions to destroy the PLAN's CSGs or SAGs.

3. Adopt a fleet-in-being strategy. Taiwan should adopt a "fleet-in-being" strategy to preserve its key offensive capabilities and prepare to annihilate the enemy at the "beach area," which extends approximately 40 kilometers from the anticipated invasion beaches.[61] According to Julian Corbett, a fleet-in-being strategy is a legitimate method of disputing sea command by assuming a defensive attitude.[62] In a situation where a superior enemy fleet needs to obtain a rapid and decisive victory, a fleet-in-being strategy can have a temporary deterrent effect by avoiding action until conditions are more favorable. This strategy requires Taiwan to preserve its air and naval forces and employ them only during the critical juncture of the war campaign. Specifically, Taiwan should not utilize its air force to conduct conventional air superiority missions; instead, it should utilize its high-end fighters for countersurface operations or air-interdiction missions.

4. Enhancements to Taiwan's armed forces by 2030. In sum, the team proposes an estimated $14.5 billion investment over the next five to six years in asymmetrical capabilities such as missiles, drones, and cyber capabilities. To enable the proposed enhancements to the Taiwan Armed Forces, Taiwan may need to consider canceling its current indigenous submarine program, which has an estimated cost of approximately $10.1 billion. The ability of Taiwan's future indigenous submarine to target high-value surface ships remains uncertain because the submarine is anticipated to be a sizable, conventional diesel-electric design, resembling Taiwan's current two *Hai Lung*-class submarines. These submarines are primarily designed for sealine operations rather than the shallow waters in the Taiwan Strait. Compared to alternatives such as harpoon missiles and drones, the savings from divesting in submarines—$10.1 billion—would equal the additional procurement of thousands of missiles and drones.

Some scholars and think tanks argue that Taiwan must still invest in submarines, large surface vessels, and fighter aircraft to modernize its legacy force, as it remains crucial for its military to maintain peacetime deterrence and effectively counteract the gray zone threat from the PLA.[63] In 2023 alone, Taiwan ordered $1.55 billion in conventional weapons and services from the US, including infrared tracking systems for F-16 jets, munitions, spare parts for aircraft, and technical support. The hard truth is that Taiwan faces a serious dilemma between apportioning its limited defense budget for high-profile, prestigious military platforms and the smaller, agile, and resilient asymmetric systems that might be more crucial for Taiwan's survival and resistance against a potential Chinese invasion. The savings from divesting these prestigious war-fighting assets can be more effectively used to boost Taiwan's asymmetrical capabilities to disrupt and deny the PRC's amphibious assault. Furthermore, the PRC is committed to modernizing its armed forces and will continue to invest heavily in procuring conventional military advantages over Taiwan. This was evident when the PRC announced a 7.2 percent increase in its defense budget in March 2024 despite its recent economic challenges.[64]

Deterrence requires real capability, the determination to use the capability, and signaling to an adversary. The redesigned joint force suggested above would increase the likelihood of a military stalemate and raise the perceived risk level for a PRC invasion. This would be achieved by combining conventional and asymmetrical capabilities and manned and unmanned resources. Ukraine's success in fighting the Russian invasion using myriad asymmetrical capabilities should compel PRC leaders and strategists to reassess their military strategy were Taiwan to pursue such a course.

Table 3.8. Proposed military enhancements to Taiwan by 2030

Proposed enhancements/ additions	*Unit cost (US$)*	*Total cost (US$)*	*Notes*
		Taiwan Air Force	
7 squadrons of XQ-58	$4 million[65]	$672 million	The XQ-58 can provide enhanced support for Taiwan's defense through its multifunctional capabilities and advanced technology, particularly in surveillance, targeting distant objectives, joint operations, and aerial defense.
20 squadrons of NCSIST *Chien Hsiang* (1 Squadron approximately equals 12–20 drones)	$127 million[66]	$2.54 billion[67]	These indigenous Chien Hsiang are highly suitable for "one-way" kamikaze missions targeting PLA's high-value naval assets such as Luyang III or Renhai.
Air defense systems and Interceptors (NASAMS, TK-III, Patriot)[68]	n.d.	~$7 billion	While this is costly, TK-III, Patriot, and NASAMS remain essential to boost Taiwan's antimissile defense capabilities, especially in the proposed fleet-in-being strategy. Taiwan must survive the initial salvos of the PLA's Joint Fire Strike Campaign. The existing Patriot PAC-3 batteries and domestically manufactured TK-III surface-to-air missiles are designed to defend air bases and critical infrastructure. Tian Kung-3 can serve as an excellent alternative to the Patriot and a combination of the systems may prove effective against the PLA. The price quoted is the worst case and could be cut significantly by acquiring more of the indigenous TK-III, which is much cheaper than the Patriot. Regardless of the precise number aquired, it is also imperative to stock missile reloads.
		Taiwan Navy	
30 Kuang Hua	$12.3 million[69]	$369 million	Kuang Hua is relatively cheaper than other vessels and possesses high speed and mobility, combined with HF-2 antiship missiles, making it important in asymmetric warfare.
300 "Sea Baby" USVs	$221,000[70]	$66.3 million	"Sea Baby" USVs carry some form of rocket or missile and range around 1 kilometer.[71] They are low cost and fit in asymmetric strategy against the superior PLAN fleet.

Proposed enhancements/ additions	*Unit cost (US$)*	*Total cost (US$)*	*Notes*
400 "Jet Ski" USVs	$250,000[72]	$100 million	Ukraine used the "MAGURA" jet-ski drones to sink a Russian warship. They have a large range of around 800 kilometers.[73] These USVs will be a cost-effective and asymmetrical solution against the PLAN vessels.
200 UUVs	$500,000[74]	$100 million	Ukraine utilized the UUVs, which can haul hundreds of pounds of explosives over a distance of up to 600 miles and strike Russian warships.[75] Its stealth and versatility put at risk PLA's HVAs.
Taiwan Missile Command			
200 Hsiung Feng-III missiles, 3 batteries of launchers, command vehicles, and radars	$2.4 million ~$100 million	$480 million ~$300 million Total $780 million	The HF-3 is designed to target high-value naval assets during the PLA's invasion and will likely pose extreme challenges for the PLA during amphibious landing.
200 Hsiung Feng-IIE missiles, 3 batteries of lunchers, command vehicles, and radars	$3.1 million[76] ~$106 million	$620 million ~$318 million Total $938 million	The HF-2E is an indigenous, modified series based on HF-2. Given its long range (600km), it can target mainland China, thereby putting its critical amphibious capabilities at ports at a higher risk during a conflict.
Cyber and Space Capabilities			
Enhancement of Space and Cyber capabilities	n.d.-	$2 billion	Taiwan should build up and enhance its organic capabilities to boost ISR capabilities.
Total Cost		~$14.5 billion	We recommend Taiwan divest itself of the indigenous submarine program, which would incur an additional $10 billion in savings, bringing the total cost to around $4 billion.

Note: All costs are estimated and referenced from open-source websites
n.d. = no data

Conclusion

This chapter focused on Taiwan's role in deterring and resisting a potential Chinese invasion with limited US support. The research aimed to foster greater regional security, cooperation among partners, and efficiency in resource allocation. Highlighting the significance of Taiwan as a geopolitical flashpoint, results from the TDWAR's war gaming show the need for a comprehensive deterrence strategy to maintain peace and stability across the Taiwan Strait.

Despite facing significant differences in numbers compared to the PLA, the goal was to identify strategies that enable Taiwan to deter and resist invasion even without direct US intervention. The team uncovered new insights through multiple war-gaming iterations, assessed operational capabilities, and formulated actionable recommendations for Taiwan's defense.

However, this study, and the war game it was based on, face limitations. Challenges include the sensitivity of military operations, the complexity of real-world considerations, and the need to make assumptions in war-gaming scenarios. In war gaming, there is also an element of chance. It is not that either side had a remarkably better plan, but the unfolding events may play to one side's advantage by pure happenstance or the luck of a die roll. This epitomizes the role of fog, friction, and chance on the outcomes of war. Good planning and strategy seek to set conditions that account for happenstance so that an outcome does not hinge on a particular roll of the die.

After a year of war gaming this scenario, the team believes Taiwan can be transformed into a formidable fortress that will effectively deter the PRC from taking undesirable actions, especially military aggression.[77] Achieving peace and stability across the Taiwan Strait is paramount to global security and stability. This study represents a crucial step in redefining defense strategies and fostering resilience against the potential threat of Chinese invasion. Taiwan already has a moat. It is time for it to become a fortress.

Appendix 3-I

Military Strength of Naval and PRC Rocket Force Inventory

Table A.1. Taiwan Strait military balance, Ground forces

Type of force	*CHINA total*	*Taiwan Strait area**	*TAIWAN total*
Total ground force personnel	1,050,000	420,000	89,000
Group Armies/Army Corps	13	5	3
Combined Arms brigades	82	31 (6 amphibious)	7
Artillery brigades	15	5	3
Army Aviation brigades	13	4	2
Air Assault brigades	3	1	0
Airborne brigades	7	7	0
Marine brigades	8	5	2
Tanks	4,200	1,100	900
Artillery pieces**	7,600	2,300	1,300

*For the purposes of this document, the "Taiwan Strait Area" includes the PLA's Eastern and Southern Theaters.

**For the purposes of this document, "Artillery Pieces" refers to systems 100 mm and larger, either towed or self-propelled, and includes multiple rocket launchers.

Table A.2. Taiwan Strait military balance, Air Forces

Type of system	*CHINA total*	*Eastern and Southern Theater*	*TAIWAN total*
Fighters	1,900 (3,100*)	750 (900*)	300 (400*)
Bombers/attack	500	300	0
Transport	500	40	50
Special mission aircraft	250	150	20

Note: This table displays estimated totals of military aircraft from both PLAAF and PLAN aviation. However, the PLAAF may supplement its military transports with civilian aircraft in a combat scenario.

*The totals in parentheses include fighter trainers.

Source: US Department of Defense

Table A.3. Taiwan Strait Military Balance, Naval Forces

Type of Vessels	*CHINA total*	*Eastern and Southern Theater Command Navies*	*TAIWAN total*
Aircraft carriers	2	1	0
Amphibious assault ships	3	3	0
Cruisers	8	4	0
Destroyers	42	30	4
Frigates	47	30	22
Corvettes	50	40	0
Medium landing ships / Tank landing ships / Amphibious transport dock	57	50	50
Attack submarines	47	31	4
Nuclear-powered attack submarines	6	2	0
Nuclear-powered ballistic missile submarines	6	6	0
Coastal patrol (missile)	60	60	43
Coast guard ships	142	N/A	168

Note: The PLAN has the largest force of principal combatants, submarines, and amphibious warfare ships in Asia. In the event of a major Taiwan conflict, the Eastern and Southern Theater Command Navies would participate in direct action against the Taiwan Navy. The Northern Theater Navy (not shown) would be responsible primarily for protecting the sea approaches to China but could provide mission-critical assets to support other fleets. In conflict, China may also employ CCG and CMM ships to support military operations.

Table A.4. China's rocket force

System	*Launchers*	*Missiles*	*Estimated Range*
Intercontinental ballistic missile	500	350	>5,500km
Intermediate-range ballistic missile	250	500	3,000–5,500km
Medium-range ballistic missile	300	1000	1,000–3,000km
Short-range ballisitc missile	200	1000	300–1,000km
Ground-launched cruise missile	150	300	>1,500km

Source: US Department of Defense

Appendix 3-II

Common War-Gaming Terms and Definitions

Term	*Definition*
Adjudication	The method of determining the outcome of (often competing) player actions in a game
Counter	A cardboard square or rectangle represents forces on a game map. Counters often display US military operational terms and graphics.
Expert adjudication	An adjudication style that relies on human expert judgment to determine the outcome of player actions in a game. Also called free adjudication.
Hex game	A game where the physical representation of terrain and the movement of representative forces is along a hexagonal grid—developed first by the RAND Corporation in the 1950s
Matrix adjudication	Adjudication style reliant on player arguments for player actions' expected success or failure
War game or game	1. A model or simulation of warfare, not involving actual forces, in which the flow of events is affected by, and in turn affects, decisions made during those events by players representing the opposing sides. 2. One of a wide variety of facilitated defense community activities, including discussions, planning activities, exercises, and adjudicated warfare simulations.
Tabletop exercise	A facilitated discussion around a specific topic of interest. The most common form is similar to a seminar classroom discussion rather than a set of adjudicated actions.

Appendix 3-III

Rocket Force Sample Missile Counter

STARTING COUNT – DAY 1

	A	B	C	D
1	System	Launchers	Missiles	Range
2	ICBM	500	350	>5,500
3	IRBM	250	500	3,000 - 5,500
4	MRBM	300	1000	1,000-3,000
5	SRBM	200	1000	300-1,000
6	GLCM	150	300	>1,500
7	PHL-16	150	1000	>160KM
8	PHL-3	150	1000	>160KM
9				

Sheet1 | **master** | Day 1 | Day 2 | day 3

	A	B	C	D
1	System	Launchers	Missiles	Range
2	ICBM	500	0	>5,500
3	IRBM	250	0	3,000 - 5,500
4	MRBM	300	92	1,000-3,000
5	SRBM	200		300-1,000
6	GLCM	150	47	>1,500
7	PHL-16	150	50	>160KM
8	PHL-3	150	96	>160KM
9				

Sheet1 | master | Day 1 | **Day 2** | day 3

ENDING COUNT – DAY 2

	A	B	C	D
1	System	Launchers	Missiles	Range
2	ICBM	500	350	>5,500
3	IRBM	250	500	3,000 - 5,500
4	MRBM	300	764	1,000-3,000
5	SRBM	200	1000	300-1,000
6	GLCM	150	253	>1,500
7	PHL-16	150	734	>160KM
8	PHL-3	150	904	>160KM
9				

Sheet1 | **master** | Day 1 | Day 2 | day 3

	A	B	C	D
1	System	Launchers	Missiles	Range
2	ICBM	500	0	>5,500
3	IRBM	250	0	3,000 - 5,500
4	MRBM	300	144	1,000-3,000
5	SRBM	200	0	300-1,000
6	GLCM	150	0	>1,500
7	PHL-16	250	216	>160KM
8	PHL-3	150	0	>160KM
9				

Sheet1 | master | Day 1 | **Day 2** | day 3

***

The starting count is on the master, and each day deducts the number of missiles used that day from the master through an Excel equation. This is extremely useful because it shows that if the PRC is aggressive, it can run out of missiles within two weeks. This is according to some iterations between the PRC and Taiwan. The calculus is different when adding the US to the target.

Notes

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35. Kelvin Chen, "Taiwan to Receive All Harpoon Missiles by 2029," *Taiwan News*, April 7, 2023, https://www.taiwannews.com.tw/.

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39. Through the war game, the authors envisaged that Taiwan would centralize all its long-range fires, akin to the PLARF. See Tien-Pin Lo and Jonathan Chin, "Missile Command to Be Set up This Year," *Taipei Times*, January 21, 2024, https://www.taipeitimes.com/.

40. Heginbotham, Cancian, and Cancian, *The First Battle of the Next War*.

41. Ian Easton, "Hostile Harbors: Taiwan's Ports and PLA Invasion Plans," Project 2049 Institute, July 22, 2021, https://project2049.net/; and Mearsheimer, "Assessing the Conventional Balance," 54–89.

42. The maximum throughput of 52,000 troops per island offloading (based on the total number of landing ships and civilian RO-RO) can be reduced to 16,000 troops per offload by destroying two-thirds of the landing ship's capacity. This reduction would prevent the PRC from achieving a clear victory, as it will not be able to land enough troops to gain numerical advantages for the land invasion or sustain its troops effectively.

43. The landing ship capacity was derived from various People's Liberation Army and People's Republic of China websites and new reports compiled by Conor M. Kennedy in "Getting There: Chinese Military and Civilian Sealift in a Cross-Strait Invasion," in *Crossing the Strait: China's Military Prepares for War with Taiwan*, ed. Joel Wuthnow et al. (National Defense University Press, 2022), 226–27.

44. "Chapter Six: Asia"; and Andrew Erickson, "New from Office of Naval Intelligence (ONI)! 2024 Recognition & Identification Guides for China People's Liberation Army (PLAN) & China Coast Guard & Government Maritime Forces," *Andrew S. Erickson* (blog), April 29, 2024, https://www.andrewerickson.com/.

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mountains and the sea, far from Taiwan's population centers and infrastructure. PLA forces landing in the east would also be more vulnerable than the landing forces in the west due to their greater distance from mainland-based firepower and logistical support.

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PART 2

TAIWAN DETERRENCE THROUGH DENIAL AND PUNISHMENT

Chapter 4

Two Birds With One Drone

Strengthening Taiwan's Deterrence and Saving America's Drone Industrial Base

Dr. Mark D. Jacobsen

Abstract

Russia's war on Ukraine has demonstrated the importance of small unmanned aerial systems, or drones, in modern warfare. US military leaders and policymakers must incorporate small drones in their plans to deter war over Taiwan and, if necessary, fight and win. Supplying Taiwan with small drones could improve deterrence by neutralizing a current People's Republic of China (PRC) advantage, showing responsiveness to lessons from Ukraine, generating combat power for Taiwan, and strengthening the drone industry in the US and partner countries. However, supplying Taiwan with small drones will not be easy. The PRC currently holds a global monopoly on small drones, with US suppliers lagging far behind. DOD's efforts to close this gap, including the recent Replicator initiative, have not been sufficient. To prepare for drone warfare in Taiwan the US must take five actions: (1) make large, recurring, and predictable purchase commitments of autonomous systems; (2) use Ukraine to test drones in an operational environment; (3) overhaul a chaotic US policy framework that inhibits drone sales to government; (4) flood Taiwan with drones and components; and (5) support the nascent Taiwanese drone industry.

Chinese Language Abstract

俄烏戰爭已經展示了小型無人航空系統或無人機在現代戰爭中的重要性，美國軍事領袖和政策制定者必須將小型無人機納入計畫，用以嚇阻針對臺灣的戰爭，如果必要的話參與戰鬥並取得勝利。向臺灣提供小型無人機改善嚇阻能力能夠抵銷中國的優勢、增加臺灣抵抗入侵的戰鬥能力、表現美國快速吸收俄烏戰爭經驗的能力、強化美國與夥伴國家間的無人機產業；然而，向臺灣提供小型無人機並不容易，中國目前在小型無人機方面擁有全球壟斷地位，美國供應商遠遠落後，美國國防部雖

做出許多努力(包含最近的複製者計畫)嘗試縮小美中無人機產業差距，但仍不足以彌補；美國必須採取五項行動為臺灣的無人機戰爭做好準備：（1）做出大規模、定期和可預測的自動化系統採購承諾、（2）利用烏克蘭測試無人機在實際操作環境中的表現、（3）改革阻礙無人機銷售給政府的混亂美國政策框架、（4）向臺灣大量提供無人機及其零組件，以及（5）支持新興的臺灣無人機產業。

The Emergence of Small Drone Warfare

In the summer of 2023, Ukrainian forces launched a devastating series of long-range drone attacks deep into Russian territory. Ukrainian drones flew more than 370 kilometers to destroy two parked Il-76 transport aircraft.[1] Days later, the Ukrainians damaged a MiG-29 and four Su-30 fighter aircraft, reportedly with folding cardboard drones from an Australian company called SYPAQ.[2] Two weeks later, Ukraine's intelligence service used drones to disable Russian radars, enabling cruise missile strikes on Russian S-300 and S-400 air defense systems reportedly worth $1.2 billion.[3] In addition to long-range strikes, both the Ukrainians and Russians have used first-person view (FPV) racing drones to destroy vehicles, kill exposed soldiers, and freeze movement of the front lines.[4] New capabilities like GPS-denied navigation and autonomous vision-based targeting continue to appear on the battlefield. The Ukraine war illustrates how mature small drone warfare has become.

US military leaders and policymakers must incorporate small drones in their plans to deter war over Taiwan and, if necessary, fight and win. A concerted effort to equip Taiwan with small unmanned aerial systems (sUAS), or drones, would show responsiveness to lessons from Ukraine, signal resolve to compete in cutting-edge technology, erode a clear advantage currently held by the PRC, and generate combat power for Taiwan. Large numbers of attritable, autonomous systems could hold Chinese amphibious forces at risk, create options for irregular forces in the aftermath of an invasion, and threaten the Chinese mainland with punitive strikes.

Unfortunately, Taiwan and its American patrons are nowhere near ready for small drone warfare. Supplying Taiwanese forces with adequate drones will be vastly more complicated than in Ukraine. The PRC dominates the global sUAS industry, and the China-heavy supply chains supplying Ukraine and Russia will be largely unavailable to Taiwan. US efforts to rejuvenate the American drone industry have been inadequate; the US government has purchased alarmingly low numbers of drones, and a morass of ill-conceived regulation has undermined the ability of many American companies to sell to government. Paltry government purchasing means that companies are struggling to design, build, and field new generations of drones incorporating lessons from Ukraine. The US has sent even fewer drones to Taiwan, an island nation that will be difficult to supply if war breaks out.

The Pentagon's Replicator initiative, announced by Deputy Defense Secretary Kathleen Hicks in August of 2023, is intended to close this gap. Replicator is aimed at "fielding thousands of attritable, autonomous systems across multiple domains within the next two years."[5] Replicator is a helpful beginning, but it does not address deep structural problems in the drone industry and government acquisitions processes. The United States must go much further in procuring and fielding drones to bolster Taiwan's defense.

An aggressive push by the US to field autonomous, attritable systems in the Pacific would simultaneously strengthen deterrence and revitalize the struggling American drone industry, creating a virtuous cycle. However, this will require dramatic changes to DOD acquisitions. A comprehensive fielding strategy should include five elements. First, DOD must make large, recurring, and predictable purchase commitments of autonomous systems. Second, DOD and its allies and partners should use Ukraine as a battle lab to validate new technology before it goes to the Pacific. Third, DOD needs to overhaul a chaotic policy framework that makes it difficult for industry to supply the war fighter with affordable, cutting-edge drones. Fourth, the US should flood Taiwan with drones and drone components, allowing the Taiwanese to build drone expertise and develop their own domestic drone capabilities in the event of an invasion and occupation. Fifth, the US should support manufacturing drones and related technology within Taiwan.

This chapter proceeds as follows. First, I provide a history of the small drone industry, with an emphasis on how the PRC monopolized the industry and nearly extinguished its American competition. Second, I summarize the role autonomous systems have played in Ukraine and derive lessons that might be relevant for Taiwan. Third, I consider the role that autonomous systems might play in deterring China from invading Taiwan. Fourth, I discuss the challenges in providing Taiwan with adequate small drones. Fifth, I lay out an acquisitions and fielding strategy that could strengthen Taiwanese deterrence and ensure the competitiveness of the US drone industry.

The Rise and Fall of the Small Drone Industry

Military visionaries have tried to unlock the potential of unmanned aerial systems (UAS), or drones, since the beginning of the airpower age. Great Britain and the United States first flew drones in 1917 and 1918 respectively, although only as targets. During the latter years of World War II, when Nazi Germany bombed London with V-series rockets, the United States experimented with sending pilotless aircraft to bomb V-weapon complexes.[6] During the Vietnam War, the United States employed UAS for reconnaissance, dropping leaflets, launching weapons, and acting as decoys.[7]

Military drones came into their own with the rise of the RQ-1 Predator. The Predator entered service in 1995, seeing action in both Bosnia and Kosovo, but it was popularized by the 2001 invasion of Afghanistan and the Global War on Terror. Although the Predator was not a particularly impressive airplane and could not survive modern enemy air defenses, it proved to be an invaluable intelligence, surveillance, and reconnaissance (ISR) platform in the permissive skies over Afghanistan and Iraq. Throughout the War on Terror, Predator drones armed with Hellfire missiles, and later the MQ-9 Reaper, became synonymous in the popular imagination with targeted strikes on notorious insurgents or terrorists.[8]

The small drone revolution began a decade later, in tandem with the smartphone revolution. Smartphones relied on three technological breakthroughs: small and powerful computers, miniaturized sensors like gyroscopes and accelerometers, and high-capacity batteries. Hobbyists and entrepreneurs around the world realized that these same components could enable autonomous flight. In California, *WIRED* magazine editor Chris Anderson built a crude autopilot using a LEGO Mindstorms kit and then started an online community called DIY Drones. Its membership quickly grew into the tens of thousands.[9] In Switzerland, a PhD student named Lorenz Meier began building his own autopilots and flight control software, known respectively as Pixhawk and PX4.[10] In 2009 Anderson and Meier, along with many other drone enthusiasts, partnered to create an American company called 3D Robotics (later 3DR). Across the Pacific, in China, a talented university student named Frank Wang started a drone company in his dorm room. That company became DJI, a powerhouse sometimes known as the "Apple of drones."[11] Optimism soared as entrepreneurs and investors imagined possible use cases for drones and contemplated an enormous emerging market.

But the fledgling industry experienced a reckoning. In 2015, backed by more than $100 million in venture capital, 3D Robotics went head-to-head with DJI in the consumer quadcopter market. It lost badly, partly due to mismanagement of its new Solo drone and partly due to aggressive price slashing by DJI. DJI's Phantom 3 and 4 drones quickly dominated the market, followed in late 2016 by the revolutionary new DJI Mavic Pro.[12] 3DR abandoned drone manufacturing entirely, pivoting toward software services using drones from DJI or Yuneec, another Chinese company. American camera company GoPro also spent $100 million trying to compete with DJI and faced a similar disaster; its Karma quadcopter was large and clunky compared to the elegant Mavic Pro, and the product had to be recalled shortly after launch because it kept falling out of the sky.[13] French drone company Parrot laid off 35 percent of its staff in 2017, and numerous high-visibility drone startups like Lily, Zano, and Fleye failed spectacularly.[14] By late 2017, China-based DJI had established a global quadcopter monopoly. No American company could compete; DJI was vertically integrated, had strong manufacturing advantages, likely benefited from state subsidies, and had enough revenue to develop unmatched components like gimbaled cameras and radios. China also continued to dominate the supply chains for other types of drones, like small fixed-wing aircraft.

The collapse of the American drone industry had major ramifications for the Department of Defense. Small drones were appearing on the battlefield in increasing numbers. By early 2017 the Islamic State had built a powerful sUAS air force, sometimes flying up to twelve drones at a time over Mosul.[15] US troops fighting the Islamic State in Iraq and Syria needed small drones of their own, but DOD sUAS technology was years behind DJI. One "go-to" quadcopter issued to US troops relied on a decade-old technology, couldn't hold a stable hover, and used Chinese hobby-grade radios vulnerable to exploits publicly available on YouTube.[16] US troops wanted to use superior DJI drones, but as they purchased DJIs with increasing frequency, alarmed DOD officials banned purchases—first of DJI drones, then of *all* commercial-off-the-shelf (COTS) drones, including US-built drones.[17] They were concerned that the PRC might use DJI drones to spy on

Americans, install backdoors, or implement hidden “kill switches” to render them inoperative in combat.[18] The full-fledged COTS ban, which was intended to be temporary while DOD developed a process to ensure the cyber security of drones, never fully went away.

This mounting industrial base crisis led to a whole-of-government effort to save the American drone industry and break DJI’s monopoly. The Army’s Program Executive Office Aviation and the Defense Innovation Unit (DIU) partnered to deliver the Army’s newest Program of Record quadcopter, known as Short Range Reconnaissance (SRR). By using DIU’s contracting authorities and processes, the Army opened the competition to commercial companies that did not traditionally serve the defense market. SRR awarded prototype contracts to six drone companies based in the US or allied countries in 2019 and ultimately awarded a production contract to US-based Skydio in 2022. Congress, for its part, included language in the FY 2020 National Defense Authorization Act (NDAA) banning DOD’s use of both Chinese drones and Chinese drone components. These policy actions effectively banned DJI in DOD, created industrial protections for the US drone industry, and forced industry to create entirely new supply chains free from Chinese influence.

While important and well-intended, these policies had second-order consequences. Although the DOD widely supported the SRR prototype drones, including them on a new authorized “Blue UAS” list, it failed to create a pathway to allow other drone companies to sell to DOD. To this day, according to DIU, DOD can only procure drones in three ways: (1) as part of a program of record, which is beyond the reach of most government organizations and drone companies; (2) as a purchase from the extremely limited Blue UAS list; or (3) as an exception to policy.[19]

Despite DOD’s promotion of Blue UAS, it has not properly invested in Blue UAS as a long-term solution. The original Blue UAS drones only covered a fraction of use cases. SRR was an Army Program of Record to meet a very specific use case: an inexpensive, rucksack-portable, platoon-size ISR drone.[20] These drones are not suitable for a wide range of mission sets requiring fixed-wing drones, larger or heavier multicopters, or swappable payloads. Furthermore, onerous Army requirements sent SRR’s price skyrocketing. The Skydio 2+ consumer drone initially cost $1,099, but by the time the Skydio X2D drone emerged from the Army requirements process, it cost upward of $15,000, not including the Army’s expensive ground control station.[21] The high unit cost means these drones are hardly attritable, and they are too expensive for most government organizations, including large parts of the DOD.

The Blue UAS list was intended to be expanded over time, but DOD has not allocated funding for security evaluations or delineated a clear process to add drones to the Blue UAS list. No entity in DOD is empowered to set an approved standard for drone cyber security, so nervous contracting officers and authorizing officials are reluctant to issue approvals. Although DIU expanded the list with a “Blue UAS 2.0” effort in 2023, the list has been essentially frozen since then (as one DIU representative told my colleague, “the list isn’t closed, but it isn’t open either”). Most drone R&D and prototyping thus requires an exception to policy to scale, widening the acquisitions “valley of death.”

US industrial policy since 2017 helped save the American drone industry and prevent full monopolization by DJI, but the industry is deeply unhealthy. No company can compete with DJI in the consumer space. The commercial market holds tremendous potential, but the Federal Aviation Administration’s (FAA) slow development of commercial drone regulations has limited that industry’s growth. Government remains the most viable market for many drone companies, but broken DOD processes make it difficult or impossible for many drone companies to sell to government.

Even approved Blue UAS companies continue to struggle because of DOD’s paltry purchasing. In 2020, DIU worked with the White House Office of Science and Technology Policy to compute the aggregate demand for small drones across the entirety of the federal, state, and local government. Forecasting a precise number was impossible, but one thing was clear: the number was much too small to sustain a thriving American drone industry.[22] Many government organizations, which cannot afford military pricing, have pleaded with Congress to avoid banning affordable drones from DJI or other Chinese companies.[23]

This was the precarious situation entering 2022, when Russian forces invaded Ukraine. The PRC dominated the small drone industry. Most American competitors to DJI had failed. SRR gave several US and allied companies a lifeline, the Blue UAS initiative created a notional pathway for other companies to sell to DOD, and NDAA language sought to excise the PRC from drone supply chains and protect US industry. However, a chaotic policy environment and low government purchase quantities left the US small drone industry in a precarious state. American drone companies struggled to earn enough revenue to survive and flourish. Lower-cost components from China continued to dominate the global supply chain, and low-cost drones from China's DJI remained the best in the world. Visionaries understood that small drones would play an important role on the battlefield, but the DOD was not willing to commit serious resources or alter its slow-moving acquisition system.

The Ukraine war quickly demonstrated the revolutionary potential of drones and illustrated the military implications of the troubled drone industry.

The Drone War in Ukraine

Any proposal to supply Taiwan with small drones must be rooted in a deep understanding of the role drones play in Ukraine. Small drones have been used in many conflicts before, including the Russo-Ukrainian War of 2014, the Syrian Civil War, and the Second Nagorno-Karabakh War between Armenia and Azerbaijan. Ukraine is not, as some pundits breathlessly declare, the world's "first drone war."[24] However, the scale of drone usage by both Ukraine and Russia is unprecedented.

Small drones perform a wide variety of roles in Ukraine. They provide distributed ISR for frontline forces, perform battle-damage assessment, and document war crimes. Small drones have revolutionized artillery spotting, providing targeting adjustments that help artillery units precisely strike targets.[25] In a war that depends so critically on limited munitions stockpiles, these accuracy improvements can constitute a strategic advantage. Armed FPV racing drones have proved effective at striking individual soldiers or even tanks.[26] The constant threat of drones has helped to freeze the front lines. "It's a war of armor against projectiles," a Ukrainian drone operator told one reporter. "At the moment projectiles are winning, and NATO doctrine is 'pretty much obsolete.' "[27] Additionally, long-range, fixed-wing drones can penetrate deep behind enemy lines to destroy parked aircraft, military production facilities, and energy infrastructure.[28]

The same technology enabling small drones is also enabling greater autonomy in other domains. Popular autopilots can be configured out of the box to control airplanes, multicopters, boats, submarines, or ground vehicles. In October 2022, the Ukrainians used a combination of unmanned surface vehicles and aerial drones to attack the Russian fleet at Sevastopol, damaging two warships. A year later, after a further series of attacks on Sevastopol, Russia withdrew much of its vulnerable Black Sea fleet.[29] In August 2023 Ukraine stood up an entire unit dedicated to explosive naval drones.[30] Ukraine and Russia have both deployed unmanned ground vehicles (UGV), which can carry more weight than aerial drones. Although the impact of UGVs has been limited in Ukraine, both sides are actively investing in and experimenting with UGV capability.[31]

The scale of drone operations in Ukraine is staggering. In a May 2023 report, the Royal United Services Institute estimated that Ukraine alone was losing 10,000 drones per month.[32] In February 2024, Ukrainian sources told journalists that Ukrainian production had increased from 5,000 drones per month a year ago to 50,000 per month.[33] According to Ukraine's minister for digital transformation, Kyiv ordered production of 300,000 drones in 2023. Ukraine has contracted to buy 1.8 million drones in 2024 and 2025.[34]

Ukraine and Russia are both heavily reliant on a China-centric supply chain. DJI drones continue to be the best ready-to-fly drones in the world and are favored by both sides for ISR. A wide range of do-it-yourself drones, including long-range fixed-wing and small FPV models, rely on components manufactured in China. After years of weak sales, the Ukraine war has delivered a windfall to drone and component manufacturers. Although hard data is difficult to come by, it appears far more profitable for a company to sell enormous volumes of inexpensive hobby-grade components to Ukraine rather than selling a few hundred expensive, NDAA-compliant parts to the DOD. Incentives for original equipment manufacturers to fully remove China from the supply chain are weak.

The Ukraine War has also exposed an urgent and embarrassing problem for the United States: Many US systems have performed extremely poorly because of the electronic warfare environment. Russian jamming of GPS and datalinks means that many drones cannot takeoff, navigate, or communicate with operators. Even some of DOD's prized "Program of Record" drones, which have been through a rigorous requirements process and formal testing and evaluation, have performed poorly in this environment.[35]

The intense demands of drone warfare in Ukraine have created an environment of continual experimentation and adaptation. Ukraine's government initially supported a large crowdfunding campaign called the Army of Drones. With help from celebrity supporters like Mark Hamill of *Star Wars* fame, the campaign raised over $108 million. The government also loosened import laws and eliminated taxes for drone components.[36] Ukraine has largely relied on an artisan model of drone production; many companies are small, secretive, and funded through private donations or grassroots networks. Ukraine's prime minister has estimated that the country now has more than 200 domestic companies producing drones, with output a hundred times higher in 2023 than the year before.[37] Savvy Ukrainians continually experiment with new technologies needed on the modern battlefield. These include GPS-denied navigation technologies, autonomous targeting systems based on computer vision, and explosively formed penetrator antitank munitions for quadcopters.[38] Russia, for its part, has scaled industrial drone production and can now outproduce Ukraine.[39] Its drones remain inferior to Ukraine's, but Russia's industrial might confers a significant advantage.

Drone warfare in Ukraine holds important lessons for the future. Drones will be ubiquitous on the battlefield. Even if they are not decisive in and of themselves, they will be an integral part of any combatant's force mix. Modern military forces will need huge numbers of attritable drones, so they will need to rely on a flexible and scalable manufacturing base. Drones will need to be low cost to be acquired at scale. Requirements will likely evolve with the conflict, so war fighters and drone suppliers will need to partner and iterate quickly.

All of this is very different from how the United States is postured today. These challenges become apparent when we consider what it would take to field drones at scale in Taiwan.

Autonomous Systems and Taiwan Deterrence

Before considering the challenges, it is helpful to consider the value that small drones could conceivably bring to Taiwan. Per the *2022 US National Defense Strategy*, US policy is "to sustain and strengthen US deterrence," with the PRC named as the Department's pacing challenge.[40] A concerted US-led effort to fortify Taiwan with small drones would strengthen deterrence in at least four ways: the campaign would help neutralize an obvious PRC advantage, show responsiveness to changing technology and battlefield lessons from Ukraine, give Taiwan a decentralized and flexible way to inflict harm on PRC forces, and strengthen the West's industrial base in a tech sector that the PRC has traditionally dominated.

First, a heavy investment in sUAS for Taiwan would help neutralize the PRC's asymmetric battlefield advantage with small drone technology. DJI retains its near-monopoly in the consumer market, DJIs remain the drone of choice for ISR missions in Ukraine, and the majority of drone components rely on Chinese supply chains. In the event of war, the PRC could bring all this industrial might to bear on Taiwan while choking off Taiwan's own drone supply. This dire imbalance calls for swift, large-scale intervention before shooting starts. While achieving battlefield parity with the PRC would be difficult, flooding Taiwan with small drones would at least erode China's advantage. Chinese Communist Party decision-makers would be forced to consider small drone threats in their operational and strategic calculations, while combat units would be forced to look to the skies and proactively defend themselves from aerial threats.

Second, a concerted effort to arm Taiwan with small drones would show responsiveness to both technological trends and battlefield lessons from Ukraine. Given the notorious slowness of military forces to adapt to change, rapid adaptation of sUAS would signal the seriousness and commitment of American and Taiwanese decision-makers. This signaling is especially important given Taiwan's traditional focus on large, expensive, legacy weapons systems that are unlikely to survive the opening salvos of an invasion.

Third, a fleet of sUAS would offer Taiwan a decentralized, flexible way to inflict losses on the PRC. Various war games and analyses suggest the PRC could cripple most of Taiwan's military forces in the opening phase of an invasion, leaving Taiwan defenseless.[41] One obvious way to improve resilience is to decentralize Taiwan's military forces by investing in larger numbers of less exquisite systems. sUAS offer an inexpensive way to decentralize combat power, survive the opening salvos of a war, and continue inflicting losses on PRC forces.

Small drones could perform three critical mission sets that would raise costs for a PRC invasion. First, they could directly target an invasion fleet. Second, in the event of a successful invasion, Taiwanese insurgents could employ them for ISR, strikes, or public affairs. Third, Taiwanese insurgents could possibly use fixed-wing sUAS to strike the Chinese mainland.

The first and most obvious role for sUAS is targeting a PRC invasion force. Open sources estimate the People's Liberation Army Navy could transport 20,000 troops in a single lift using 70 amphibious ships.[42] Crossing the 150-mile-wide Taiwan Strait would be exceedingly dangerous for the PRC, especially given Taiwanese defenses and the scarcity of suitable beaches. A ready arsenal of armed drones would ratchet up this danger. The DOD has already embraced this principle, at least in theory, with PACFLEET's "hellscape" concept envisioning using "thousands of lethal drones on, above and under the sea" to wreak havoc on a PRC invasion force.[43] Larger military-grade drones and loitering munitions would be essential for operationalizing this vision, but large numbers of smaller drones could augment this force. Small drones could assist with target identification and tracking, perform battle damage assessment, confuse enemy radars and fire control solutions, and even provide additional kinetic capability.[44]

Small drones could also serve as potent weapons for Taiwanese insurgents, contributing to a larger "porcupine strategy," if the island is overrun. Taiwan has a population of more than 23 million, and approximately two-thirds of the island is mountainous.[45] Subduing Taiwan would be a formidable challenge. Admiral Lee Hsi-min, retired, chief of staff of Taiwan's armed forces from 2017 to 2019, oversaw the release of a new Overall Defense Concept that called for using "a large number of small things" to create lethal, survivable, asymmetric advantages. Ubiquitous small drones would create a persistent sense of threat and complicate PRC efforts to control the island.

Finally, fixed-wing sUAS could potentially reach the Chinese mainland. In the same way that Ukrainians have launched spectacular high-profile attacks deep within Russia, Taiwanese insurgents—even those not reporting to Taiwan's military—could impose costs on the Chinese homeland. Such grassroots attacks would be controversial and potentially dangerous, but that is precisely the point. Thomas Schelling famously wrote that to win a game of chicken—in which two drivers race at each other to see who flinches first—one should throw away the steering wheel and ensure your opponent sees you do it.[46] By decentralizing the means of violence, the Taiwanese government would create unpredictability and elevate the risk of dangerous escalation. These risks could bolster deterrence.

Equipping Taiwan with large fleets of drones would ultimately bolster deterrence in a fourth and less direct way: by strengthening the drone industrial base outside the PRC. A sustained, large-scale drone fielding program would infuse much-needed capital into the drone industry. This would help companies flourish, drive down unit costs, and lay a more sustainable foundation for ongoing technological competition with the PRC.

The Challenges of Providing Small Drones to Taiwan

Realizing this vision will be difficult because of the reciprocal relationship between drone technology and market conditions today. The US military is woefully unprepared for the type and scale of drone warfare on display in Ukraine. Defense acquisitions systems optimized for exquisite weapons systems are still largely incapable of delivering drones at low cost or in large numbers. This has throttled the drone industry, which in turn means that industry cannot currently deliver drone fleets like those seen in Ukraine. Absent meaningful reform in how government procures, the PRC will win the small drone war before the shooting starts.

Despite a whole-of-government effort to save the drone industry since 2018, US government procurement of small drones remains paltry. Sales of Chinese drones provide a striking reference point. The FAA states that approximately 800,000 drones have been registered in the United States as of December 2023.[47] Most estimates place DJI's market share at over 70 percent, and many companies in the remaining 30 percent are either based in China or use components sourced from China.[48] A highly conservative estimate of $1,000 per drone would mean that industry has sold over $8 billion worth of drones, most of which have China-dependent supply chains.

The US government's aggregate purchasing of drones is vanishingly small in comparison. The Army's SRR program, probably the largest quadcopter Program of Record in the DOD, awarded a production contract with a maximum ceiling of $99.8 million over five years but awarded only $20.2 million in the base year.[49] The Army only purchased 540 total systems across FY20 and FY21, with 215 planned in FY22.[50] SRR obligations were $6.7 million in FY23 and $20.8 in FY24; at the published unit cost of $39,806, that equates to roughly 170 and 520 drones respectively.[51] In 2018 the US Marine Corps launched its most ambitious effort yet to field quadcopters at the squad level. Its purchase order was for 800 drones.[52] In summary, the Army and Marine Corps bought as many quadcopters over a four-year period as the Ukrainians expend every five days.[53]

These purchase volumes are far too low to sustain one cutting-edge drone company, let alone an industry. Founders and investors are eager to provide new drone technology and have taken tremendous risks to build world-class companies, often in response to calls from senior DOD leadership. To date, however, DOD has not shown a serious willingness to buy. Weak procurement could ultimately kill America's flagship companies and sour a generation of patriotic venture capitalists.

The numbers are worrying. Drone maker Skydio has raised $562 million in venture funding, including a $230 million Series E round in 2023 at a $2.2 billion valuation.[54] Given such a high valuation, the Army's purchase of fewer than 2,000 drones is alarming. Furthermore, in late 2024, Skydio lost the SRR contract to Red Cat Holdings.[55] Shield AI, another drone company, is valued at $2.8 billion and raised a Series F round of over $500 million in late 2023.[56] However, aggregate government contracts reported on usaspending.gov are only in the tens of millions.[57] In a recent interview, the exasperated CEO of a drone company told me that every US general officer he speaks with wants his company to show "scalability," but nobody in DOD is actually purchasing drones.[58] Other drone company executives have expressed similar frustrations.

This mismatch between government rhetoric, investor expectations, and actual procurement is untenable. The industry cannot turn on a dime. Designing and building new drones is capital-intensive, and DOD has unique requirements. If companies cannot get purchase guarantees, designing and building new defense-focused drones will be seen as a risky or losing proposition. DOD currently has a window of opportunity to grow a wide range of small, innovative drone companies. If that window closes and these companies fold, DOD will have no choice but to continue relying on major defense primes that charge outrageous prices for technology that lags behind China's.

DOD appears to recognize the need for disruptive action, as evidenced by Deputy Secretary of Defense Kathleen Hicks's announcement of the Replicator initiative in August 2023. The goal of Replicator, Hicks said, was "to field attritable, autonomous systems at a scale of multiple thousands [and] in multiple domains within the next 18-to-24 months."[59] Hicks grounded Replicator in competition with the PRC and emphasized the need to counter the PRC's advantage in mass. Her vision was for large numbers of inexpensive systems, which could create "new concepts and new ways to fight." Replicator would catalyze the development of these technologies and help DOD overcome the production valley of death.

Replicator is the right idea at the right time, but it has been plagued by challenges and does not go far enough. Hicks gave the department a vision but not necessarily a game plan; for that, she turned to the DIU, the military services, and the combatant commands.[60] Furthermore, she announced at the outset that Replicator would not be a Program of Record and would not require new funding. She said, "We're not creating a new bureaucracy, and we will not be asking for new money in [fiscal 2024]. Not all problems need new money; we are problem-solvers, and we intend to self-solve." The initiative would use "existing funding, existing programming lines, and existing authorities to accelerate production and delivery at scale."

Unfortunately, even the clearest vision gets diluted when executed through a bureaucracy, especially one as large as the Department of Defense. From a staff perspective, Replicator came down as an urgent tasker that needed to be promptly satisfied. Staff responded admirably, working aggressively to meet the deputy secretary's intent. However, public reporting and my own interviews among DOD stakeholders and industry executives suggests that DOD never truly developed a strategy for Replicator that would meet both United States Indo-Pacific Command needs and address gaps within industry.

Replicator has suffered from two significant problems from the outset: a lack of funding and a lack of transparency. Many observers believe that the "no new funding" mantra indicates DOD is not actually serious about scaling autonomy. Companies that build low-cost attritable technology need large, recurring, and predictable purchase orders to flourish. Christian Brose, Chief Strategy Officer at Anduril, said that DOD has a long history of ambitious announcements without adequate follow-through. "The question is: Is this one going to turn into a meaningful procurement program?"[61] By not funding Replicator or explicitly sheltering it in a Program of Record—which is the only secure way to sustain procurement in today's Department of Defense—the department has put Replicator's future on shaky ground. In March 2024 Hicks said the initiative would cost around $1 billion across FY24 and FY25, but the details of how this would be funded were ambiguous, and the Pentagon eventually insisted the details would be classified.[62]

DOD has also been tight-lipped about Replicator, which has created tremendous frustration in industry. Hicks initially advertised Replicator as an opportunity for industry, saying, "We're open for business." Within months, questions were swirling. Industry executives were caught off guard and waited cautiously for details about how to compete. Those details never arrived. In October 2023, Representative Mike Gallagher told a Congressional subcommittee, "The American people are still left without any details on Replicator."[63] In November, Hicks said the DOD would select its first tranche of systems the next month. In December Hicks traveled to the DIU, met with executives from nine companies, and visited two companies.[64] The invite-only meeting created great consternation from companies still expecting instructions on how to compete for Replicator. That consternation grew to fever pitch in January, when Hicks announced that DOD had selected the first tranche of companies before Christmas.[65] The selectees were classified. This undermined the DOD's implied intent for Replicator and crushed industry's expectations while also sheltering Replicator from scrutiny.

It appears that Replicator has fielded real capability. In November 2024, Hicks stated that Replicator awarded contracts to more than thirty hardware and software companies.[66] However, the aggressive timeline meant pouring additional resources into existing capabilities. More than half of Replicator's fielded systems will be Switchblade 600 kamikaze drones.[67] The limited opportunities for new entrants is exacerbating the industry's crisis.

Furthermore, the future of Replicator appears murky. Deputy Secretary Hicks showed great leadership in driving Replicator forward and was personally involved in finding funding, but her departure from the DOD in January 2025 raises questions about the program's longevity. Replicator is aimed at all-domain autonomy, not just small drones. However, all public evidence suggests that Replicator has done little to change the health of the small drone industry; DOD procurement of small drones remains untenably low, meaning Taiwan won't have the small drones it needs to deter or fight a PRC invasion.

Recommendations

The Department of Defense still has an opportunity to improve Taiwanese deterrence, invest in the future of sUAS, and bolster the drone industrial base. However, it must act quickly and make a radical departure from its current acquisitions approach.

First, DOD must make large, recurring purchase commitments to drone manufacturers. This is the single most important investment DOD can make to ensure a healthy drone industrial base. This funding should be placed into the federal budget for years to come, with the expectation of completely refreshing drone fleets every few years, in the same way that DOD replaces computers and mobile phones.

This does not necessarily mean DOD needs to commit to specific companies for the long haul—ongoing competition is important—but it must create orderly, transparent, and meaningful opportunities for companies to sell to DOD at regular intervals. How to do this is an open question, but multiyear weapons purchasing authorities first granted in the 2023 NDAA might help.[68]

Recurring purchases are essential. Drone technology evolves rapidly, and drones purchased today will likely not survive on tomorrow's battlefield. The poor performance of many US drone systems in Ukraine should serve as a cautionary tale. The way to remain competitive is to iterate quickly, and iteration requires regular generational replacements informed by real-world experience. It also demands a new way of thinking about requirements. Drone procurement needs to be exempted from a traditional Program of Record requirements process, or else requirements need to be written flexibly enough to allow for future, unforeseen technological developments.

Second, the US should use Ukraine and other contemporary conflicts as a form of operational testing. To the maximum extent possible, the Department of Defense should help Western drone companies establish a presence close to the front lines, where their engineers and designers can interact with the war fighters using their technology. Soldier feedback should not come only at major milestones but also continuously, including during war. This will require active effort from entities like the DIU and United States European Command, which can facilitate relationships and help companies gain entry to Ukraine. Battlefield lessons should guide regular software updates and the design of next-generation products. Companies that repeatedly fail to adapt to the battlefield should lose their contracts; strong new performers should be rewarded. A continuous, combat-driven requirements mindset could also help chip away at DOD's calcified, formal requirements process, which often impedes innovation, drives up costs, and delivers technology unsuitable for the modern battlefield. The Test and Evaluation community will not enact such a sweeping change itself; such a move would require leadership from the top of the Defense Department or even Congress.

Third, DOD must overhaul a deeply flawed security evaluation process that continues to shut many innovative drone companies out of government sales. DOD should do what DOD staff proposed six years ago, days after the COTS drone ban: establish a clear standard for drone security, along with a clear process for certification, and empower and fund an organization to say yes. Furthermore, DOD should adopt a "continuous Authority to Operate (ATO)" approach to cybersecurity, which would allow vendors to push continual software updates to drone fleets. This is best practice in modern software development and will allow drone vendors and users to collaboratively improve their products in real-time. Clear rules for "getting to yes" would empower war fighters to acquire the best drone technology and would give drone companies an honest shot at taking their product to the government market.

Fourth, DOD should send vast numbers of its newly acquired small drones to Taiwan and US bases in the Pacific. This would put the US drone industry to work to achieve an important purpose: rapidly bolstering deterrence in the Pacific. These drones should not sit idle. Military forces should train with them, incorporate them into exercises, and integrate them into operational activities. Distributing technical and operational knowhow across military forces will amplify the value of the drones themselves. The United States should make plans now to continually replace these drones as new generations arrive on the market. Taiwan should consider standing up drone "monster garages" in the same way that the DOD has stood up teams like DIU's Rogue Squadron, CENTCOM's Task Force 99 at Al Udeid Air Base, or the Navy's task Force 59.

Another, less direct way to bolster Taiwanese deterrence is to build up drone programs in universities, police, and other civil organizations on the island. The Ukraine war has demonstrated how a smart, entrepreneurial population can rapidly build and adapt technology when called upon to do so. Drone engineering programs in Taiwanese universities would graduate experienced engineers who can grow Taiwan's technology industries while also providing drone expertise in the event of a conflict. Stockpiled drone components would be useful for academic projects but would also be available in the event of war.

Fifth, and related, the US should support the manufacturing of drones and related technology in Taiwan. NDAA language prohibiting government purchase of Chinese drones and components, and a general wariness of Chinese technology, have led the drone industry to search for manufacturing hubs outside of China. Taiwan is an attractive location and has already drawn market-leading companies, such as CubePilot, which manufacture the most widely used autopilots in the small drone industry. Taiwan is also building its own domestic drone industry, partly in response to lessons from Ukraine.[69] Encouraging the growth of a drone industry in Taiwan will develop local expertise, allow stockpiling of drones and related hardware, and increase local scaling capacity. However, current US policy complicates this goal. Given that the US does not formally recognize Taiwan as a state, its status under the NDAA ban on Chinese drones is murky. Risk-averse government bureaucrats, encouraged by lobbying from some American companies, frequently prohibit US government purchasing of Taiwan-manufactured drone technology because it is "Chinese." Adding clarifying language about Taiwan to the NDAA drone language would be an immediate, actionable way to remedy this problem.

Conclusion

If the greatest window of threat to Taiwan is indeed in the next few years, as many analysts believe, then Taiwan and its partners must act quickly to bolster deterrence. The Ukraine war has dramatically shown the importance of sUAS in modern warfare, but the PRC has a significant advantage thanks to the strength of its drone industrial base. The US industry's collapse in 2017 set the stage for a PRC near monopoly. Government efforts to save the US drone industry have been hampered by paltry purchasing; an acquisitions system poorly suited for fast-moving emerging technology; and an incoherent, ill-defined, and poorly resourced security validation process that shuts many drone companies out of the market.

Leveling the playing field for sUAS could quickly erode one of the PRC's advantages, bolster Taiwanese deterrence, and strengthen the drone industry in the United States and allied or partner countries. This is exactly what Replicator was intended to do, but Replicator is only the beginning. DOD must undertake significant reforms to achieve the vision that Hicks laid out for Replicator.

Senior leaders increasingly agree that the United States needs to field larger numbers of lower-cost systems. The Ukraine War illustrates why, and we have no reason to believe that small drones will be any less important in a Taiwan conflict scenario. However, given the shape of today's drone industry, the PRC will hold all the cards. To change that, DOD will have to engage in a task that is both easy and hard: put its money where its mouth is.

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18. Assessing these claims is difficult and beyond the scope of this chapter. DJI is guilty of sloppy security practices over the years and does indeed collect data from users. It is difficult to tell whether this is deliberate espionage or the same kind of invasive data collection that US tech companies continually engage in. DJI insists users have control over their own data and has steadily improved its security over the years. Different US government assessments have reached starkly different assessments about the level of threat.

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Chapter 5

Restoring Taiwan's Air Force Deterrent Through Fielding Group 5 Short Takeoff and Vertical Landing Unmanned Aerial Vehicles

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Abstract

Taiwan's Air Force (TAF) stands at an inflection point. In a conflict with the People's Republic of China (PRC), it would be outmatched. The TAF's current modernization of advanced fourth-generation fighters is cost-prohibitive and will not change the balance of power versus the People's Liberation Army Air Force (PLAAF). Group 5 short takeoff and vertical landing (STOVL) unmanned aerial vehicles (UAV) offer an asymmetric approach to Taiwan's airpower problem. These UAVs can provide a more survivable solution to the TAF through improved mass, maneuver, and concealment. These UAVs are less expensive than the TAF's current acquisition of fourth-generation fighters. This capability can be fielded in mass before the decade's end and would represent one of the few new advanced capabilities the TAF could deploy in the near term to increase deterrence with the People's Republic of China (PRC).

Chinese Language Abstract

在與主要對手解放軍空軍（PLAAF）的可能衝突中，臺灣空軍的裝備不足以應對這種衝突，臺灣空軍正處於一個關鍵轉折點。臺灣空軍目前採購的第四代戰鬥機成本高昂，且無法在數量上改變與解放軍空軍的力量對比。第五級短距離起飛和垂直降落（STOVL）無人機（UAV）為臺灣與解放軍空軍的空中武力衝突問題提供一種不對稱的解決方案。這些無人機可以透過提高數量、機動性和隱蔽性，為臺灣空軍提供一個更具生存能力的解決方案。這些無人機比臺灣空軍目前採購的第四代戰鬥機成本更低，並且可以在十年內達到大量部署。這種不對稱能力是臺灣空軍少數可以在短期內部署的新型國防科技產物，並可增強對中國的嚇阻

Figure 5.1. Proposed Taiwan Air Force MQ-58 (Used by permission of Kratos Unmanned Aerial Systems Inc.)

Introduction

After a multi-day PRC joint fires campaign, TAF is a shell of its former self. Its air bases and logistics have been destroyed, along with a large percentage of its combat aircraft. What is left of the TAF will not survive the coming onslaught of the PLAAF. This is the narrative of many war games of a hypothetical war between the PRC and Taiwan, but it does not have to be this dire.[1] The TAF faces an overwhelming threat from the PLAAF and the People's Liberation Army Rocket Forces (PLARF). The PLAAF has both a qualitative and quantitative advantage over the TAF. Simultaneously, the PLARF holds Taiwan's air bases at risk of destruction with well over a thousand ballistic missiles and thousands of rockets.[2] Dispersing TAF squadrons into smaller units to nontraditional locations in Taiwan, similar to the United States Air Force's (USAF) Agile Combat Employment (ACE), may reduce the loss of some TAF aircraft. Still, the magazine depth of the PLARF's ballistic missiles coupled with the rapid target acquisition of the PRC's intelligence, surveillance, and reconnaissance (ISR) apparatus make ACE less survivable.[3] Group 5 STOVL Unmanned Combat Aerial Vehicles (UCAV) offer a more survivable solution to Taiwan, through improved mass, maneuver, and concealment. While these UAVs are not as capable as manned fighters, they are relatively inexpensive when compared to the current acquisition of the F-16V, ranging from just over $1 million to $7 million depending on capability.[4] The TAF could field anywhere between six to fifty UCAVs compared to a single

F-16V, meaning that the TAF would be able to provide airpower in mass even under this anticipated operating environment.

Group 5 STOVL UAVs are one of the few areas where the TAF could increase deterrence against the PRC in this decade due to their near-term availability, coupled with advanced long-range capabilities and low cost, allowing attritable mass. These UAVs represent a new advanced capability that creates complex problem sets for the PRC, more specifically the PLAAF. This future asymmetric approach to the TAF would represent a credible threat to the PRC. These UAVs can challenge many of the fundamental requirements of the Joint Island Landing Campaign (JILC), specifically air superiority, secure logistics, and an uncontested amphibious landing, in novel ways that are currently unavailable to the TAF.

Current State of the TAF

At the turn of the century, the TAF had a qualitative advantage, and it was possible to achieve localized air superiority in a potential conflict. Today, the TAF is aging and ill equipped to handle the threat it faces from across the strait. The combat air fleet of the TAF is composed of 141 upgraded F-16A/Bs, 126 Indigenous Defense Fighters FCK-1s, and fifty-seven Mirage 2000-5s.[5] These approximately 300 fourth-generation fighters are over twenty years old and face over 1,300 younger PLAAF fourth- and fifth-generation fighters.[6] The TAF has been approved for sixty-six newly built F-16Vs, but these will not be delivered until the end of 2026 and are set to replace the last sixty F-5s, retiring this year after over forty years of service. This procurement does not increase the size of the combat fleet; instead, it increases the lethality of the TAF—at a cost of $8 billion.[7] The United States is the only country willing to sell advanced weapon systems to Taiwan openly, but it has been unwilling to sell its most advanced systems, such as the F-35. This leaves the F-16V as the most logical choice to modernize the TAF, but the total recapitalization of the TAF combat fleet with F-16Vs would cost roughly $36 billion or just under twice the entire Taiwan defense budget of $19 billion.[8] This approach is unaffordable and unadvisable. Even with the acquisition of over 300 brand-new F-16Vs, by the time the recapitalization was complete, the PLAAF would have well over 500 fifth-generation fighters, resulting in qualitative and quantitative disadvantage for the TAF.[9]

To add to this growing disparity in the air, the TAF is unlikely to survive the multiple days of the PRC's joint fire campaign. RAND studies estimate that it would take approximately forty ballistic missiles to disable an airbase by destroying upward of 80 percent of unsheltered aircraft, hitting key taxiways and runways, and scattering submunitions across the base to interfere with the ability of repair crews.[10] With almost 3,000 ballistic missiles in its inventory, the PRC would be able to disable approximately seventy air bases. The depth of the People's Liberation Army's (PLA) missiles exceeds the number of available air bases for fighter operations on the island of Taiwan. Furthermore, even if Taiwan were to use a strategy of dispersion, like the USAF's ACE concept, by 2030 the PRC's intelligence satellite network will be able to locate any TAF forward operating location in Taiwan in just over ten minutes.[11] Any piece of concrete on the island of Taiwan that can support fighter operations will be found, fixed, and targeted in less than an hour. This PRC satellite capability would add to the hundreds of PLAAF UAVs and balloons that conduct similar missions. In a conflict with the PRC, the combat fleet of the TAF will effectively have nowhere to hide. The TAF's combination of an aging and less advanced combat air fleet coupled with the vulnerability of sustaining air operations from the PRC's ballistic missile force drives the need for a new approach for its combat aircraft fleet. Group 5 STOVL UCAVs can fill gaps in the TAF by providing high-end combat capability with affordable mass.

What Is a Group 5 Unmanned Aerial Vehicle?

In 2011, the Department of Defense (DOD) standardized the categorization of the growing list of UAVs into five groups. Group 1 UAVs are typically hand-launched, self-contained, portable systems employed for "over the hill" or "around the corner" reconnaissance and surveillance similar to the popular first-person drones used in Ukraine. Group 2 UAVs are small to medium in size and usually utilized in support of an army brigade's ISR and target acquisition requirements, much like the Scan Eagle.[12] Group 3 UAVs operate at medium altitudes with medium to long range and endurance; an example is the RQ-7 Shadow.[13] Group 4 UAVs are relatively large UAVs that operate at medium to high altitudes and have extended range and endurance. The most famous example is the MQ-1 Predator.[14] Group 5 UAVs are the largest systems, operate at medium to high altitudes, and have the greatest range, endurance, and airspeed capabilities. They typically weigh more than 1,300 pounds and operate at altitudes higher than 18,000 feet mean sea level at any speed.

This category has a large range of airframe possibilities, but the best-known examples are the RQ-4 Global Hawk and the MQ-9 Reaper.

Each class of UAV has its advantages and disadvantages regarding cost and capability. The wide range of UAV classes allows for militaries to find an optimal balance between mass and mission sets. The small UAVs allow for a large mass of expendable weapons systems, while the large UAVs are more advanced and allow for a high-end capability that can still achieve mass, but they should only be expended if the mission requires it.

The Elephant in the Room

Currently, many experts are calling for the Ukrainian model of smaller, cheaper, and expendable UAVs that can be produced in mass. There are three reasons why this research focuses on Group 5 STOVL UAVs instead of smaller UAVs: First, the research and operational results are clear: smaller UAVs must be a part of the overall solution. Second, Taiwan already has the demonstrated capability to build smaller cheaper UAVs. Third, there is still a need for a larger UAVs as part of an overall force mixture.

Smaller UAVs such as the Group 1 Ukrainian first-person UAVs and the larger Group 3 Iranian Shahed-136 UAVs used by Russia have been a new evolution in the war in Ukraine; the availability and affordability of UAVs provide greater operational reach per dollar and at every echelon than in previous generations.[15] It would be unwise for a modern military to ignore this evolution, especially in Taiwan. These UAVs provide an asymmetric threat to the PLA and would create complex problems for the PLA in the event of a conflict. These systems are part of the overall solution for the defense of Taiwan.

Taiwan has recognized this revolution and has invested in its domestic industries to produce these new systems in mass.[16] Additionally, Taiwan fielded a UAV similar to the Iranian Shahed-136 back in 2017, the *Chien Hsiang*. These domestic UAVs were originally designed for suppression of enemy air defense systems, but new variants are being built as one-way attack drones.[17]

The evolution of UAVs in the Russo-Ukraine war has been impressive, but there are some drawbacks to these systems. The low cost of these systems is due to design choices that result in short-range, small payloads, and single-purpose use. Additionally, the interception rates for the Shahed-style weapons have been high in the war, with sources claiming Ukraine Air Defense destroyed up to 85 percent of Shahed-136s.[18] While details are limited, 100 percent of Iran's low-cost drones were intercepted by Israel and coalition forces on April 13, 2024, in what was the largest mass, long-range strike in the region up to that time.[19] These systems have their place in a modern military force structure, but clearly, there is room for more capable systems.

Why Group 5 UAVs for the TAF?

As the largest of the UAV categories, Group 5 UAVs often have the most range, speed, and capability but are still quite affordable compared to manned aircraft. Group 5 UAVs have been around for over sixty years, with Lockheed first flying the AQM-60 Kingfisher in 1951. In the last fifteen years, Group 5 UAVs have matured to the point that they have now proliferated en masse and are available for export from several different countries.[20] TAF requires other UAV categories, but Group 5 UAVs should be the focus for six main reasons: high-end combat capability, long-range, affordable mass, survivability, flexibility, and STOVL.

First, the TAF needs high-end firepower to challenge the PLAAF, and the recapitalization of the combat air fleet would be too costly and still leave the TAF at a disadvantage. Group 5 UAVs can carry fighter-sized weapons and sensors that the smaller groups cannot carry. This allows for advanced capabilities to supplement the current TAF fleet and has the added advantage of leveraging the same logistics system for both manned and unmanned fleets. The TAF can use the same bombs and missiles that are currently in TAF service to equip both fleets.

Second, Group 5 UAVs have the range and payload to conduct ISR and strikes at over twice the distance of the TAF's current fighter fleet, without the need for an aerial refueler. This capability solves a current shortfall in TAF capabilities. The XQ-58 for example has a maximum range of 3,000 nautical miles,[21] almost three times the maximum range of an F-16.[22] This long range and endurance allow the UAVs to place more PLA targets at risk than what is currently available to the TAF.

Third, the cost of this group of UAVs allows the TAF to procure them in large numbers and allows for the TAF to have a higher risk tolerance for their loss if the mission deems it necessary. The UTAP-22 costs between $2 and $3 million,[23] and the XQ-58 cost ranges between $2 and $6.5 million, depending on production quantities.[24] In contrast, the F-16 Block 70 cost approximately $65 million.[25] This allows the TAF to procure Group 5 UAVs at a rate of ten-to-one over the F-16s.

Fourth, some of the most modern Group 5 UAVs can be more survivable than many fourth-generation fighters and smaller UAVs. Modern Group 5 UAVs like the Kratos XQ-58 Valkyrie and Boeing MQ-28 Ghost Bat have low-observable characteristics, making them less detectable to the PLAAF.[26] Additionally, the UAVs are large enough to carry countermeasures to decrease the probability of kill. The low observability coupled with onboard countermeasures increases the survivability of these UAVs over most aircraft currently fielded by the TAF.

Fifth, these UAVs have the most flexibility in regard to mission sets. They are capable of ISR, strike, electronic warfare (EW), counter air, and serving as a loyal wingman. In addition, these UAVs can change mission sets after each flight, allowing the TAF to rapidly fill capability gaps in the event of a conflict with the PRC. This flexibility would be the key to continued air operations in the contested environment.

Sixth, some Group 5 UAVs, such as the UTAP-22 or the XQ-58, utilize rocket-assisted takeoffs (RATO) that allow the UAVs to take off without the need for a runway and land via a parachute system that brings the vehicle slowly back to the ground on a pad. This takeoff and recovery system will allow the UAVs to operate from areas that are slightly larger than the vehicle itself, like small parking lots. The size of these areas will strain the PRC's ability to create targeting solutions and will challenge the PLARF's missile magazine depth. Instead of surveilling dozens of known targets that are at least 5,000 feet long, the ISR network will have to surveil thousands of targets all over Taiwan, and if targeted, PLARF lacks the munitions to hit all possible targets.

What Mission Sets Should STOVLS UAVs Perform?

Group 5 UAVs are capable and flexible in the missions that they could perform for the TAF. The most likely mission sets that the TAF would need the UAVs to perform are ISR, strike, EW, loyal wingman, and defensive counterair (DCA). The TAF has gaps or limitations in all these mission sets, meaning the Group 5 UAVs would be capable of fulfilling these missions.

In the event of a conflict with the PLA, ISR would be a critical capability for Taiwan. The TAF plans to conduct ISR with a combination of F-16s equipped with MS-110 reconnaissance pods,[27] Indigenous UAV National Chung-Shan Institute of Science and Technology Teng Yun,[28] and the MQ-9 Sea Guardian.[29] The survivability of this combination is in doubt.[30] The American experiences with operating MQ-9s in lightly defended airspace have resulted in the downing of several of these UAVs, meaning the small numbers of TAF MQ-9s (four) and *Teng Yuns* (three) are unlikely to survive for an extended period against the advanced air defenses of the PLA. This would result in a gap in ISR in the early stages of a conflict. The TAF could field the UTAP-22 or XQ-58 to fill this gap. Because of their fighter-like performance and onboard countermeasures, these UAVs are more survivable than the MQ-9s and *Teng Yuns*. Additionally, with lower unit costs of $1–7 million versus $ 31 million,[31] these UAVs could be procured in larger numbers to allow for attrition during a conflict. The UTAP-22 and XQ-58 can be equipped with synthetic aperture radars, electro-optical-infrared sensors, or signals intelligence sensors. The XQ-58 would be more capable with its 600-pound internal payload versus the UTAP-22's 350-pound internal payload.[32] Both systems have long range and long endurance, allowing for persistent ISR. If the TAF could field a larger and more survivable fleet of UAVs, then it is more likely that Taiwan would be able to maintain ISR for longer in a conflict than currently planned.

The current TAF long-range strike capability solely resides in the F-CK-1 AIDC employing the Wan Chein air-launched cruise missile.[33] This is a serious limitation that allows the PLA sanctuary for its key enablers of a Taiwan invasion: the ballistic missile force, amphibious lift capability, airborne forces, and combat air force.[34] The UTAP-22 and XQ-58 have the range and payload to hold these key enablers at risk. If the TAF were to field these systems in large numbers, then the combination of mass and survivability could allow the TAF to contest the PLA's ability to project power.

The TAF has only one airborne EW platform, the outdated C-130HE. The capability gap decreases the survivability of the TAF fleet and cedes the electromagnetic spectrum to the PLA. The UTAP-22 and XQ-58 are both designed with EW as part of their mission sets. The UTAP-22 is a derivative of the USAF BQM-167 target drone, which normally carries EW systems to simulate a high-threat environment during missile testing.[35] The United States Marine Corps is currently testing EW systems on the XQ-58 as part of its Force Design 2030.[36] Introducing dedicated airborne EW to the TAF with UAVs could allow Taiwan to diversify its airborne EW portfolio and operate in the electromagnetic spectrum, thus complicating any PLA operation in a conflict.

The aging TAF combat fleet is less survivable every year, and a traditional recapitalization is cost-prohibitive. The UTAP-22 and XQ-58 are designed to be loyal wingmen to traditional manned fighters. In this role, these UAVs can provide additional sensing and weapons to increase the capability of their manned peers. This capability could be a force multiplier for the TAF, allowing for the numerically smaller force to increase the survivability of their limited fighter force and increase the lethality of the aging fleet.

In addition to the loyal wingman role, the XQ-58 can serve as a launch platform for the AIM-120 advanced medium-range air-to-air missile (AMRAAM).[37] This capability opens the option to use the platform for DCA missions. Each XQ-58 can carry two AMRAAMs externally, and if there were two XQ-58s paired with each F-16, this would result in double the available airborne air-to-air missiles for an employed F-16 squadron. The ability to employ larger numbers of air-to-air missiles could help curb the quantitative disparity between the TAF and PLAAF.

Lastly, in the competition phase between the TAF and PLAAF, the XQ-58 could be used to intercept PLAAF aircraft entering the Taiwan Air Defense Identification Zone (ADIZ) or Median Line, occurring almost 3,000 times a year.[38] Utilizing the XQ-58 for this mission could save airframe time on the TAF fighter fleet, allow for more operationally relevant training time, and save an estimated $905 million a year.[39] Overall, introducing a DCA UAV to the TAF would improve the capability of the force in peace and war.

What Are the Limitations and Vulnerabilities of These Systems?

One weapon system alone does not win a war, and when introducing a new weapons system, there should be an understanding of the limitations of that system. UAVs have several inherent limitations: they need a datalink for command and control (C2), their payloads are typically less than a manned aircraft, and their autonomy has not surpassed human pilot performance in complex situations. Group 5 UAVs suffer from all these limitations; however, there are some mitigations and risk acceptance for these limitations.

All UAVs require a datalink for C2 of the system. This requirement presents a risk for the operator of the system. If the adversary can degrade or deny the datalink to the UAV, it could become difficult for the UAV to continue its mission. The PLA has some of the most capable EW systems on the planet, so the risk of disruption to these datalinks is high.[40] Experiences in Ukraine suggest there are methods to overcome this disadvantage through spectrum management. Owing to classification and proprietary data, the specific counter-electronic warfare tactics are beyond the scope of this research; however, in general terms, Ukraine has successfully utilized multiple communications bands for C2 of its UAVs, switching between bands in the event of jamming.[41] Additionally, Ukraine has used airborne communication relays to overcome jamming with improved signal strength due to the closer proximity to the UAV.

The majority of Group 5 UAVs have lesser payload capability than traditional manned aircraft of a similar mission type. Considering this limitation on an aircraft-to-aircraft basis, when the cost of the procurement of the systems is factored into the equation, more UAVs can be procured in place of their manned peers. As an example, six XQ-58s can be procured at the cost of one F-16V, and those six XQ-58 could carry twelve AIM-120 AMRAAMs or twenty-four GBU-39 small-diameter bombs (SDB) or six GBU-38 500-pound Joint Direct Attack Munitions (JDAM) (versus the one F-16, which can carry six AIM-120 AMRAAMs [50 percent of the XQ-58] or eight GBU-39 SBD [33 percent], or four GBU-38 500-pound JDAMs [66 percent]). This payload increase allows UAVs to overcome the F-16 payload limitation because of the larger fleet size, and the UAVs allow for less capability-per-platform-loss throughout a conflict.

Autonomy in UAVs cannot rival human pilots in the overall complexity of war. However, these weapons systems are not designed or recommended to replace manned aircraft now. The autonomy gap can be overcome by the use of manned-unmanned teaming systems where the unmanned aircraft can autonomously fly to its assigned mission area, and when it begins its mission, a human in the loop can guide employment to close the autonomy gap.[42]

Does this Capability Represent a Deterrent to China?

Deterrence is communication between two parties, so understanding how the PRC views the subject is instructive on how best to achieve successful deterrence. Deterrence at the basic level is a given nation's capability coupled with credibility to inflict great harm if the target audience is unwilling to conform to the will of the deterring nation.[43] The Chinese Communist Party (CCP) views deterrence as fundamentally similar to this basic level of understanding.[44] The core components of CCP deterrence revolve around a nation's capability, resolve, and communication. The CCP specifically values a nation's "deterrence strength," which focuses on a nation's offensive military capability but also includes other sources of national power.[45] The STOVL Group 5 UAV would serve as a deterrent to the CCP for three reasons: First, it represents an increase in Taiwan's offensive military capability; second, it is an "advanced weapons system" that in the view of the CCP serves as a deterrence message; and third, publicly exercising the capabilities of the UAVs creates a credible threat to the CCP.

Currently, Taiwan's military power and specifically its offensive capabilities are in decline relative to China. Fielding these Group 5 UAVs would fulfill many requirements to serve as a deterrent to the CCP. The long range of these UAVs coupled with their ability to employ advanced weapons will create a new offensive capability that Taiwan does not have. As the CCP values a nation's offensive military capability as part of its understanding of deterrence, this increased capability could create an increase in deterrence for Taiwan versus China.

One of the ways that the CCP conducts deterrence actions is to "display advanced weapons."[46] By acquiring these Group 5 UAVs and then displaying them through both traditional and social media, Taiwan would be using the CCP handbook on deterrence against it. These weapons systems represent an advanced capability to the PLA, which is working to field a similar system, the FH-97 drone.[47] This would reinforce the deterrence message from Taiwan to the PRC that it is a capable adversary.

Another CCP deterrence action is "holding military exercises." When Taiwan fields these weapons systems, it should exercise the capability publicly. These exercises would prove to the CCP the credibility of these systems' survivability in combat operations against the PLA. This would create new complexities for PLA planners. The core tenets of the success of the JILC are air superiority and an uncontested landing.[48] If the TAF can message that the Group 5 UAVs are a credible capability to complicate the ability of the PLA to achieve air superiority and to contest a landing, then it is likely that the PLA would be deterred in the near term until these issues can be resolved.

What STOVL UAV Suppliers Exist Today, and Which Might Be Available to Taiwan?

There are multiple Group 5 UAVs available on the market today; however, many of these systems lack the features that the TAF requires. The chart below is a market survey of available Group 5 UCAVs.

Table 5.1. Comparison of Group 5 UCAV options

Name	*Manufacturer*	*Origin*	*First flight*	*Maturity*	*Available*	*Exportable*	*Air to air*	*Air to ground*	*Low observ-able*	*STOVL*
Fury	Anduril	USA	TBD	Development	No	No	Yes	Yes	Some	No
Akinci	Bayraktar	Turkey	2019	Production	Yes	Yes	Some	Yes	No	No
Kizilelma	Bayraktar	Turkey	2022	Testing	No	No	Yes	Yes	Some	Some
MQ-28	Boeing	Australia	2021	Testing	Yes	Yes	Yes	Yes	Some	No
Teng Yun	NCSIST	Taiwan	2018	Testing	Yes	No	No	Yes	No	No
Hermes 900	Elbit	Israel	2009	Production	Yes	Yes	No	Yes	No	No
MQ -9	GA-ASI	USA	2009	Production	Yes	Yes	Limited	Yes	No	No
MQ-20	GA-ASI	USA	2011	Testing	Yes	Yes	Yes	Yes	Some	No
XQ-67A	GA-ASI	USA	2024	Testing	No	No	Unknown	Unknown	Some	No
Eitan	IAI	Israel	2004	Production	Yes	Yes	No	Yes	No	No
UTAP-22	Kratos	USA	2015	Testing	Yes	Yes	No	Limited	No	Yes
XQ-58A	Kratos	USA	2019	Testing	Yes	Yes	Yes	Yes	Some	Yes
Anka-2	TAI	Turkey	2023	Testing	No	No	Unknown	Yes	Some	No
Aksungur	TAI	Turkey	2019	Production	Yes	Yes	No	Yes	No	No
Anka-1	TAI	Turkey	2010	Production	Yes	Yes	No	Yes	No	No

As table 5.1 illustrates, there are a few STOVL-capable Group 5 UAVs: Kratos UTAP-22, Kratos XQ-58, and the Bayraktar Kizilelma. The Bayraktar design is a short takeoff and short-landing drone designed to operate from the deck of an amphibious assault ship. This design is less than ideal for the survivable requirements of the TAF due to its requirement for a traditional runway for takeoff and landing, albeit shorter than traditional aircraft. This essentially leaves two contenders for this research: the Kratos UTAP-22 and Kratos XQ-58A. These designs are both RATO and parachute-assisted landing, giving both aircraft true STOVL capability. Additionally, the cost of the systems is relatively inexpensive by modern combat aircraft standards; the UTAP-22 is approximately $1 million and the XQ-58A is currently $7 million. The capability difference between the UTAP-22 and XQ-58A is vast, as seen in the chart below.

Table 5.2 Comparison of UTAP-22 and XQ-58A capabilities

Type	*Cost*	*Speed*	*Altitude*	*Range*	*Payload*	*LO*	*A2G*	*A2A*
UTAP-22	$1M	0.91 Mach	5,000ft	1,400 nm	1,350lbs	No	Yes	No
XQ-58A	$7M	0.85 Mach	4,500ft	3,000 nm	1,800lbs	Some	Yes	Yes

LO=low observable; A2G=air to ground; A2A=air to air

While the altitude and speed are similar between the airframes, the range, payload, survivability, and air-to-air capability favor the XQ-58A.

The United States has approved the export of the MQ-9B and F-16 Block 70 to Taiwan, representing the willingness of the US to export modern combat systems to Taiwan.[49] The XQ-58A does not represent a capability that is more advanced than these two systems, thus suggesting the acceptability for exporting this system. The XQ-58A has two main headwinds for its export to Taiwan. First, the US is party to the Missile Technology Control Regime (MTCR) and the XQ-58A is classified as a Category I item. The MTCR's presumption for Category I items is that they are unable to be exported; exceptions licensing them for export are rare. Additionally, exports of production facilities for Category I items are prohibited absolutely.[50] Second, the XQ-58A is not a Program of Record (NPOR), making the Foreign Military Sale of such systems more difficult. Both issues are not insurmountable.

The MTCR built in the ability for countries to export Category I items as long as the governments consider six factors: (1) concerns about nuclear, biological, and chemical (NBC) proliferation; (2) the "capabilities and objectives of the missile and space programs of the recipient state"; (3) the "significance of the transfer in terms of the potential development" of NBC delivery systems; (4) the "assessment of the end use of the transfers," including the government assurances described below; (5) the "applicability of relevant multilateral agreements"; and (6) the "risk of controlled items falling into the hands of terrorist groups and individuals."[51] In the case of the XQ-58A and export to Taiwan, all six are non-factors. Taiwan does not have an active NBC program and does not sponsor terrorism. The US has always had robust end-user requirements for its weapons sales, particularly those of sensitive nature. Additionally, the US in 2020 reinterpreted the MTCR to treat selected MTCR Category I UAS with maximum speeds less than 800 kilometers per hour as Category II in part to increase sales of these systems.[52] All of this suggest the MTCR is a more of speed bump and less of a barrier to export for the XQ-58A.

The US Defense Security Cooperation Agency prefers the foreign military sale of Program of Record Systems or systems that the US has designed and fielded in its own military. The XQ-58A is currently not a Program of Record; it is in test for both the USMC and the USAF to further the inform force design concepts and unmanned aerial vehicle technology. However, there is a process to export non-programs of record weapons systems; in fact, the DOD has an industry handbook on how to accomplish this goal. The XQ-58A is a NPOR Type 3, which is a NPOR in US inventory or commercially developed munitions items. For example, strike-enabled UAVs or in this case the XQ-58A. There is a Community of Interest (COI) comprised of US government entities, primarily within DOD, that have roles and responsibilities related to the export consideration, acquisition, and transfer of NPORs.[53] The NPOR process is an approximately sixty-day process to determine if a NPOR can be exported. Here again, the a process will slow the transfer but will not stop this potential acquisition. The XQ-58A needs strong advocates from both Taiwan and the US to push this process along.

To further support a case for foreign military sales potential, the XQ-58A's baseline was derived from an Air Force Research Labs (AFRL) program Low-Cost Attritable Aircraft Technology (LCAAT) that is now over a decade old. The purpose of LCAAT was to build combat-capable UAVs quickly and at low cost to introduce a system that the USAF could afford to lose in combat against a near peer. AFRL has already moved on to more advanced follow-on programs in this portfolio, such as the Off-Board Sensing Station that took flight in 2024.[54] Additionally, China already has many active UAV programs that meet or exceed the XQ-58A capabilities, such as the GJ-11, WZ-8, and CH-7, resulting in no loss of the US technological lead to China.[55] Few UAVs offer this balance of capability and readiness for export.

Kratos has an active production line, and the XQ-58 was not selected for the CCA program, resulting in a drop in anticipated production orders. Additionally, Kratos has publicly stated that, if properly funded, it could achieve a production rate of 300 aircraft per year in eighteen months, and with additional funds, it could achieve even higher rates. This production capability would allow large numbers of aircraft to be fielded in a short timeframe, which is a key requirement to increase deterrence in the near term. It could be possible for Taiwan to produce these systems with the assistance of Kratos. However, the objective of this volume's overall research project is to provide a near-term solution to the deterrence imbalance with China. Indigenous coproduction with US suppliers would have extended timeframes resulting in fielding of these systems into the early 2030s instead of the late 2020s due to the need to negotiate for and establish a production facility in Taiwan.

Operationalization of STOVL UAVs

To operationalize this concept, three overarching steps will need to be accomplished: first, the order and production of the UAVs; second, training for operators and maintenance personnel; and last, the logistics sustainment for the aircraft. When compared to manned aircraft or even other unmanned aircraft, standing up this capability can be achieved more rapidly. These UAVs were designed with low cost and attrition at the forefront. Because of these factors, ease of use, ease of maintenance, and low sustainment overhead were built into the programs.

The first step in fielding Group 5 STOVL UAVs for Taiwan is building a Foreign Military Sales (FMS) case to procure the weapons systems and training from the United States. This process takes an estimated 240 days from the Letter of Request to the Contract Award.[56] As previously mentioned, Kratos states that it would take eighteen months to build out the production capacity of 300 UAVs a year.[57] If it takes Kratos eighteen months to build up production, the earliest possible timeline to deliver the system is approximately twenty-six months.

This would allow for the training of the operations and maintenance personnel to take place in parallel with the production process.

Group 5 STOVL UAVs have been designed with attrition in mind. The result of this mindset is a lower training and sustainment infrastructure than manned aircraft. As one of the UAV developers states: "The intent for training for operators relies on the operating aircrew. We'd like to make them automated enough that a button push commands takeoff, with no stick/throttle needed. For maintenance operations, [the UAVs are] designed for simplicity and ease of maintenance."[58] Using the Ukrainian F-16 program as a benchmark, the estimated time to complete a squadron of F-16 pilot training was five months.[59] While the Ukraine example is an accelerated wartime example, the training for UAVs would be less complex and could be completed in a similar timeframe. The longer timeframes would be developing tactics, techniques, and procedures (TTP). Most FMS cases are for existing platforms in the US inventory. While the US has XQ-58s and UTAP-22s in the inventory, they are currently in testing and development. There is no written playbook on how to employ these UAVs in combat conditions. While the testing the US has done thus far could provide a reference point, Taiwan would be left to develop more in-depth TTPs on its own. This process is iterative and will take years, but that should not stop the introduction of the system to the TAF.

These UAVs have fewer sustainment requirements than their manned peers. Here again, the program managers on one such program are quoted with much the same: "Additionally, to save costs, there'll never be a depot or service life extension program on these aircraft. When they don't work, or get too many hours on them, scrap and move on."[60] The infrastructure required is limited, and the maintenance would be more akin to cruise missiles than fighters. This philosophy in design allows these UAVs to be fielded on an accelerated timeline.

Concept of Operation

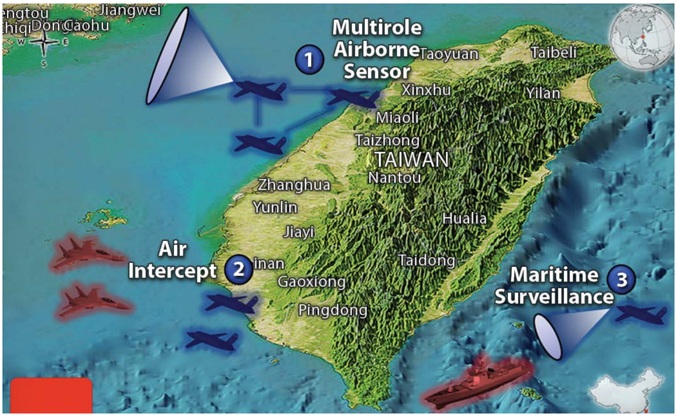

Figure 5.2. Overview of competition phase operations (created by the author)

The vision of the Group 5 UAV would be to operate during competition and conflict. During the competition phase (0 and 1; in doctrinal parlance, the shaping and deterrence phases), these UAVs could provide real-time ISR for the air, land, and maritime domains. Additionally, these UAVs could be armed to intercept PLA aircraft that enter Taiwan's ADIZ or cross the median line. The combination of these mission sets would help relieve the burden that has been placed on the TAF's overworked fighter and airborne ISR aircraft.

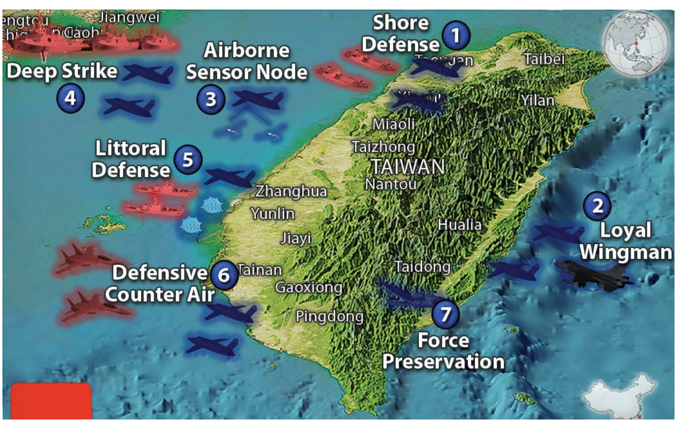

Figure 5.3. Overview of conflict phase operations (created by the author)

During the conflict (phases 2 and 3: seizing the initiative and dominating the battlespace), these UAVs would be used as a part of a larger asymmetric strategy against the PLA. The UAVs would be dispersed and concealed until their time to operate. Depending on the needs of the TAF, there are multiple roles these systems could fill, from deep strike of People's Liberation Army Navy (PLAN) amphibious ships in Chinese ports to providing loyal wingman to TAF fighter operations. Peacetime experiences demonstrate that these types of UAVs require only forty minutes of launch preparation with the use of a generator and lift.[61] The launch surface is preferably concrete but in contingency operations can be any surface that can bear the weight of the UAV and launcher.[62] Once launched, the UAV can be commanded through a line-of-sight ultrahigh frequency or tactical data line, SATCOM, or preprogrammed autonomous missions.[63] Once the mission is complete, the UAV will arrive at its preprogrammed recovery area, where it will deploy a parachute to land softly on the ground to be regenerated for its next mission. The regeneration timeline is currently unknown. The current peacetime regeneration process is up to ten days, but this is due to the large availability of aircraft and low generation requirement for test operations, not a systemic system issue.[64] It is conceivable that in wartime operations these UAVs could be regenerated in less than twenty-four hours.[65]

Conclusion

The TAF has a dangerous adversary with the PLAAF having both a qualitative and quantitative advantage paired with the PLARF, which has an inventory of thousands of missiles that can reach anywhere in Taiwan. Group 5 STOVL UCAVs offer a more survivable solution to Taiwan, through improved mass, maneuver, and concealment. Their low cost and high performance mixed with their ability to operate without a runway fill a need gap in the TAF force structure. With an open production line and ease of operation, this capability is one of the few that could be fielded within this decade. Most importantly, this capability represents a credible advanced, offensive weapons system that would add to the calculus of the CCP's perspective of Taiwan's deterrence. Should deterrence fail, these UAVs would provide the TAF with a capable weapons system to defend itself.

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Chapter 6

Modernizing Taiwan's Conscripted Service and Reserve Force

Maj Tiffany A. Basham, USMC Reserve

Abstract

Taiwan's recent reforms to its conscripted service and reserve force organization present a unique opportunity to enhance its defense capabilities against increasing gray-zone coercive pressure from China. This chapter argues that Taiwan's new conscripts and future reserve forces can effectively counter China's aggression and deter a potential invasion by focusing on the active defense capabilities required in modern warfare: mobile firepower, cyber, unmanned aerial systems, and information operations. Taiwan has historically used conscripts and its reserves for manpower replacement but has not offered them credible tactical training. The All-Out Defense Mobilization Agency, consolidated and reorganized in 2021, aimed to shift Taiwan's approach. However, merging defensive agencies and emphasizing improved training requirements for conscripts has not translated into more robust reserve capabilities. This chapter argues that Taiwan should align its conscription training and reserve formations to improve traditional defenses while undermining China's gray-zone tactics.

Chinese Language Abstract

臺灣對其徵兵制度、訓練和後備部隊進行改革，對抗中國日益增長的灰色地帶行動所帶來的壓力，而這些改革提供獨特的機會對抗中國的灰色地帶行動。本文認為，臺灣未來的義務役和後備部隊可以通過專注於現代戰爭所需的主動防禦能力（如機動火力、網絡、無人機系統和資訊戰）有效抵抗中國的侵略並嚇阻潛在入侵。臺灣歷來使用徵兵制度和後備部隊作為人力補充，但並未為其提供有效的戰術訓練；2021年新增設的國防部全民防衛動員署目標放在改變臺灣的現行做法；然而，合併防禦機構並強調改善訓練需求，並未轉化為更強大的後備戰力。本章節認為臺灣應該對其徵兵後的人員戰鬥訓練和後備改革進行調整，以改善傳統防禦同時削弱中國的灰色地帶戰術。

Introduction

In the face of China's increased gray-zone coercive pressure threatening its sovereignty and shaping the environment for a potential all-out invasion, Taiwan is improving its defense capabilities to counter these threats.[1] Taiwan's Overall Defense Concept (ODC) policy called for increasing passive asymmetric defensive capabilities through low-cost and high-volume units that could inflict prohibitively high damage on an invading force.[2] However, increasing Chinese gray-zone operations challenge the ODC as a credible peacetime deterrent, with some calling for more active defense mechanisms.[3] By examining the historical utilization of conscripts and reserves, analyzing ongoing reforms, and considering the evolving nature of Chinese military strategies, this chapter argues that Taiwan's new conscripts and future reserve forces can be effectively deployed as an active defense, trained in mobile firepower, information operations, cyber, and as unmanned aerial system (UAS) operators, countering China's gray-zone aggression now while building capacity to resist a future invasion.

Historical Development of the Taiwanese Reserve Force

Since the 1940s, Taiwan has used conscripts to maintain a strategic reserve of nonprofessional soldiers, address personnel shortages, and enhance deterrence against Chinese aggression.[4] Under the auspices of Taiwan's Armed Forces Reserve Command (AFRC), conscripts served for two years after four months of initial training. However, this was reduced to only one year in the 2010s and finally to only the four-month initial training period in 2017. Once discharged, conscripts were required to register with their local reserve unit. Using a lottery mobilization system, they mobilized only once every two years for five to seven days of refresher training.[5]

The reserves have been predominantly filled with prior conscripts and former active-duty soldiers waiting to age out of the mandatory reserve service requirement on January 1 after their thirty-sixth birthday. This means that, on paper, Taiwan claims large amounts of reservists, sometimes upwards of two million, as ready to mobilize for defense.[6] These claims, however, are likely theoretical counts of any previous conscript under thirty-six rather than a realistic total of men qualified, capable, and willing to mobilize and fight. For many in this cohort, initial training and follow-on reserve service rarely included tactical training. Instead, follow-on service was primarily geared toward administrative duties and manpower replacement, which lacked the tactical depth to repel a determined invasion.[7] Though Taiwan has publicly touted a large reserve force, its ability to operate credibly has been openly questioned, even hand-waved, depending on those making the assessment.

That said, Taiwan's AFRC peacetime mission included humanitarian assistance and disaster relief operations, enabling training for rapid mobilizations under stressful conditions.[8] The AFRC's rapid mobilization preparation and certification capabilities were critical to its mission and included constructive collaboration with civil industry mobilization. Before 2019, the AFRC was responsible for organizing, assessing, and certifying Taiwan's national capacity for mobilized defense, including civilian industrial and infrastructure assets. Taiwan's reserve force practiced mobilization, or "recall drills," most clearly seen in the annual mobilization exercise called Tung Hsin drills.[9] According to a 2017 RAND study, Taiwan's focus on mobilization speed, organization, and efficiency made it likely that its reserve could mobilize within twenty-four hours of Taiwan's president issuing relevant orders.[10] However, the Tung Hsin drills aimed to practice summoning and forming individual reservists into units, not training them. Moreover, at that time, Taiwan planners anticipated up to thirty days of warning before the onset of missile and air strikes preceding an invasion, giving time to train and deploy reservists into defensive positions.[11] Taiwan's focus on defensive mobilization with minimal tactical training underlines that Taiwan's reserve force is a critical, if not entirely credible, part of its deterrence strategy as a passive defense—a well-organized but only nominally trained force.

Awareness of New Threats and Challenges

When China launched wide-ranging sovereignty assertions in the 2010s throughout the East and South China Seas, Taiwanese and US military analysts began reconsidering expectations for Taiwan's conscripted training and reserve force. China's gray-zone strategy, including using encroachment tactics to normalize military behavior and control in pursuit of its territorial claims, challenged Taiwan's previous assumptions of preemptive invasion warnings.[12] In 2019, for example, a *Taiwan News* article noted concern that over 60 percent of the reserve force had not trained for the past eight years.[13] Increasing Chinese gray-zone operations may mask its military intentions, denying Taiwan the time to spin up its reserve as a passive defense. Conscripted Taiwanese youth have increasingly expressed even more alarm at the prospect of being sent as cannon fodder rather than operating as a capable tactical force, and for good reason.[14] Taiwan's AFRC considered conscripts and reservists as "backup warriors," who reduced government pressure to recruit professional soldiers at higher costs but who only train regularly "in principle."[15] Taiwan's reservists, from this perspective, were well-organized civilians expected to deny China an easy invasion by massing numbers, not capabilities.

According to Taiwan's Ministry of National Defense (MND), Taiwan could mobilize more than double its standing force of 169,000 in wartime, which could cause significant issues for China regardless of its capabilities.[16] With Taiwan's dense urban population and challenging terrain, such a force could exact enormous costs on an invader. Troop counts and locations have long been critical for amphibious assault invasion calculus. Historical evidence and conventional Western military wisdom establish a 3:1 ratio of invading force to defenders for any chance of success.[17] Additionally, given the unique terrain, port, and beach limitations, as well as the dense urban environment, any full invasion of Taiwan intent on holding the entire island would theoretically require a significantly higher force ratio, potentially 5:1.[18] Even as "cannon fodder," rapidly mobilized massed reserve forces present China with several problems impossible to ignore.

Despite Taiwan's relatively small size, on paper, an invasion might require millions of troops to forcibly seize the island. China, however, has those numbers. The PRC can mobilize up to two million soldiers along with ninety million supporting forces in its civil industrial base to support an invasion.[19] Furthermore, Western studies into Chinese invasion plans posit multiple tactical approaches to overcoming prepared passive and active defenses. China has invested in its ability to execute paralyzing strikes that deny Taiwan the capability to leverage mass numbers in critical locations, particularly its mobilizing reserve.[20] China would likely strike transportation and roadway infrastructure necessary for Taiwan's reserves to aggregate at the locations required to be a denial force. Combined with its gray-zone normalization of military exercises, China's laser focus on seizing ports through rapid and overwhelming force may further erode Taiwan's reserve force effectiveness.

Reconsidering Taiwan's Reserve Force

Taiwan recognizes discrepancies between its conscripted and reserve force's purported strategic value and functional capabilities and has taken some steps to address these deficiencies. Taiwan passed the All-Out Mobilization Act of 2019, merging the All-Out Defense Mobilization Office with its AFRC and creating the All-Out Defense Mobilization Agency (AODMA). Launching officially in 2022, the agency improved cooperation between civil and military organizations while reforming reserve and conscripted service, including more explicit organization and improved tactical training requirements. Additionally, Taiwan's new conscription laws went into effect on January 1, 2024, increasing mandatory conscription of males over eighteen from four months to one year while refocusing tactical training requirements toward an anticipated future coastal defense. These significant changes were made to increase the number of conscripts and follow-on reservists and improve the credibility of Taiwan's ability to defend against a rapid invasion. However, Taiwan's conscription law went into effect without answering the complicated question of training effectiveness and long-term employment, particularly as conscripts integrate into its reserve force at the end of mandatory service.

Analysts have advanced mixed opinions about conscripted training and its effectiveness as a deterrent against a highly capable and determined military. Sheu Jyh-Shyang, an assistant research fellow at the Institute for National Defense and Security Research in Taiwan, has argued that mandatory conscription—as currently practiced—is useless in the modern military environment.[21] Citing popular belief that compulsory military service is a "waste of time," he argued for specifically training reservists on Javelins and Stinger man-portable air defense, small drones for intelligence, surveillance, and reconnaissance (ISR) and offensive assault, robotic technologies, urban warfare, and logistics. This analysis was based on Ukraine's unexpected performance against Russia's invasion in 2022. Indeed, many have looked to Ukraine's mobilizations for recommendations on transforming Taiwan's conscription and reserve.[22] In 2022, Ukraine's reserves and territorial defense forces, comprised of at least 100,000 veterans, helped defend against Russia's initial invasion.[23] However, Ukraine's forces had significant operational experience fighting Russian troops in

Donbas and did not require lengthy training.[24] After two years of fighting with substantial losses in its veteran ranks, Ukraine signed new conscription laws to fill the gaps in manpower, but it is struggling to match Russian tactics with basically trained conscripts.[25] If Taiwan expects to use its reserves to repel an invasion force, it should consider operational experience matters as much as, or perhaps more than, initial training.

Strengthening Perceptions

AODMA and Taiwan's MND have launched a messaging campaign to alleviate concerns about its military and its reserve's ability to defend the island. One YouTube video published in March 2024 gave a tailored glimpse through video footage of the new, hardened tactical training that seeks to reassure Taiwanese civilians that young, "virile" eighteen-year-olds were ready to defend Taiwan's population.[26] The training in this video explicitly highlights conscripts completing tactical training for traditional coastal defense. In this regard, Taiwan's qualitative improvements to conscripted training, including more robust tactical training, are undoubtedly crucial to improving Taiwan's chances to withstand an invasion. However, to maintain these gains, Taiwan must also focus on transferring conscripted skills into an organized reserve force to ensure consistent training and relevance. While Taiwan's historical focus on its ability to mobilize rapidly gives it some advantage, ensuring those mobilizing are already trained, well-organized, and equipped before a fight will make its defense all the more formidable.

While changing domestic perceptions of Taiwan's reserve force is essential, influencing external perceptions is perhaps even more so. Because of Taiwan's interest in deterring China rather than fighting it, Taiwan must consider how China and Xi Jinping view Taiwanese conscripts and reservists and also ensure that its capabilities are messaged appropriately. Indeed, Taiwan's reserve force has garnered some attention from publicly available pro-Chinese military analysis and news articles since the turn of the century.[27] For instance, a 2017 RAND report, *Transformation of Taiwan's Reserve Force,* identified multiple sources from the early- to mid-2000s that suggested substantial PLA interest in the tactical and operational size of Taiwan's reserve force and capabilities.[28] These analysts explicitly focused on reserve force size and roles in beach defense, counter-airborne landing, urban warfare, and electronic-warfare capabilities—necessary areas of operations in an amphibious assault invasion.[29] The same studies, however, expressed that the Taiwan Reserve Force lacked sufficient funding and tactical training to present a significant challenge for the PLA.[30] This dismissal is understandable. While Taiwan has improved its conscripted training, it has yet to offer clear insight into future reserve reform and how it intends to maintain the operational capabilities of its young soldiers beyond their first year.

More concerning, however, is that China appears to continue dismissing Taiwan's conscripts and reservists despite recent reforms. Even with Taiwan's aggressive AODMA messaging and increased visibility into tactical training, Chinese analysts considered Taiwanese reservists as "barely useable."[31] Such commentary underscores the possibility that these tactical improvements have minimal deterrent value in the eyes of Chinese commentators.

From Passive to Active Defense

Any all-out Taiwan invasion would require planning and execution at a scale never seen in history.[32] Taiwan has fourteen small beaches, congested ports, and a dense urban population of over 23,000,000 people on an island only 245 miles long and ninety miles wide. Moreover, Taiwan's towering mountains cover and conceal a wide range of defenses, including Taiwan's 169,000 active-duty forces. In considering this terrain, Taiwan has been investing considerably in asymmetrical defensive options and acquiring sophisticated, active-defense weapons. Nonetheless, Taiwan's natural geography, congested roads, and dense urban areas will also hamper a defense that needs to mobilize, move, and organize against an attack. Any all-out invasion campaign will likely be proceeded by air and sea strikes targeting coastal defense batteries, command posts, early warning systems, and power nodes.[33] Therefore, China will also likely target mobilizing reservists, roadways, and transits to paralyze defenders, rendering them ineffective regardless of their perceived competence.[34] The ability of Taiwan's reserve forces to mobilize, organize, and move to a coastal or port location to await the PLA's assault will likely be degraded, perhaps significantly, reducing the impact of their training and the numbers brought to the fight. Consequently, if Taiwan wants to rely on large numbers of reservists beyond their first conscripted year, it must maintain the operational credibility of that force by creating functional, wellorganized, regionally based reserve units.

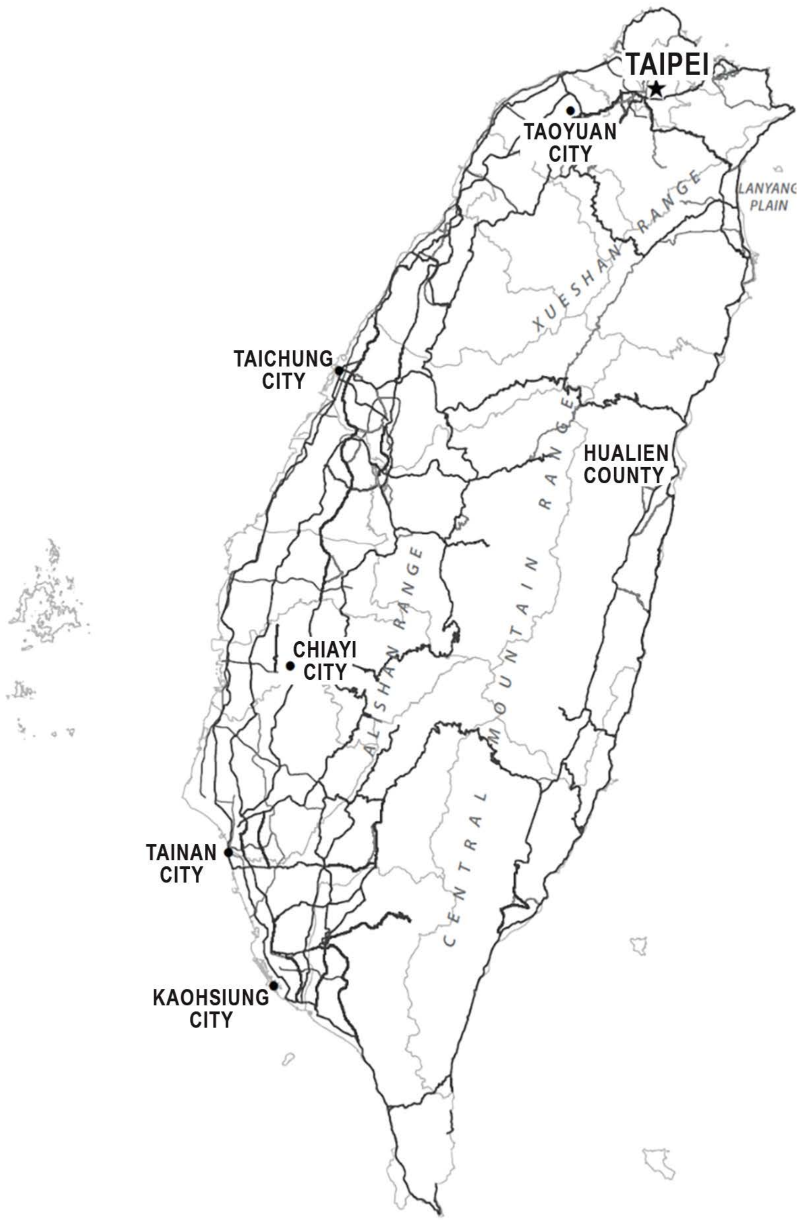

Figure 6.1. Taiwan's regions and major roads (Source: Steven K 234 Wikipedia Commons 2018 Creative Commons ShareAlike 4.0 Inter-

national License)

Enabling Taiwan's reserve force to take active, not simply passive, measures can increase its defensive capabilities. First, Taiwan could refocus its conscripts and reserves on more valuable areas in active defense against an all-out invasion. Shang-su Wu, one of Taiwan's leading academic strategic analysts, has identified mobile firepower as a critical capability required for Taiwan's asymmetric defense.[35] Taiwan needs not only the ability to counter an immediate antiair defense assault but also to maintain the ability to disrupt China's pre-invasion and invasion firepower over time.

Second, while Taiwan expects to acquire more antiair defenses and mobile firepower, it lacks sufficient material depth, training, and units to meet anticipated defense demands and other operational needs.[36] Its active forces are stretched thin and cannot meet the manpower needs to fulfill Taiwan's antiair defense requirements. Therefore, Taiwan should consider creating a pathway from conscription to organized reserve units for some of its air and missile defense requirements.

Conscripts filling air and missile defense (AMD) roles could train on mobile firepower platforms before being assigned, as well as train with mobile firepower units. For example, US Army AMD crewmembers attend ten weeks of basic training followed by ten weeks of Advanced Individual Training specific to their crewmember role.[37] Tactically trained conscripts could begin filling and actively participating in mobile firepower units within five months. This leaves seven months for on-the-job training and execution of tasks, freeing active-duty military members for operational demands while demonstrating to the PLA a significant increase in Taiwan's anti-invasion capabilities.

Once conscripted service is over, AMD-trained conscripts would check into their local mobile firepower reserve unit, which would be organized according to region and tasked to maintain, train, and maneuver mobile firepower assets in an invasion scenario. While it stands to reason that Taiwan's military might not want to place high-value assets like the Harpoon or Patriot systems under the control of conscripts or even reservists, extensive training and organization around short-range air defense systems (SHORAD) and maneuverable short-range air defense systems (M-SHORAD) would be valuable, particularly as these systems are developing with directed energy, anti-UAS capabilities.[38]

Mobile firepower units must paradoxically remain relatively hidden and concealed while retaining an ability to maneuver, receive replenishments, and potentially fire. Taiwan's geographical restrictions, limited routes, and dense urban terrain make mobile firepower particularly challenging.[39] It seems appropriate to allocate air defense assets by region, making regionally based reserve units ideal for the tasks because members are more likely to understand the area. Reservists could maintain, resupply, and move physical assets as part of a reoccurring training cycle, minimizing exposure risk due to continual traffic and creating ambiguity for the PLA on how many functional assets Taiwan has available. Taiwan's AODMA is already actively recruiting reserve officers and noncommissioned officers capable of organizing training plans and managing these complex cycles. While unorthodox, having well-trained reserves available to rapidly increase Taiwan's ability to mass antiair, antiship, and surface-to-surface fires against China might make a difference in an all-out invasion.

Taiwan could also consider training and using its conscripts and reservists to challenge China's gray-zone activities. Whereas a Chinese invasion remains hypothetical, it is clear the PLA is currently using gray-zone coercion and salami-slicing tactics to solidify and normalize its regional control against Taiwan.[40] Because of its local escalation dominance, the PLA has been relatively unchecked when probing redlines and applying strategic gradualism.[41] For example, in 2020, the PLA began sending PLA Air Force planes and PLA Navy vessels across Taiwan's Air Defense Identification Zone (ADIZ). This invoked a reactionary, but not retaliatory, response from Taiwan's MND while remaining below any threshold where the US might respond. China increased these incursions to coerce Taiwan and normalize them, and Taiwan's determination to conventionally match each incursion only serves to wear down its relatively small active force. Indeed, despite Taiwan's efforts to meet each incursion, China has stalwartly increased them, sending over 1,600 in 2023, and recently signaled that it no longer recognizes the existence of the median line.[42]

To prevent normalizing unwanted or alarming behavior, Taiwan could train conscripts and organize reserve units to match gray-zone tactics and challenge Xi's strategies today. These areas include information operations (IO), cyber, and UAS operations. While Taiwan's active military can meet these missions, using conscripts and reservists to do so would increase Taiwan's military capacity during peacetime and war while further offering opportunities for substantial training in conflict situations. Additionally, reservists trained in easily transferrable civilian skills often bring civilian practice into military tasks, and vice versa, reducing the need for continual military training while enhancing civilian defense capabilities. Such dual-use skills are relevant across the spectrum of conflict and would be helpful in a coercive blockade or all-out invasion.

For example, Taiwanese conscripts can be trained in IO and conduct counter-disinformation and offensive transparency operations during their active tenure. China's weaponized disinformation campaigns against Taiwan are well documented; China pursues disinformation campaigns that aggressively seek out weaknesses in Taiwan's public forums and government systems, targeting and manipulating vulnerable populations to sow discontent and conflict.[43] Furthermore, the PRC's willingness to decentralize these operations and maintain pressure creates a continuous insidious threat against Taiwan's population.[44]

To meet this challenge, conscripts can be trained in modern IO techniques to counter China's influence campaigns, undermine normalization practices like ADIZ incursions, or detect IO anomalies that might indicate early warnings for invasion. These "IO reserve units" could plan their mobilization and training around PLA exercises or highlight Taiwan's counteractions to ADIZ incursions to increase transparency while denying the PLA its desired normalization. In this regard, at the end of compulsory service, Taiwan's "IO conscripts" can either continue serving through reserve service or contribute to Taiwan's resilience against disinformation as ordinary citizens. Such efforts would, in part, reflect steps already taken by the Philippines. To counter coercive Chinese activities, Manila has recently adopted an aggressive transparency model that appears to not only have curbed the frequency of overt Chinese actions without escalation but also helped the Philippines win international support.[45]

Integrating cyber capabilities within reserve forces would yield significant immediate advantages for Taiwan's defense strategy. For example, conscripted forces trained in cyber antiair capabilities can effectively deny China's attempts to disrupt or compromise Taiwan's air defense networks through cyber intrusions. Additionally, conscripts trained in cyber defense can search for and detect "living off the land" intrusions widespread with Chinese cyber offensive units that may be there today.[46] Proactively employing cybersecurity measures, such as intrusion detection systems, threat intelligence analysis, and rapid response protocols, Taiwan's reserve forces can mass cyber defense capabilities on known cyberattacks. Training conscripts in basic cyber offense and defense capabilities strengthens the nation's overall defense resilience while sending a clear message about Taiwan's technological prowess and commitment to safeguarding national security interests. As cyber threats continue to evolve and pose complex challenges, the proactive adoption of advanced cybersecurity measures within reserve forces can be sustained at low costs while increasing cyber defensive-minded civilian populations, which is imperative in today's digital environment.

In support of the above-mentioned efforts, Taiwan's reserve force can leverage conscripts' youthfulness to its advantage. Taiwan's conscription force offers a unique advantage as younger soldiers are often more adept at navigating digital platforms and social media. This demographic will likely be more capable of crafting and sending IO messages that broad demographics will understand, including domestic and international audiences concerned about Chinese coercion in the region. Empowering young service-minded individuals with the tools and knowledge to leverage IO would significantly bolster Taiwan's ability to counteract disinformation targeting its population while undermining China's attempts to normalize coercive and controlling behavior.

Finally, Taiwan can utilize its conscripted youth culture to develop additional asymmetric advantages in drone warfare by tapping into its reservists' gaming community to train conscripts on small UASs. While both Ukraine and Russia have used drones to target troops and destroy the other's critical infrastructure, drones have given Ukraine an outsized advantage relative to its military size and strength.[47] For instance, in early 2024, Ukrainian Navy drones appeared to corral Russian Black Sea Fleet missile corvette *Sergei Kotov* into open water before damaging it outside the port of Feodosiya.[48] Ukraine's actions demonstrate that UASs can be used for sea control, particularly around disputed territories. As drone warfare requires a significant scale—scale that would drain Taiwan's active-duty forces—leveraging the reservists would help identify individuals already skilled with the motor skills and reflexes required to operate high-speed drones and ensure these skills are maintained, while reducing training time. Therefore, using UAS-trained conscripts for ISR operations, especially for ADIZ incursions, could decrease the operational strain on Taiwan's traditional Air Forces. Reservists could rapidly mass UAS capabilities without significant delay in a blockade or all-out invasion scenario. Furthermore, these skills are easily transferrable to reserve units that can organize training events to support ISR requirements.

Conclusion

Taiwan can maximize its new conscription and reserve service reforms to deter China more effectively across a spectrum of conflict if it considers training and employing them in areas critical to gray-zone conflict and modern warfare. Training improvements and increased service times signify a willingness to create a more credible reserve force. Focusing conscript employment while orienting reserve units on mobile firepower, IO, cyber defense, and UAS operations would not undermine initial tactical training but rather improve Taiwan's ability to defend itself across the conflict continuum without risking escalation. Overall, Taiwan's reserve force has the potential to serve as a credible deterrent, but Taiwan must ensure its conscripted training retains operational readiness beyond its first year by organizing its reserve and focusing on emerging technologies and tactics essential to deter aggression and safeguard national security interests.

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PART 3

TAIWAN DETERRENCE THROUGH RESILIENCE

Chapter 7

Linking Up

A Space-Based Communication Network for a Resilient Taiwan

Maj Nicholas Stockdale, USAF

Abstract

Information power is a doctrinal imperative for the People's Liberation Army (PLA). The PLA is likely to seek control of the information space at the onset of a Taiwan invasion, and in today's conditions, it could easily do that. Barely a dozen undersea cables stand between Taiwan and a nearly total telecommunications network blackout. Making Taiwan's network resilient is key to denying the PLA information dominance. Non-terrestrial networks (NTN), like Starlink and OneWeb, offer a solution to Taiwan's communications vulnerability, but NTNs are also susceptible to threats if not designed for security. In this chapter, the tenets of network security are applied to NTNs to develop the principles of space-based resilience: proliferation, segmentation, and network agility. Applying these principles to the NTN landscape reveals the shortfall of Taiwan's partnership with OneWeb and highlights the challenges Taiwan faces in producing its own resilient space-based network. The paper recommends Taiwan acquire services from multiple providers, seeking interoperability with Starlink and expanding to other services like Amazon's Project Kuiper as they become available. Multiple services not only provide redundancy but increase the likelihood Taiwan will have a credible service in a crisis. Ultimately, Taiwan should produce an indigenous NTN, designed for resilience, to provide the most credible deterrent.

Chinese Language Abstract

訊息戰對解放軍具有至關重要的意義。根據現今的條件，解放軍在入侵臺灣初期階段實現控制訊息空間的目標具有高度可行性。在海底的幾十條電纜是臺灣能夠維持通信網路的原因，使臺灣的網路具備抵抗能力是阻止解放軍獲得訊息優勢的關鍵。非地面網路（Non-Terrestrial Networks），如星鏈(Starlink)和一

網(OneWeb)，為臺灣通信的弱點提供了解決方案，但如果設計不考慮安全性，非地面網路也會受到威脅。本文討論將網路安全的原則應用於非地面網路，發展以太空為基礎的抵抗能力，包括擴散、分段和網路靈活性，揭示了臺灣與一網合作的不足之處，並突顯了臺灣在建立具抵抗能力並以太空作為基礎的網路所面臨的挑戰。本文建議臺灣從多個供應商處獲取系統，尋求與星鏈的互操作性，並擴展到類似亞馬遜(Amazon)的柯伊伯(Kuiper)等其他系統。額外系統不僅提供備援手段，還增加臺灣在危機中擁有可靠訊息服務的可能性，最終，臺灣應以抵抗解放軍的訊息控制為目的生產一個本土的非地面網路，以提供最具可信度的嚇阻能力。

Introduction

On February 24, 2022, an hour before 130,000 Russian troops crossed the Ukraine border, internet service suddenly cut out for tens of thousands across Europe. Ukraine's military and government agencies unexpectedly went dark. The GRU, Russia's main intelligence directorate, hacked satellite internet provider Viasat, causing mass blackouts that lasted days. Experts dubbed it "one of the first real-world examples" of a cyberattack used in conjunction with military forces.[1] Disrupting communication at the onset of war has a long historical precedent, however. The American Civil War saw the first wartime sabotage of telecommunications with both sides cutting telegraph wires. By the Spanish-American War, cutting telegraph cables was part of US prewar planning.[2] The outbreak of World War I saw British forces severing all but one of Germany's undersea cables, tapping the only remaining wire, and in 1959, a Soviet ship cut five undersea cables near Newfoundland. Presumably an accident, it caused an international incident that could have led to war and prompted the US to declare that preserving telecommunication cables "constitutes an international obligation."[3]

Today, just fifteen undersea telecommunication cables connect Taiwan to the outside world.[4] The vulnerability of Taiwan's terrestrial telecommunication networks is evident in that, in 2006, an earthquake off Taiwan's coast damaged many of these cables, severely disrupting the internet for months.[5] More recently, in 2023, Taiwan's National Communications Commission accused two Chinese ships, a fishing vessel and a cargo freighter, of cutting the two cables that provide internet to Matsu, one of Taiwan's outlying islands, causing an internet blackout for the island's

14,000 residents.[6] Chunghwa Telecom, Taiwan's major telecommunication corporation, reported undersea cables around Taiwan have been cut twenty-seven times in the past five years, an unusually high number for normal wear and tear, leading some to call it a deliberate attack.[7] Regardless of past intent, the ease with which China could black out Taiwan at the onset of an invasion is a serious problem Taiwan needs to address.

Making Taiwan's communication network resilient to attack can bolster deterrence in the Taiwan Strait. Because Chinese doctrine considers information power (信息力) the "key to controlling the battlespace,"[8] denying China's ability to swiftly disrupt Taiwan's communications can reduce Chinese perceptions of a successful invasion. As experts note, Xi Jinping is "likely to adjust his plans for annexing Taiwan" based on China's ability to control the information space before an attack.[9] To achieve this, Taiwan needs a broadband telecommunication non-terrestrial network that is proliferated, segmented, and agile through a service provider that would be credible in a crisis. Although no current or planned broadband NTN provider offers an optimally proliferated, segmented, and agile network, some are better than others. To optimize factors, Taiwan should secure multiple internet service providers like Amazon, Telesat, and Rivada Space Networks. It should advocate for increased collaboration among Eutelsat OneWeb, SES, and Hanwha Systems. Finally, it should seek interoperability between commercial networks like Starlink and defense partnerships as it works toward an indigenous constellation.

This essay unfolds in three parts. The first lays out the framework for understanding resilient telecommunication architectures and concludes an NTN is Taiwan's optimal choice. The second advocates Taiwan should develop a low Earth orbit (LEO) satellite network and details the unique challenges and opportunities in doing so. The last part provides an assessment of Taiwan's LEO prospects, arguing for multiple providers and an indigenous capability developed as quickly as possible.

Theory and Background

Integrated deterrence . . . means space systems that are ever-more resilient.

—Lloyd Austin, US Secretary of Defense (2021–2025)
Stars and Stripes

Pursuing a resilient telecommunication architecture—one that prevents easy destruction from China—requires an understanding of both the enduring principles and modern obstacles of information networks. Although terrestrial networks have become more secure in recent years, physical vulnerabilities will always be inherently more accessible than NTNs. While NTNs possess the same cyber vulnerabilities—as well as unique electromagnetic and kinetic threats—they can be mitigated if designed for proliferation, segmentation, and agility. Taken together, Taiwan's investment in an NTN can increase survivability and reduce downtime for its networks, delivering a resilient capability to deny China information dominance in an invasion.

Principles of Network Security

While telecommunication technology changes over time, three enduring principles exist. The tenets of network security aim to (1) reduce system susceptibility by focusing on what is critical, (2) diminish threat accessibility by moving access points out of band, and (3) prepare and respond to threat capabilities through detection, reaction, and adaptation technologies.[10] Safeguarding these efforts is crucial not only to battlefield success but also to strengthening deterrence. As the Russo-Ukraine war shows, when a network is breached it can be devastating to a nation's infrastructure, crippling the government from providing basic needs to its population. Likewise, when a network is secured it enables an effective information campaign that supports a nation's domestic population, unites the government leadership, and rallies international organizations to the nation's aid.[11] Hence, Russia's initial success and subsequent failure to control the information space in Ukraine is a lesson closely observed by Chinese leadership,[12] especially given the centrality of information control in PLA doctrine.[13] Applying this lesson to deterrence in the Taiwan Strait, Taiwan's networks must be resilient if it is to instill doubt within the Chinese

Communist Party (CCP) regarding the costs and likelihood of a successful invasion.

System susceptibility. Weaknesses like software bugs, misconfigurations, or physical constraints are inherent in all systems due to design trade-offs. AcidRain, the malware Russia used at the onset of the Ukraine invasion, infiltrated Viasat through a poorly configured virtual private network.[14] In September 2022, Ukrainian hacktivist group OneFist retaliated when it identified a misconfiguration in the interface setup of Russia's Gonets LEO satellite network. The error allowed the group to enter the network and delete its entire user database. This locked out all users for five days, including regional offices of Russia's Federal Security Service. In remote locations without terrestrial networks, this meant a complete blackout. These two cases show that NTNs, like terrestrial networks, are susceptible to a wide variety of attacks that designers cannot always anticipate. Scholarly literature instructs designers to "focus on what is critical," that is, using a conscious, methodical approach to design that seeks to simplify systems to their essential functions. This reduces unforeseen paths for attackers to infiltrate, thereby decreasing points of system susceptibility.[15]

Threat accessibility. A susceptible system is only exploitable if a threat has access to it. Threats infiltrate systems through a variety of access points, such as a wireless network, service port, or automatic update. In June 2023, hackers claiming affiliation with the Wagner Group (although suspected to be Ukrainian "false flag trolling") accessed Russia's DoZor satellite network at the ground terminals, causing a reboot and destruction of server information.[16] In some cases, threats can even access a system as a legitimate user. In OneFist's attack on Gonets, the hackers gained access because the poor configuration of the customer relationship management system was spread over multiple systems and accessible on the open internet. Accessibility can also blend physical and cyber effects. While Starlink has received attention in the Russo-Ukraine war for its resilience, Russia briefly infiltrated the network through credential abuse on stolen tablets the Ukrainian military was using for planning and executing combat missions.[17] A malicious code discovered by Ukraine's Security Service appeared to be designed to provide Russian intelligence with target locations and troop movements.[18] Regardless of whether an attack is physical or in cyberspace, system designers should put access points "out of band." This means moving user access points and potential attacker access points far away from each other, whether physically or logically. If attackers cannot access a system through their preferred or available access methods, it severely reduces the types of attacks at their disposal.[19]

Threat capability. The third and final tenet refers to an attacker's ability to tamper with or gain control of a system. Recent Chinese-linked cyberattacks demonstrate China's sophistication. In November 2023, Palo Alto Networks Unit 42, a cybersecurity research team, linked malicious activity to Chinese state-sponsored hacking groups in which twenty-four Cambodian government agencies were infiltrated, including their national defense ministry and telecommunications infrastructure. The hackers used a spoofing technique to exploit the systems, mimicking the telemetry of their cloud storage service for several months undetected.[20] In July of the same year, Japanese cybersecurity firm Trend Micro published findings of Chinese-made malware Shadowpad infiltrating Pakistani government, financial, and telecommunications institutions by sideloading on a Microsoft installer. Over three months passed before the telecom provider detected the malware.[21] These are two of many examples that demonstrate China's offensive cyber capability and, especially, its ability to infiltrate without detection for an extended period of time. Cybersecurity literature recommends employing dynamic sensing and responding technologies to "detect, react, adapt." This defeats attackers' capabilities by making defenses unpredictable and adaptive.[22]

These recent real-world events show that the three tenets of network security hold true for terrestrial networks and NTNs alike. The challenge is to adapt terrestrial network solutions for NTN applications.

Applications to Non-Terrestrial Networks

Making a NTN resilient relies on the tenets of network security, but differences in the physical and electromagnetic (EM) architecture present further challenges. To reduce system susceptibility, diminish threat accessibility, and respond to threat capability, an NTN should be designed for *proliferation*, *segmentation*, and *agility*. This can be achieved by constructing a larger, more dispersed architecture with flexible dataflow that is subdivided by functions. Such a network is more survivable and will suffer less downtime, making it a more resilient deterrent.

Proliferation. Proliferated NTNs diminish threat accessibility by moving many of the network's key access points out of band. While the terrestrial component still faces the physical threats of traditional ground-based networks, like cutting cables or sabotaging access points, space is a sanctuary from these traditional physical threats. Instead, the space architecture faces new threats like directed energy weapons (DEW), antisatellite (ASAT) missiles, and satellite-on-satellite collisions. These are legitimate concerns, but because of the number and dispersion of satellites, a proliferated network is not nearly as susceptible to their effects as a ground network is to physical attack. For example, SpaceX's Starlink currently has over 7,000 satellites in LEO, comparatively much more prolific than the next largest constellation today, Eutelsat's OneWeb, with just over 650 satellites in orbit. Taking no other factors into consideration, for every DEW or ASAT missile directed at a OneWeb satellite, Starlink could sustain ten such attacks and still have better coverage.

Proliferated networks also reduce system susceptibility because many of the network's critical functions are in the space architecture, and the ground architecture is inherently more redundant. While ground stations are still accessible to adversaries, dispersing hundreds of them across Taiwan makes the network less susceptible to degradation. Ground stations are nodes in a network, each linking to every user terminal in line of sight (LOS). The fewer links or nodes a network has, the easier it is to degrade. Today, Taiwan's limiting factor is its links—fifteen undersea cables—but Chunghwa Telecom plans to deploy 700 ground stations across Taiwan.[23] China could undoubtedly cut fifteen undersea cables. Striking 700 ground stations dispersed across the island would prove a much harder challenge.

Segmentation. Like the tenet of accessibility, segmenting an NTN moves key access points "out of band" by setting up barriers within the network. Segmentation is separating a network by its sections, functions, or processes. If a threat gains access to one segment, it is still barred from the rest of the network. For traditional networks, this can be done either physically or logically. For a NTN, it can also be done electromagnetically. NTN system architectures should move links out of band, literally. The use of multiple frequency bands limits an electronic attack to one segment rather than the whole network. For example, if an adversary jams the downlink frequency over Taiwan, Taiwan would still be able to communicate via the uplink frequency, which, after crosslinking between satellites on yet another frequency, could then downlink in a region that is not being jammed. The transmission would then crosslink between ground stations on still another frequency until the message reaches its intended recipient. Networks can also segment between fixed and mobile service systems. Each operates on different frequency bands, so even if an entire service system were jammed, it would be contained in that system, and service would continue uninterrupted in the other.

Operators have more flexibility and resilience when user terminals can connect to multiple orbital regimes.[24] Dispersing satellites into multiple orbits is not just about proliferation; it segments the network across orbits. Geosynchronous Earth orbit (GEO) satellites provide higher data throughput but are more susceptible to attack because of their stationary orbits, while the much smaller LEO satellites cannot transmit nearly as much data but are significantly harder for ASAT missiles and DEWs to strike because of their orbital velocity. This gives multi-orbit architectures an added edge of resilience.[25]

Network agility. Network agility enables rapid, ad hoc adaptation of dataflow to counter a threat's capability. NTNs differ from terrestrial networks not only physically and electromagnetically, but also logically. Consider again the proliferation example of Starlink's ten satellites for every one of OneWeb's. If an adversary degrades a Starlink satellite, the other nine are only useful if the network can adapt the dataflow from the degraded satellite to one of the others. The simplest network topology is a point-to-point connection. As the name implies, this connects one node to another by a single, direct link. If that link is cut, signals cannot pass from one end to the other. Other topologies are less vulnerable at their links but are vulnerable at their nodes. An example of this is a star topology, which links all points through a central node, such that nodes are like spokes on a wheel, and data must pass through the hub before reaching its destination. The most resilient logical structure is a mesh topology, which is characterized by all nodes linking to all other nodes. In this network, degrading a single link or node will have little effect on the system's performance because it can reroute the flow of data through another link to another node ad hoc until it reaches its intended recipient. If China wants to isolate Taiwan, it must cut all fifteen cables that connect it to the outside world. A LEO constellation with a mesh topology has a lot more than fifteen links, though. Starlink uses inter-satellite links (ISL) to create a mesh of its constellation, which, with more than 7,000 satellites, theoretically equates to more than twenty-five million links. Realistically, not every satellite will link to every other satellite without LOS, but even if only ten satellites have LOS with each other, there would be forty-five links and more than 360,000 possible routes for dataflow.

Furthermore, these links can be designed to be beamforming and steerable, as well as to modulate internet protocol routing. Satellites can be equipped with their own propulsion, and logic sensors can detect if a link is broken. Together these technologies allow satellites to maneuver out of the way of potential threats, revector their links to stay connected, and adjust modulation in response to jamming. This ability to detect, react, and adapt boosts resilience by overcoming a threat's capability.

Why Space Resilience Matters for Deterrence

> *Resilience is important because it denies the adversary first mover advantage.*
>
> —General John Raymond, Chief of Space Operations, US Space Force (2019–2022)

NTNs bolster deterrence because they can be made more resilient than their terrestrial counterparts. Space resilience denies the PLA its ability to seize the battlefield initiative.[26] Non-kinetic attacks against satellite communications "will likely be the first moves in any PLA counter-intervention operation."[27] Degrading enemy satellite communications is tantamount to information dominance, which Chinese doctrine calls "necessary" and "prerequisite" to air and maritime dominance.[28]

In the space and cyber domains, resilience is the best deterrent. This is especially true in Taiwan's case. Scholars note numerous challenges in these domains for the other main type of deterrence, deterrence by punishment. First, the threat of punishment must be credible. This means that a state must be both willing to respond and capable of responding. In the prelude to war, however, Taiwan is unlikely to respond to a non-kinetic attack with lethal means. International law is ambiguous on the matter, and the normative precedent is that a cyberattack is not a just cause for war. Once an invasion has begun, Taiwan would certainly respond, but by that point deterrence would have already failed. Secondly, a cyberattack is reversible, and therefore less escalatory, further reducing the case for casus belli. Finally, cyberattacks are difficult to attribute. If Taiwan cannot definitively tie the cyberattack to Chinese state-sponsored activity, it would be irresponsible to respond with punishment.[29]

Deterrence by denial, on the other hand, does not rely on a credible willingness to respond, only a credible capability to deny the adversary its objective. Building a credible denial capability in space is rooted in resilience. Making Taiwan's communication network resilient steals an easy win from China, making the CCP recalculate the cost-benefit ratio and decreasing the incentive of a first strike because of the lower likelihood of success.[30]

Deterrence by resilience is the ability to "withstand, fight through, and recover quickly from disruption."[31] The proliferation factor enables the network to *withstand* through physical redundancies, both in the space and ground architecture. Segmentation through EM spectrum and orbital disaggregation boosts resilience by *fighting through* an attack, continuing to operate even after a segment is degraded. Finally, an agile network topology is resilient because it *recovers quickly*, minimizing system downtime by reacting and adapting to an attack. These enhancements to resilience deny China the benefit of easily degrading Taiwan's communications in the days or hours leading up to war, and given the lower likelihood of achieving first-strike information dominance, China will be less likely to commit to an air and maritime invasion.

The Low Earth Orbit Landscape

> *For [any] country that builds out a [LEO] constellation, it can be used for national security [and] commercial purposes.*
>
> —Cheng Wu, General Partner, Taiwania Capital

A proliferated, segmented, and agile NTN would boost Taiwan's communication resilience and therefore increase deterrence against invasion. But building an NTN is not easy. To maximize resilience, the NTN should use a LEO constellation. LEO constellations present challenges, however, such as the ultra-competitive marketspace and high cost of entry, as well as the geopolitical landscape and a state's reliance on the commercial sector. These challenges pose a risk to resilience because they cast doubt on whether a service provider will be available and reliable in a crisis. For deterrence by resilience, the capability to deny an adversary's action must be credible, but if the capability is unavailable or unreliable, it calls into question that credibility. Without credibility, the deterrence value is lost.

Why Low Earth Orbit?

Not all orbits are equal. For satellite communications, orbits are generally grouped into three categories: LEO, medium Earth orbit (MEO), or GEOs, also called geostationary orbit (GSO). Other orbits, like a highly elliptical orbit, are generally not suited for quality, uninterrupted communications. NTNs are also not limited to space-based networks. NTN is a blanket term for all networks other than ground-based ones, which would include a stratospheric balloon network, like Google's now defunct Loon Project, or a high-altitude drone network, such as the one British telecommunication company, BT Mobile, is researching. These are intriguing options but are too early in development to be viable for Taiwan in the near term. This leaves LEO, MEO, and GEO as feasible options.

A multi-orbit constellation is the most resilient because of the segmentation of having two or more networks and multiple frequencies, as well as certain weapon types having access to one orbit more than another. However, one of the orbits needs to be LEO. GEO orbits are not proliferated because doing so is not economical. GEO corporate fleets are never more than a few dozen satellites, and most are much less. This is because at the GEO altitude, full coverage of the earth only requires four to six satellites.[32] MEO offers a compromise between LEO and GEO. While a bit more proliferated, most commercial entities are not interested in MEO because it offers neither the most economical coverage, nor the best latency, but is somewhere in the middle. This translates to fewer and less resilient options in MEO, leaving Taiwan with either contracting a commercial LEO constellation or constructing its own, state-operated proliferated constellation. The latter is untenable in the near term as the challenges below will show, so Taiwan must trust a commercial LEO provider for its defense.

Taiwan's Challenges for a LEO Constellation

Taiwan's need for a resilient NTN begins with acquiring a LEO broadband internet service, but this relies on commercial providers that face potential financial failure, supply chain restrictions, and even geopolitical influences. These call into question the credibility of any singular service, damaging its deterrent effect. Resilience is only a deterrent if it is credible, and if a company fails, cannot provide service, or *will* not provide service, it is not credible. Taiwan must solve these challenges to ensure deterrence is credible.

Boeing,[33] Facebook,[34] Google,[35] and Samsung[36] are among the aerospace and technology giants to propose NTNs that have since backed out of direct competition. Others have been bought out or merged to stay competitive. In September 2023, Eutelsat, the world's third-largest satellite operator, merged with OneWeb. Four months earlier, Viasat completed a full acquisition of Inmarsat, one of the longest standing companies in the industry, founded in 1979. The oldest satellite internet company, HughesNet, founded in 1971, was also bought out, becoming part of EchoStar, which also just acquired DISH Network in January 2024. Bill Ray, vice president at Gartner Inc., a technology research and consulting firm, noted there are "a very large number of competitors coming into the field, several of which are already struggling financially. Eventually, there will be just four or five global providers."[37] With so many companies vying for marketspace that only four or five can share and be profitable in, Taiwan's chances of surviving in the market are low, especially when considering how far behind it is. Taiwan has no LEO communication satellites currently in orbit and only a single GEO communication satellite that it shares with Singapore. In comparison, four broadband internet service providers will have more than 500 satellites in LEO by the end of 2026, before Taiwan even has one.

Taiwan's efforts for a LEO constellation are government backed, with its first two LEO internet satellites to be state owned. However, state-owned internet projects are no exception to the struggles of the industry. Roscosmos, Russia's state corporation for space activities, announced in 2018 its plans for the *Efir* (ether) project, a LEO broadband internet service as part of its greater *Sfera* (sphere) proposed satellite network. Originally planned for service by 2030, full Russian coverage would require 622 satellites in that year, increasing to 924 by 2035 based on projected bandwidth requirements. Yet its planned 640 satellites constellation was later scaled back to 380 and then reduced again to 162 because of funding issues. Initial deployment was planned for 2025, but few updates have been released, and it is possible that the date will slip because of funding as well. In April 2023, Russia opened the project to foreign investment, with Iran expressing interest, but otherwise gained little support.[38] While financial support does not affect China in the same way, its national network, or *Guowang*, has yet to launch at scale owing to setbacks with its launch vehicle technology.[39] If states as large as China and Russia have pushed back and downsized their LEO broadband ambitions, Taiwan cannot rely on government backing alone to secure its LEO network.

Government entities across the globe are looking to the commercial sector for LEO broadband services. The United Kingdom maintains a 10.9 percent stake in OneWeb, a UK-based company. The United States primarily contracts its LEO broadband defense services through the US-based SpaceX. Since OneWeb and SpaceX are the only current LEO internet providers, all other countries are forced to rely on a foreign company, many choosing OneWeb because of its business-to-business/business-to-government model rather than Starlink's direct-to-consumer approach. Choosing OneWeb is not as simple as trusting a UK company, however. OneWeb merged with Eutelsat, a French company, in 2023. Japan's Softbank and India's Bharti hold more than a 10 percent and 20 percent stake in OneWeb, respectively. Hanwha Systems, a South Korean conglomerate with its own LEO internet ambitions, invested $300 million in OneWeb in 2022, gaining a representative on its board of directors. OneWeb does not manufacture its own satellites. It relies on Airbus, a German company. It also does not launch its own satellites. Its early satellites were launched by Roscosmos, and more recent launches used NewSpace India Limited's LVM3 rockets and SpaceX's Falcon 9. To date, OneWeb satellites have launched from French Guiana, Kazakhstan, Russia, India, and the US. A Taiwan bet on OneWeb is a bet not on UK support in time of crisis but on a complex, interconnected supply chain, which if broken at any link may result in failed coverage. The problem is not unique to OneWeb, either. Rivada Space Networks, a German company with plans for its LEO internet service OuterNet, is owned by a US parent company, used a Liechtenstein company for its spectrum filing, and is outsourcing satellite manufacturing to Terran Orbital, a company Lockheed Martin acquired in 2024.[40]

Even when supply chain problems do not directly affect a company, other external and internal factors may affect its reliability. While SpaceX manufactures and launches Starlink satellites in-house, it has limited their use in Ukraine because of CEO Elon Musk's fear that if Ukraine attempted to regain Sevastopol, Russia would respond with nuclear weapons.[41] This is not the only time Musk's geopolitical opinions allegedly interfered with Starlink's service. In February 2024, US Congressman Mike Gallagher accused Starshield, SpaceX's defense version of Starlink, of "possibly withholding broadband internet services in and around Taiwan."[42] SpaceX denied the allegation, and it is difficult to prove definitively. Nevertheless, this came after Musk incited vehement backlash in Taiwan by stating it was "an integral part of China."[43] Added to the fact that one of Musk's other major companies, Tesla, has nearly 40 percent of its battery supply chain tied to China, Taiwan remains wary of dealing with SpaceX.[44]

Analysis of Taiwan's LEO Prospects

> *The vision [is] not to tie ourselves to any particular satellite provider. We want to work with many of them concurrently—that's resilience.*
>
> —Audrey Tang, Taiwan Minister of Digital Affairs

Taiwan recently acquired a very limited LEO broadband internet service through OneWeb, but the service is not as proliferated, segmented, or agile as others, and its telecommunications industry has tied it to this single provider. Taiwan can improve these factors in the near term, but it will continue to face a challenging environment that puts credibility at risk. Its own credible, resilient network is more than a decade off. To deter China, Taiwan needs a resilient stopgap for today; a plan to boost proliferation, segmentation, and agility in the near term; and a response to the credibility problem as a long-term solution.

The "Now": Taiwan's Current Approach

The best Taiwan can do in a fight today is rely on US LEO defense services. Taiwan is in a better position than most, with a space industry that is attracting some of the biggest satellite broadband providers. Its exclusive deal with OneWeb hurts it, however, because OneWeb does not offer the best architecture for proliferation, segmentation, or agility. While Taiwan should press forward with OneWeb as an immediate solution, it needs to augment its service. Procuring ruggedized and mobile ground segment equipment that is interoperable with existing LEO defense networks would be more survivable, raising deterrence by presenting China a greater challenge to achieving information dominance.

Despite the challenging environment, Taiwan has an industry advantage: its expertise in manufacturing satellite components and terminals. Taiwan has manufactured LEO satellites with 82 percent of components being sourced domestically,[45] a fact that Telesat finds uniquely attractive. Glenn Katz, Telesat's chief commercial officer, visited Taiwan in November 2023, meeting with the Taiwan Space Agency (TASA) and other government and commercial entities. He expressed Telesat's interest in "trying to utilize and maximize the ecosystem that already exists," adding that, "Taiwan can be a leader going forward over the next X years in the technology needed for low Earth orbit, both all the components of the satellites themselves, as well as the ground segment equipment."[46]

This incentivizes companies to work with Taiwan. Chunghwa Telecom, Taiwan's telecommunications giant, which holds 85 percent internet market share and over 95 percent of the fixed telecommunications market,[47] already entered a contract with Eutelsat OneWeb to exclusively provide LEO broadband services starting in 2024.[48] With three new foreign hot spots in Japan, Guam, and Thailand providing service to Taiwan as of December 2024, Chunghwa Telecom plans to establish an additional 700 ground hot spots and seventy base backhaul links directly in Taiwan. With Telesat knocking at the door, it is likely other major players would also willingly cooperate with Taiwan's space industry, but because Chunghwa Telecom's deal with OneWeb is exclusive, it is locked out of discussions. The Taiwan Telecommunications Management Act prevents foreign direct ownership of more than 49 percent and total ownership of more than 60 percent of any telecommunications resource.[49] Since Chunghwa Telecom owns so much of the domestic market, Taiwan may have tied its hands. This does not preclude Taiwan itself from establishing partnerships with other services, however. Taiwan's National Science and Technology Council has entered talks with Amazon Kuiper on providing broadband services. Taiwan has also secured an agreement with Luxembourgian company Société Européenne des Satellites, better known as SES, which operates GEO satellites, as well as its O3b (Other 3 billion) constellation, a broadband-internet service in MEO that targets the three billion people around the world in rural areas without access to terrestrial internet.[50]

Still, Taiwan is forced to look outside for its LEO broadband, and options are very limited. SpaceX is the only other current provider. Taiwan authorities ruled out Starlink, both for geopolitical concerns and SpaceX's refusal to join a venture with less than 50 percent stake.[51] Starshield is currently providing initial capabilities for the US Department of Defense (DOD) as part of its proliferated LEO program, also called the Proliferated Warfighter Space Architecture (PWSA). As the name implies, proliferation will be a key aspect of its architecture, with as many as 700 satellites in orbit by 2026. US Space Force's Chief of Space Operations General B. Chance Saltzman stated, "We are seeing evidence that proliferated low Earth orbit constellations are resilient against attack," noting that this was known to be true theoretically but now has combat evidence from the war in Ukraine.[52] In 2023, PWSA launched its first twenty-three satellites, with five more following shortly thereafter in Tranche 0. The separation into Tranches is not just a consequence of launch vehicle payload capacity, but part of a deliberate network design. PWSA will use a "layered network" architecture.[53] A layered network is one in which tasks are assigned to subdivisions (or "layers") which have specific functions or responsibilities. This reduces unnecessary crossflow and unforeseen system susceptibilities, keeping malicious activity limited to a single layer. In other words, it is segmented. Assuming interoperability with US military GEO satellites, PWSA would be further segmented—a move DOD satellite communication users are advocating, calling for "hybrid networks that combine frequency bands and satellites in geostationary, medium and low Earth orbits."[54] PWSA will also be agile. The Space Development Agency confirmed it will use a mesh topology with optical (laser) ISLs.[55] PWSA Tranche 1 will add 173 satellites to the constellation in 2025.[56] Tranche 2, scheduled for its first deliveries to start in September 2026 will add 300–500 more.[57]

PWSA is Taiwan's only immediate solution to augmenting OneWeb in LEO. As a DOD network, operating on Starshield is subject to US approval, but Taiwan does not need to operate on Starshield to benefit from it. Starlink and Starshield are interoperable. Operating on Starlink presents regulatory hurdles, but as with Ukraine, such hurdles disappear in a crisis. Looking past Musk's comments may be a more difficult hurdle for Taiwan. When asked about Musk's outsized role in national defense, General Saltzman was unperturbed. "We write contracts with SpaceX, not Elon Musk," he responded.[58] Taiwan must take the same pragmatic approach. Ruggedized, mobile user terminals with Starlink antennas designed for defense and police use are commercially available today with the ability to hop between satellite and mobile networks.[59] If Taiwan is willing to procure these terminals despite the geopolitical concerns and the lack of Taiwan ownership stake, it will deliver proliferated and segmented resilience in a crisis. Furthermore, it will signal cooperation with the US's LEO defense network, an arrangement Taiwan should try to formalize. A commitment from the US to integrate Taiwan in its LEO defense network in a crisis raises the stakes in a PLA attempt to gain information dominance, and—if properly signaled ahead of time—could also add deterrent value.

The "Near Term": Analysis of Alternatives in this Decade

Taiwan needs a more resilient option than OneWeb, and before the end of this decade it should not have to rely on a foreign military for it. By comparing the constellation attributes of potential partners, Taiwan can build a multi-constellation solution that maximizes proliferation, segmentation, and agility.

The current commercial players in the LEO broadband market are (1) SpaceX's Starlink and (2) Eutelsat OneWeb, with credible plans for market entry from (3) Amazon Kuiper, (4) Telesat Lightspeed, (5) Hanwha Systems, and (6) Rivada OuterNet. Each of these six services are compared below in terms of proliferation, segmentation, and agility, but first this section describes why these six out of the myriad others should be considered.

Over 250 constellations comprise the satellite communications industry.[60] From there, the following requirements narrowed the field down to the six mentioned above. First, the constellation must not be owned or operated by China or Russia because of their contentious relations with Taiwan. Second, the constellation must be (or plan to be) at least partially in LEO. Multi-orbit constellations are the most resilient, but without at least a LEO component, the constellation cannot meet the proliferation criterion. Third, the constellation must have broadband coverage over Taiwan. This eliminates two groups: constellations that do not offer broadband services and constellations that do not provide Taiwan coverage. The latter is self-explanatory, but the first bears further explanation. The broad term "communication satellites" covers everything from internet to television broadcasting to amateur radio, but within the internet subset, there are three general types: broadband, mobile, and Internet-of-Things (IoT). Broadband and mobile are each designed for human communication, while IoT is often machine-to-machine, and the human interface is limited. Mobile is also limited both in architecture and often in bandwidth. In an emergency, mobile and even IoT might be used to transmit a message, but it would be severely limited in comparison to broadband. Thus, broadband is required; however, that does not preclude networks that operate in two or all three internet services. In fact, multiple services add resilience as another means of network segmentation. Finally, TASA Director-General Wu Jong-Shinn calculates that 120 LEO satellites will be needed for twenty-four-hour coverage of Taiwan.[61] With this information, constellations that do not have or (plan to have) at least that many satellites were not considered.

Proliferation. SpaceX's constellation is the most proliferated with over 7,000 currently on orbit. This dwarfs by thousands the next largest constellation, Eutelsat OneWeb, with its 654-satellite constellation. After these two, all other LEO broadband internet constellations are still under development with Amazon Kuiper being the closest to readiness. It launched its first test satellites in 2023 and its first two operational batches in 2025.

Over the next few years, the competition will intensify. Starlink remains the largest, with plans to expand to 12,000 satellites and Federal Communications Commission (FCC) filings that allow further expansion up to 42,000. Companies often file for more satellites than they plan to launch. Regardless, Starlink already has more in orbit than the second largest even has plans for and has shown no signs of scaling back. Amazon's Kuiper is next, with 3,236 expected fully in orbit by 2026 but is offering initial services in 2025 with its initial launches. Unlike many of the other future broadband internet providers, Amazon has remained consistent on its FCC filings and its news releases on the number of satellites it plans to launch for Project Kuiper. In sharp contrast, OneWeb, whose FCC filings initially authorized 6,372 satellites, has now taken a new direction after the Eutelsat-OneWeb merger. Its latest public statements indicate its first-generation constellation is complete, with "about 300" new satellites to be added in the second generation.[62] The interconnection with Hanwha Systems adds further ambiguity to the future constellation of OneWeb. Hanwha Systems has plans for a 2,000-satellite constellation, making it the third and final "mega-constellation," indicating greater than 1,000 satellites. It plans to offer 6G internet by 2030. If the future of OneWeb and Hanwha are intertwined, these constellations may be integrated. On the low end of the constellation size, Rivada Space Networks' OuterNet is set for 576 satellites offering service in 2026, and Telesat's Lightspeed, which is now years behind schedule, has expanded its initial plans for a 117-satellite constellation to 198 satellites by 2026. It has an additional 100 on order and stated ambitions considering expansion to 512. Its FCC filing authorizes up to 1,671 satellites, and while it may not reach that quantity this decade, Telesat's objectives seem directed at expansion, rather than scaling back like Eutelsat.

Segmentation. Telesat, in addition to its forthcoming Lightspeed in LEO, already operates GEO communication satellites. OneWeb and SES, which are partnering in Taiwan on ground station interoperability, combined have constellations in LEO, MEO, and GEO. This gives Telesat, and especially the OneWeb-SES partnership, an added layer of segmentation over the others. They both underperform in EM segmentation, though. All the satellite internet service providers divvy up their frequencies to some extent, but some are better than others. For example, Starlink, OneWeb, and Kuiper use different frequency ranges between user links and gateway links, but Lightspeed does not. Starlink, Kuiper, and Lightspeed use ISLs, while OneWeb does not. Frequencies are further segmented between fixed satellite systems and mobile satellite systems. All the satellite services provide, or will provide, cellular backhauling, acting as a bridge between cell towers where there is no LOS, which provides SOS voice and potentially video transmission in an emergency, but Kuiper has an agreement in place to offer direct-to-cell services, and Starlink has already begun providing this service through T-Mobile. This is a direct connection between a smartphone and the internet service provided by the satellite network. This gives Starlink and Kuiper the edge in segmentation, while Telesat suffers for not banding between terminals and gateways, and OneWeb falls behind as the only network not using ISLs. This is even more critical in the next section since it prevents OneWeb from using a mesh topology.

Network agility. Starlink and OneWeb both used point-to-point or "bent-pipe" architecture when they first came online, but Starlink shifted to a mesh topology when the constellation became large enough. OneWeb abandoned its plans for a mesh network in the same way it no longer plans for a larger constellation. This is a design trade-off OneWeb chose because national regulators "want to know the physical path of their traffic, and they want to make sure it lands in a place where they have control and management of that data" according to OneWeb founder, Greg Wyler.[63] This is a stance unique to OneWeb among LEO broadband internet providers. Telesat Vice President Erwin Hudson said, "We have the flexibility in our network control system to route traffic all kinds of different ways. There are no rules that traffic has to go over the intersatellite links."[64] In fact, Kuiper and OuterNet have also proposed mesh networks, and Hanwha System's acquisition of a phased-array antenna maker may imply it will too. This puts OneWeb at the bottom of the list in terms of agility.

Table 7.1. Relative characteristics of satellite networks

Provider/Timeline		*Proliferation*		*Segmentation*		*Agility*
Broadband service	*Ready date*	*Satellites (Jun '25)*	*Satellites (planned)*	*Orbit(s)*	*Direct-to-cell*	*Network topology*
SpaceX Starlink	Now	7,083	12,000+	LEO	Yes (T-Mobile)	Mesh
Eutelsat OneWeb	Now	654	~948	LEO, MEO*, GEO*	No	Bent-Pipe
Amazon Kuiper	2025	54	3,236	LEO	Yes (Vodafone)	Mesh
Telesat Lightspeed	2026	3	198+	LEO, GEO	No	Mesh
Rivada OuterNet	2026	0	576	LEO	No	Mesh
Hanwha Systems	2030	0	2,000	LEO	No	Mesh**

Note: Table is the author's own, any errors herein are the author's.

* Eutelsat OneWeb is partnering with SES, which owns MEO and GEO constellations
**Presumed

Overall, Starlink boasts the most proliferated network by far. Kuiper and Hanwha both have plans for mega-constellations, while OneWeb, OuterNet, and Lightspeed fall far behind the top three. Lightspeed and OneWeb offer some consolation for their small constellations with the potential for multi-orbit segmentation; however, both have inferior EM segmentation. Starlink and Kuiper provide the best EM segmentation, especially with their direct-to-cell edge. Finally, in network agility, OneWeb falls far behind the others with its bent-pipe architecture. This makes Starlink and Kuiper the top choices for proliferation, segmentation, and agility in the near term, but in terms of credibility, past allegations and Musk's personal sentiments make Starlink a hard sell when another option is available. In contrast, Amazon has been largely consistent in its messaging, FCC filing, and timeline. With its initial broadband services anticipated in 2025, Kuiper offers the most promising near-term solution.

The "Long Term": Taiwan's Indigenous LEO Ambitions

Forecasting beyond the current decade is unrealistic. It is difficult to predict which service providers will hold the market, whether Eutelsat will acquire Hanwha Systems, or if Elon Musk's perception of Taiwan will change. This is why Taiwan needs an indigenous LEO broadband solution. It will definitively answer the credibility question.

Taiwan is in the early stages of its "Beyond 5G" (B5G) LEO broadband internet network development. B5G, a project of TASA, is a proposal for two state-owned LEO communication satellites, followed by four commercial Taiwan-company-owned communications satellites, a construct they call the "2+4" network. The first two state-owned satellites were initially planned for deployment in 2025 and 2026 but are now two years behind schedule.[65] While the latter commercially owned satellites appear to be on schedule, with Hon Hai Precision Industry Co. deploying two test satellites via SpaceX's Falcon 9 rocket in November 2023,[66] the six satellites in the "2+4" construct are not nearly enough compared to the 120 required for continuous Taiwan coverage. This puts the B5G timeline much farther out than other LEO broadband constellations and well outside the decade. Still, this provides Taiwan with the time to incorporate resilient principles of proliferation, segmentation, and agility into its forthcoming network.

Even though its LEO broadband service will not be ready this decade and will face an uphill battle gaining market share, Taiwan should continue to push for its B5G network because of the credibility of having an indigenous capability. Using the time it will take to get B5G on orbit, Taiwan should ensure it is designed with all the principles of a resilient network. This will give Taiwan the strongest deterrence by resilience value for its long-term communications plan.

Recommendations

For the immediate, near-term, and long-term road ahead, Taiwan's ability to deny China's information dominance relies on how credible its network is. It should focus on boosting resilience with proliferation, segmentation, and agility through the most credible means.

Today, Taiwan must continue to cooperate with OneWeb and SES to provide multi-orbit communications. Together, these service providers offer a multi-orbit constellation that is much more proliferated and segmented than either one on its own. Ground stations must be rolled out as quickly as possible to proliferate the ground architecture, and they must be interoperable between OneWeb and SES constellations for network agility. With US cooperation, building an additional, crisis-specific ground architecture that is interoperable with the DOD's PWSA stands to give Taiwan the most credible deterrence boost in the immediate term.

In the near term, Taiwan does not need to be so heavily reliant on a foreign military. It can boost proliferation, segmentation, and agility by selecting new providers that better optimize those factors. Amazon's Kuiper is the front runner, and Taiwan has already begun partnership talks, but Taiwan should obtain as many service providers as possible to be less dependent on any particular one. This will boost credibility because the likelihood of all providers failing to provide services is much lower than one provider on its own. This will require intervention by the Taiwan authorities. It will need to establish domestic telecommunications infrastructure apart from Chunghwa Telecom for LEO broadband companies to work with or waive the foreign ownership stipulation in the Telecommunications Management Act.

The long-term solution is a domestic NTN broadband service. This is the most credible option, with Taiwan fully in control of its own resources. In working toward this, Taiwan must incorporate the factors of a resilient NTN. B5G should be designed as a mega-constellation for proliferation with a robust ground architecture. It should segment frequency bands, orbits, and services with broadband and direct-to-cell. Finally, it should be agile, using a mesh topology and sensing and antenna technology that allows it to detect, react, and adapt to threats. While this is a long-term solution, Taiwan must work toward this vision today.

Conclusion

At any moment, seemingly innocuous Chinese fishing vessels could black out Taiwan in a prelude to war. Russia's cyberattack before entering Ukraine showed how devastating an invasion can be when a state is cut off from the world, but the war also demonstrated the resilience value of LEO constellations for communication. Securing a constellation that maximizes resilience through proliferation, segmentation, and agility will make China recalculate the merits of a first strike. To sway deterrence firmly in Taiwan's favor, that resilient capability needs to be credible. Multiple constellations, a domestic capability, and strengthening the relationship with the partners Taiwan relies on will make that capability credible. The value of ensuring communication channels stay open cannot be understated. The security of the 23 million people of Taiwan may very well depend on it.

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Chapter 8

Addressing Vulnerabilities in Intra-Island Logistics

Durable Energy Delivery in Taiwan

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Abstract

This chapter examines the vulnerability of Taiwan's power infrastructure in the context of a People's Republic of China (PRC) Joint Firepower Strike Campaign. Power availability contributes to civil and military resistance efforts. Survivable delivery of electricity could influence PRC perceptions of success, thereby positively affecting deterrence. Analysis of Taiwan's energy infrastructure finds that (1) coal and natural gas generation are dependent on imported fuel, (2) renewables hold seasonal and regional limitations, and (3) limited fuel storage and pipeline infrastructure are vulnerable due to geographical consolidation on Taiwan's west coast. Furthermore, the ability of Taiwan to provide electricity is dependent on not only the availability of power generation but also intact transmission infrastructure to get electricity to the point of need. Such infrastructure is at risk and mirrors weaknesses exploited by Russia in Ukraine. To mitigate these vulnerabilities, the author proposes investments, exercises, and communication strategies that would create a more resilient energy infrastructure and, in so doing, strengthen deterrence.

Chinese Language Abstract

本文探討了臺灣電力設施在面對解放軍聯合火力打擊下的弱點。電力供應對於民間和軍方均有重要影響。能夠持續供應電力可能會影響中國對成功的認知，從而正面影響嚇阻效果。分析臺灣的能源設施發現：1.燃煤和天然氣發電依賴進口燃料；2.可再生能源存在季節性和區域性限制；3.燃料儲存有限，且管道設施因集中於臺灣西部而易受攻擊。此外，臺灣供電能力不僅依靠發電量，還仰賴輸電設施將電力傳輸至所需地點。這些設施存在風險，電力設施在俄烏戰爭中成為烏克蘭的弱點且被俄羅斯所利用，為了減少這些弱點可能造成的危害，本文建議進

行投資、演習和溝通策略，以創建更具抵抗力的能源基礎設施，從而增強嚇阻能力。

Introduction

The 1995 and 1996 Taiwan Strait crises revealed severe limitations in Beijing's ability to deter Taiwanese independence. Since then, the PRC has pursued reforms to People's Liberation Army (PLA) doctrine, strengthened its military capabilities, and developed military campaigns to deter Taiwan from declaring independence, preserving military options for reunification. These campaign plans include a Joint Firepower Strike Campaign (JFSC), Joint Blockade Campaign (JBC), and a Joint Island-Landing Campaign (JILC). While each of these options varies in their strategic objectives, the JFSC serves as the precursor for the second and third and affords Beijing the most flexibility to shape a conflict with Taiwan.[1] Specifically, the purpose of the JFSC is to "intimidate an adversary's leadership and population, break its will to resist, and force it to abandon or reverse its strategic intentions."[2] In accordance with PLA strategists' notion of "system destruction warfare,"[3] a JFSC would likely target the critical linkages and nodes that hold Taiwan's operational systems together. In this instance, "to degrade Taiwan's war-fighting ability, the PLA would likely target transportation infrastructure such as highways, bridges, and tunnels; energy infrastructure such as power stations and petroleum, oil, and lubricant storage sites; and intelligence collection facilities."[4]

This chapter focuses on efforts to preserve Taiwan's civilian power infrastructure as the availability of power contributes to resistance efforts in multiple sectors of Taiwan's defense. Whether enabling military resistance to a JILC, acute civilian resistance to the same, or prolonged civilian resilience during the JBC, providing power is a critical enabler the PRC will likely seek to deny. Consequently, Taiwan's energy infrastructure contributes to deterrence only when it is prepared to deliver required functions despite joint, long-range fires by the PRC at the outset of a possible conflict. Resilient delivery of electricity will likely influence PRC perceptions of success, regardless of what campaign strategy is considered in advance.

Unfortunately, the development of Taiwan's power infrastructure combined with its topography leaves it vulnerable to widespread degradation by PRC surface-to-surface fires, airborne fires, or land-based fires. These vulnerabilities make it more likely that the PRC could isolate and subdue portions of the island or severely hamper organized resistance by limiting the ability of Taiwan to communicate and coordinate, provide food and medical care, or expeditiously deploy. However, by hardening Taiwan's power infrastructure, Taiwan can increase the survivability and lethality of its defense forces, thereby increasing the perceived risk of failure to invading PRC forces. Taiwan's infrastructure hardening presents planning dilemmas that increase the cost calculation within the PRC and challenge perceptions within the PRC that Taiwan could be divided, subjugated, and won expeditiously. Such enhanced defensive capabilities can "undercut the plausibility of the best-case outcome (e.g., demonstrate resolve, prepare for long war, or maintain imperfect defenses adequate to preclude quick and easy victory)"[5] and support the *2022 US National Defense Strategy*'s objectives of increasing deterrence by resilience through "the ability to withstand, fight through, and recover quickly from disruption."[6] Toward that end, this chapter identifies areas of vulnerability in the energy infrastructure, methods to increase the resilience of that infrastructure, and suggests methods to communicate such developments for deterrent value. In sum, hardening these capabilities in the short term will buy time for larger programs and weapon systems to positively affect the balance of power beyond the decade.

Taiwan Power Generation

Taiwan's energy structure is fragile. Responding to green energy objectives and air quality concerns, Taiwan has taken steps to increase natural gas generation, decrease nuclear generation, and invest in renewable energy. Such efforts, while useful, ignore the potential risks of a PRC attack on the island's energy infrastructure. Taiwan's primary sources of energy are liquified natural gas (LNG) and coal that make logical sense in peacetime as cheap and effective energy sources. However, the system becomes fragile in wartime because fuel must be imported and is vulnerable in transport. System fragility is also evident in grid development. Taiwan has been makingefforts to improve the power infrastructure in response to three significant blackouts in 2021 and 2022. In one example, the outages on March 3, 2022, affected 5.49 million households, out of a total population of 24 million.[7] A grid malfunction at a coal and natural gas power plant in the south at Kaohsiung caused impacts as far north as Taipei, with more than 400 people stuck in elevators.[8] A drought that decreased hydropower output, high temperatures that increased demand, and a grid failure at a single coal and gas plant caused these outages.[9] PRC JFSC strikes will be more dynamic and demanding than the conditions of the 2021 and 2022 blackouts, particularly when compared to Russian long-range fires against Ukraine's power grid in the winter of 2021.[10] These blackouts show the current interconnectedness of interruptions, whereby disruptions at one plant can induce cascading effects for tens of millions. As Taipower and the Ministry of Economic Activities continue to cite these blackouts as impetus for continuing change, it suggests the energy infrastructure design is vulnerable to the more stressing JFSC.

The generation of power in Taiwan is a mixture of retiring nuclear power; imported LNG and coal power; limited hydropower and geothermal power; and emerging solar power and wind power generation. In 2023, 78.2 percent of the power generated or purchased by Taipower, the state-run utility on Taiwan, was LNG or coal.[11] Both LNG and coal are imported to Taiwan by ship, as neither are naturally available in necessary quantities on Taiwan. All LNG is purchased from Chinese Petroleum Corporation, Taiwan (CPC). This LNG is a mixture of modest domestic production and LNG terminals at Kaohsiung and Taichung with a third terminal presently under construction at Guantang, near Nanpu, Tunghsiao, and Datan powerplants, respectively, as shown in figure 8.1.[12] In support of environmental objectives, many of the power plants are thermal power plants that operate primarily on LNG but leverage coal generators when excess capacity is required.[13]

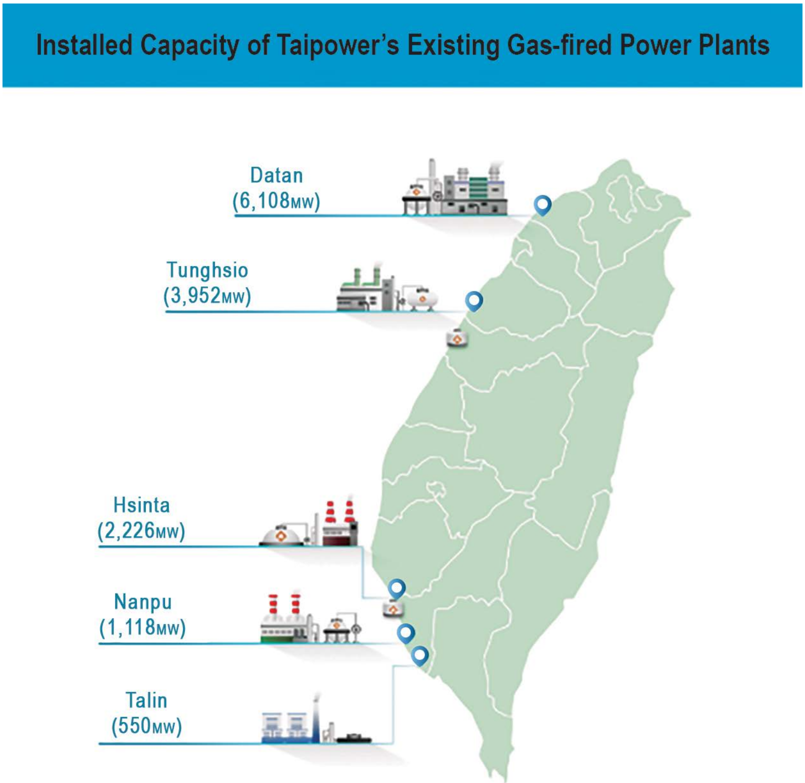

Figure 8.1. Installed Taipower LNG facilities (Source: Taipower and Global Energy Monitor, used under Creative Commons Attribution 4.0 International Public License)

Recently, Taipower has invested heavily in LNG power infrastructure and views LNG as the energy of Taiwan's immediate future. This LNG energy is environmentally friendly and cost effective, and Taiwan has found suppliers in the United States, Qatar, Papua New Guinea, Australia, Indonesia, and Malaysia.[14] Taiwan's LNG power generation facilities are all coastal, and most are colocated with port or industrial facilities.[15] In summary, electricity generation is centered on LNG plants, which require ship-based imports of LNG to a limited number of receiving terminals on the west coast of the island. Therefore, Taiwan cannot continue to support thermal power generation and provide power at or near peacetime volumes without continual import and transmission of LNG via limited ports of entry, all in the potentially contested Taiwan Strait.

Taiwan leverages other sources of energy, and each source has implications on its energy grid supply and ability to withstand potential PRC aggression. The following subsections will detail Taiwan's energy generation and delivery, including nuclear and renewable energy, fuel storage and transmission, implication of supply and demand during conflict, as well as Taiwan's grid infrastructure and its vulnerabilities. Taiwan's key vulnerabilities to PRC degradation include seasonality of renewable energy, limitations of natural gas storage and transmission, and consolidation of extra high voltage (EHV) transformers. These vulnerabilities can be mitigated by hardening transformers, adding mobile transformers, and exercising wartime grid management. Taken together, efforts to make Taiwan's energy system more resilient contribute to deterrence in the Taiwan Strait by attenuating the PRC's targeting of will and capabilities necessary for resistance.

Nuclear and Renewable Energy

While LNG and coal provide the bulk of the power generation output, Taiwan has one remaining nuclear power facility and growing renewable electric facilities. Nuclear energy may not be available in a time of conflict due to current political considerations and may be easily severed from the network if still available. Meanwhile, renewable energies have varying seasonal or transmission limitations. Due to political sensitivities, Taiwan is presently in the process of divesting itself of nuclear power generation facilities. The certification for the first reactor of the last nuclear power plant at Ma'anshan expired in the summer of 2024, and operations at the plant completely shut down in May of 2025 when the number two reactor was disconnected from the power grid.[16] The operational challenge with delivering power from Ma'anshan in time of conflict is the limited number of high-voltage transmission lines and substations from the extreme south of the island where the plant is located.[17] This power could be denied even to the southern population center of Kaoshiung and surrounding districts with the interruption of just three substations.

Renewable energy sources are similarly regional. The primary solar fields are in the salt flats and plains of western Taiwan from Tainan to Taichung.[18] Additionally this same west-central region is host to the largest on- and offshore wind farms in Taiwan.[19] Wind power is highly seasonal in Taiwan, with 70 percent of annual power generation occurring in the six months from October–March each year based on monsoon winds.[20] During Operation Neptune, the Allies landed at Normandy in the summer to avoid similar rough winds and sea-states that would be hazardous for slow landing craft.[21] Therefore, the monsoon winds that contribute electricity would also inhibit landing operations. If the PRC were to follow similar logic to the Allies and choose to attempt a landing in calmer summer months, the contribution from wind power may be negligible during conflict.

Taiwan also leverages the mountainous terrain and valleys to generate hydropower. This hydropower is generated in a series of dams and reservoirs throughout the central mountain range. Hydropower is also seasonal, but the seasonality tends to make it most available in early or late summer.[22] However, the valleys of the central ranges that generate hydropower also funnel its transmission infrastructure. The effect of the terrain is to consolidate multiple hydropower generation facilities on a single power transmission pathway, resulting in consolidation at substations as the energy transits down the valleys to the populations in the western plains below.

In sum, solar energy generated approximately 4 percent of the total demand for Taiwan, while hydropower accounts for approximately 2 percent of the total demand.[23] Despite the smaller contribution, solar and hydropower are important to consider because of their more distributed nature, lack of dependence on imported fuels, and inherent resilience as targets. Each renewable energy source has unique vulnerabilities and seasonality that may demand prioritization of preservation and restoration actions between power sources depending on the short-term availability of that power source in the season the PRC may choose to act. For example, restoring distribution from wind energy in the early summer may contribute less to available power than restoring solar based on seasonal output. These variables are the trade-off to independence from imported fuel.

Fuel Storage and Transmission

The availability of LNG or coal power generation in a time of conflict is likely dependent on the regular availability of fuel. Fuel storage is limited to days of supply, and the LNG storage and pipeline infrastructure is consolidated on the west coast in vulnerable positions. LNG arrives in Taiwan via two LNG delivery terminals, with a third under construction. Taipower (TPC in figure 8.2 below) is exploring adding its own LNG terminals, but these are also located on the potentially vulnerable north and west coasts. Domestic LNG exploration and production totaled 95.8 million cubic meters in 2022, but this would only satisfy 3.6 percent of the 26.54 billion cubic meters of demand in the same year.[24] In a short- to medium-term crisis, such as repelling an island landing or generating support to counter the JBC, volume and vulnerability of storage reserves will be more important than sourcing. CPC designed its LNG infrastructure to serve Taipower as its primary customer, in addition to industrial and residential users in northern and central Taiwan.[25] The primary LNG terminal at Taichung has six 160,000 kiloliter tanks for LNG owned by CPC.[26] Presently, CPC intends to add a second LNG-dedicated wharf and two additional 180,000 kiloliter tanks to the same facility, thus increasing the throughput and storage. Most of the storage is concentrated at each port, with additional on-site storage at each Taipower and private power generation facility.

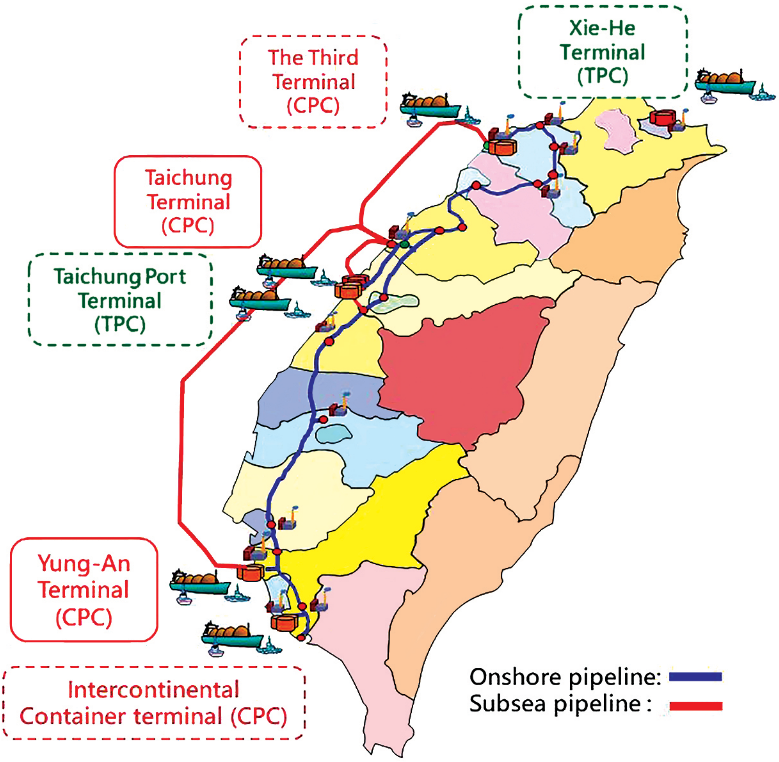

Figure 8.2. Taiwan LNG terminals and distribution pipelines (Source: Taiwan Energy Administration, Ministry of Economic Affairs, used under Government Data License, version 1.0 [OGDL-Taiwan-1.0])

Expanding storage capacity is part of a concerted effort as Taiwan seeks to decrease emissions, reduce reliance on legacy coal, keep up with increasing demand, and increase its security stockpile as expressed in days of utilization. The requirement, according to the Energy Administration under the Ministry of Economic Affairs, mandates maintaining eleven days of LNG security stockpile at any given time by 2025 then 14 by 2027.[27] This eleven-day supply is based on mitigating "occasional interruptions of LNG importing countries or temporary delays caused by weather conditions."[28] The professed design drivers of the LNG infrastructure are peacetime reliability, where contingencies are envisioned as maintenance interruption; weather; and shipping delays, rather than the resilience required in the case of a cross-strait conflict.

Not only is the ability to store LNG at scale essential to power generation, but also so is the ability to move natural gas from the terminals to the end users. Taiwan's natural gas pipeline infrastructure is designed as a "figure eight" structure, which provides redundancy for the movement of natural gas.[29] One half of Taiwan's figure-eight-pipeline structure is under the Taiwan Strait. In time of conflict or blockade, the undersea portion of the pipeline would be a soft target. If damaged, it is highly unlikely that Taiwan would have the capability to repair it given the PLAN presence in time of conflict. The remaining natural gas infrastructure would then be vulnerable, which would isolate power generation and population centers from natural gas stores.

The vulnerability of pipeline infrastructure is important because LNG storage and its proximity to port facilities may be perceived as a profitable target by the PRC. The LNG tanks at Yung-An, Taichung, and under construction in Guantang (Labeled "The Third Terminal" in figure 8.2 above) are all tightly spaced, with all the 1.6 million kiloliter or 1.8 million kiloliter tanks within 1,300 feet of one another. This is less than the 675 m buffer range the Joint Explosive Ordinance Procedures would cordon for an unexploded bomb.[30] The entire storage field is likely then a target that would result in large organic (secondary) explosions after adversary action that would result in large quantities of smoke and fumes. The smoke and fumes may affect the PRC's decision to attack the storage. The smoke could serve as obscurant for amphibious vehicles and frustrate port defense or sabotage operations. Alternatively, that same smoke could inhibit landing operations and delay risky landing actions by the PRC. Researchers from National Taiwan University conducted annual wind analysis to assess wind speed and direction in the Taiwan Strait in support of wind power development. They produced the following wind rose.[31]

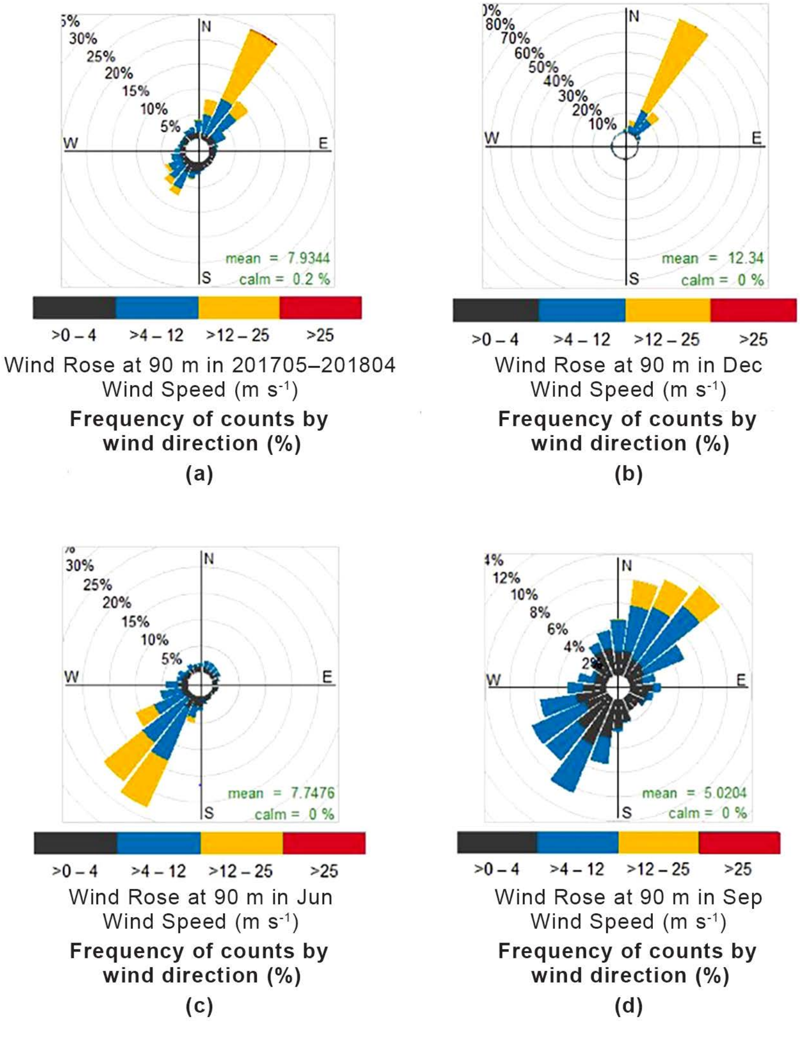

Figure 8.3. Seasonal wind roses for Taiwan Strait (Source: MDPI, used under an open access license)

This annual sampling reflects the two principal wind directions for the year.[32] Because of the oceanographic features discussed earlier, and applying the June wind model to the port of Taichung, the prevailing summer winds would drag the smoke and fumes directly across the port, or at Yung-an, would drag the smoke directly inland from the port. For these reasons, LNG storage would likely be an early objective of long-range attacks from the PLA and render gas power a limited and expiring solution as on-site reserves dry up with the inventory and pipeline infrastructure degraded or destroyed. Additionally, the secondary effects of fire and smoke would likely inhibit port defense and sabotage efforts. This would severely degrade Taiwan's short-term power availability, without kinetic damage to any power generation facilities, thereby maintaining the mid- to long-term economic viability of territory.

Supply as Compared to Demand

Electricity availability in times of conflict must be considered in terms of electricity demand and electricity distribution. Electricity demand in wartime will not equal the peacetime demand based on changes in economic activity, but establishing a baseline around supporting civil services and communication would contribute to organized resistance and resilience. Electricity consumption by sector in 2022 was 56.1 percent industrial, 18.2 percent residential, 17.1 percent services, 0.6 percent transport, 6.8 percent energy, and 1.2 percent other.[33]

In times of crisis, maintaining residential electricity likely preserves the population's ability to resist and act in coordination with the Taiwan authorities by preserving communications. Also, because Taiwan's emergency food supply is primarily rice, it is essential to have heat available to tap into that food supply, most readily available from electricity or natural gas, especially in urban areas.[34] Therefore, civil food, communications, and water are all dependent on electricity availability in the urban areas, and predictable power availability likely is the difference between unified resistance and resilience, and variations of panic, mayhem, and disunity.

Even with reduced demand, Taiwan will be dependent on coal and LNG power and cannot meet essential demands from renewable energy alone. If supplying energy equivalent to peacetime residential demand is the objective, Taiwan will have to preserve some mix to provide approximately 20 percent of peacetime electricity. Using the 2022 figures for electricity generation, 42 percent was coal, 38.8 percent LNG, 8.2 percent nuclear, 1.5 percent oil, 1.1 percent pumped storage, 2 percent hydropower, 3.7 percent solar, 1.2 percent wind, and 1.3 percent waste-generated.[35] Taiwan presently does not have the capacity to achieve 20 percent with renewables alone. Nuclear power is easily isolated due to transmission limitations and, regardless, is being decommissioned. Wind is least effective in the summer season, and LNG storage and delivery will be vulnerable. Therefore, traditional coal and on-site natural gas will likely be required to meet even 20 percent of peacetime demand. While coal and LNG capacity exceeds this figure and plants will likely have varying access to fuel, the true limitation will be the capability to move that energy to the point of need. Twenty percent of peacetime is an attainable total from many combinations of generation sources. The more effective and resilient the grid infrastructure, the more efficiently the island can operate as a system to supply varying power demands through dynamic power and generation resources resulting from destruction and restoration of capacity during JFSC actions.

Grid Infrastructure

The power infrastructure presently is built to supply the needs of the electricity-demanding industrial base in Taiwan. Russia's strikes against Ukraine's energy grid caused multiple negative second-order challenges for civil authorities, and Taiwan lacks access to the mitigating influx of generators and fuel. Alternatively, the continued effective transmission of electricity, despite the JFSC, will allow both operational flexibility and efficiency to meet the reduced demands in crisis.

Preserved efficient and resilient grid connections would allow Taiwan to be most efficient with consumable resources, such as fuel, and enable redundancy. Grid infrastructure in Taiwan is designed to provide reliable energy to industrial and residential customers but presents vulnerability in conflict consistent with vulnerabilities exhibited in Ukraine. The generation system in Taiwan operates in three voltages. Nuclear and large thermal or hydroelectric plants step their voltage up to 345 kV for transmission through extra-high voltage substations. Medium hydroelectric, medium thermal, and large renewable plants generate 161 kV that directly feed transit and some industry or go through primary substations or distribution stations. Small hydroelectric power plants and medium renewable facilities feed 69 kV either directly to some customers or, through secondary substations, to smaller industrial and residential customers (through transformers). The transmission infrastructure is largely linear, with few redundant loops. This structure enables isolating regions or cities from available power generation facilities with destruction of limited vulnerable targets, particularly transformers and substations.

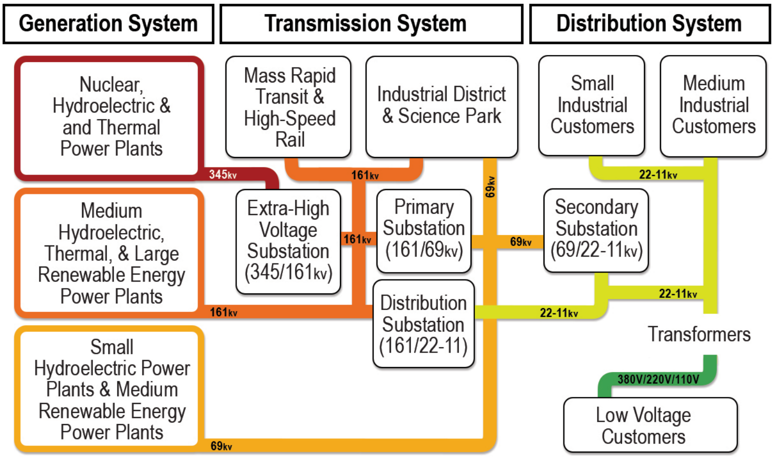

Figure 8.4. Power distribution systems (Source: based on Taipower)

Targeting of transformers and substations is one of the strategies Russia increasingly leveraged since inducing blackouts through the winter of 2022/23. According to reporting, "Russia pounded Ukraine with hundreds of missiles and drones, leaving millions without electricity, heating and water during the coldest months."[36] Ukraine had sufficient energy generation available in the system but was unable to meet the demand due to Russia's damage to the grid. Russia's attacks on Ukraine's transmission infrastructure began the first winter to broad effect; however, power generation has been more marginally affected until the spring of 2025, with most power generation coming from remaining nuclear facilities.[37]

The nuclear facilities provide inherent deterrence to kinetic impacts because of the international concern with their safe and contained condition, but the power transmission continues to limit the nuclear plants' ability to reliably provide energy.[38] With large power generation facilities serviced by one or limited transformers and power routes, Taiwan is at risk of similar lack of power delivery outcomes in a conflict with the PRC. The power generation may be diverse, but given its consolidated distribution, Taiwan risks losing disproportionate power availability from transformer and substation disruption.

The effect of the power outages in Ukraine also illustrates some of the secondary effects of extended power outages. According to the Patrol Police in Kyiv, "Since October 10 (when the power cuts were first introduced), the number of traffic accidents has increased by 55% . . . and the death rate of those who got into accidents increased sixfold."[39] Additionally, the number of fires increased as people leveraged more gas stoves, heaters, and generators, and internet traffic dropped coincident with attacks.[40] Losing power availability increases the burden on civil security sectors, decreases communication with the population, and negatively affects the population's ability to contribute to resistance duties or functions. Taiwan, because of its topography, will not be able to sustain the same generator-driven economy as Ukraine when faced with a JBC or JILC because of limitations on fuel imports.

Example Grid Vulnerabilities

As illustrated in Taipower's 2023 sustainability report, Taiwan's centralized power supply, with its geographically concentrated power generation facilities and transmission lines, is vulnerable to outside influence and disruption.[41] Nodes that disproportionately affect dissemination, where multiple power sources or regions have services collocated, represent vulnerabilities to kinetic action. The limited redundancy, consolidation, physical exposure, and availability of information on the criticality of various transformers and substations make them the most likely target for JFSC efforts against power supply. Data readily available from Taipower and the Energy Administration, Ministry of Economic Affairs, reveals nodes that represent critical points for broader dissemination. One of the first areas of examination is the EHV transformer at Zhongliao.[42]

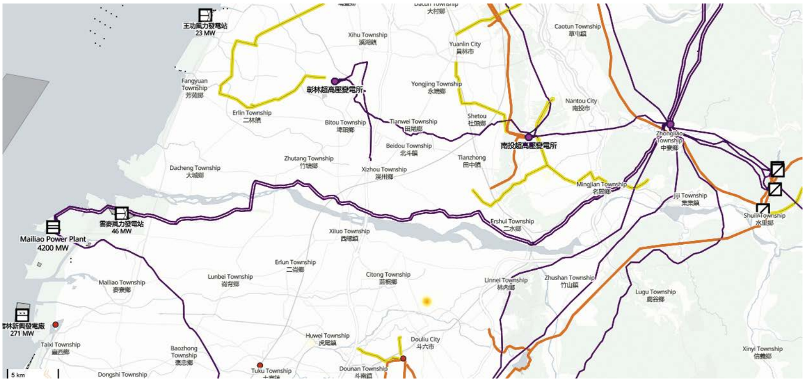

Figure 8.5. Zhongliao EHV transmission lines (Source: open infrastructure map, used under the Open Data Commons Open Database License [ODbL] by the OpenStreetMap Foundation)

In figure 8.5 above, purple represents 345 kV powerlines. Zhongliao is the only EHV path to get power from the hydropower and storage at Takuan, Jugong, and Mingtan down to the western plains. Additionally, Zhongliao's transformer is the gateway for any North-South EHV transmission across the Cho-Shui River that bisects Taiwan's power system. Furthermore, this station supports EHV power lines as far west as Mailiao and Taichung power plants on the west coast and Feglin on the east.[43] Similar limitations exist in the network around Taichung, where three transformer sites, in addition to the Zhongliao site, support all the EHV transmission capabilities for Taiwan's largest coal power plant and large renewable energy developments nearby.[44] Last, Datan (one EHV site), Hseih-ho (one EHV site), or Ma'anshan (two EHV sites) all have similar lack of depth in transmission capability.[45] Additionally, the EHV transformer with the highest utilization is southeast of Taipei in Guishan District and brings power from four separate power plants into New Taipei.[46] In targeting terminology, the power generation facilities have greater depth, cushion, reserves, dispersion, and physical characteristics that make them less critical and vulnerable than the exposed, vulnerable EHV transformer network with limited depth.

Opportunities to Strengthen Resilience

Deterrence by resilience requires communicating the capability and the readiness to operate and resist within the environment required. Taiwan's power infrastructure needs to deny the PRC ability to set the conditions for follow-on campaigns through the JFSC. With respect to the vulnerabilities described, there are mechanisms that Taiwan can pursue to improve the resilience of the power grid to wartime threats rather than simply optimizing for natural disasters and mechanical variances. The mechanisms Taiwan can leverage to increase the deterrent effect of its power infrastructure break largely into two areas: communication and material solutions. Communication solutions tailor the branding and messaging regarding the actions taken to elevate the deterrent effect. Material solutions offer opportunities to reduce the criticality and vulnerability of the power generation and distribution system in light of PRC objectives.

Existing resilience communications from Taipower center around the green energy transition, responses to the 2021 and 2022 power outages, the exquisite power needs of the manufacturing sector, and the potential interruptions to fuel supply. However, Taiwan has an opportunity to clearly contribute a deterrent effect through communication that includes PRC capabilities and intent as demanding change in the power grid. Ukraine remains resilient, but only with continued import of critical equipment that may not be feasible for Taiwan.[47] Militaries and governments study lessons learned from Russia's war in Ukraine and apply them across military, industrial, and logistics disciplines. Taiwan working overtly to make critical infrastructure suitable for the attacks that Ukraine faces would not likely be escalatory in the international narrative. Domestic political concerns may moderate narrative to ensure both continued support and funding for resilience developments. However, to use the Ukraine example, Ukraine's resilience was demonstrated only after deterrence failed. Proactive measures in direct mitigation to tactics demonstrated in Europe can only be considered prudent. Advance demonstrated resilience would strengthen perceptions of Taiwan's ability to continue to frustrate the objectives of any aggressor, especially if consistent with the conditions presented by JBC, JFSC, or JILC.

Communication of increased resilience would be most effective if it relates to the cost the aggressor should expect to incur. Current language regarding Taiwan's energy resilience efforts focuses on economic needs and natural threats. According to Taipower, "In response to the threat of extreme weather and the growth of the proportion of renewable energy power generation, the corresponding 'Design Plan for Strengthening Grid Resilience' is in full swing."[48] A communication strategy, led from the ministerial level rather than the utility, would add credibility to the national security implications of resilience efforts and allow for integration across the Taiwan administration's functions.

A ministerial communication campaign would also have the opportunity for a broader reach than Taipower's own in-house journal. The reference to resilience, which does have meaningful improvements addressed later, has only 847 views in a six-month period, which is insufficient reach to be an effective venue for deterrence.[49] Even during the 2023 Han Kuang exercise, which included simulated attacks on key civilian locations such as ports and airports, no discussion or participation from Taipower or the Ministry or Economic Affairs occurred.[50] Changes do not have to be brash or drastic to be effective; Taipower already leverages stories from disaster relief to celebrate values they want to promote, whether the 1999 earthquake or 2015 Typhoon Soudelor, overtly tying those values and lessons from being attacked by storms to an attack by an aggressor.[51]

The communication strategy employed needs to emphasize both the impact on civilian resilience and military utility, all with conditions that are commensurate with the operational conditions of the threat:

- For civilian resilience, the integration between the emergency services, Taipower, and defense priorities should be identified. Then the competing needs of hospitals, military bases, and communications networks should be exercised in a way that answers both evolving needs and changing conditions.
- For mitigating fragility, the relevant parties should exercise balancing power availability dynamically, as generation units and electricity transportation systems come online and go offline (when damaged), in order to develop and demonstrate reduced fragility.
- For strengthening military capabilities, it is necessary to exercise nationalized control of cogeneration facilities and private power facilities in order to generate pockets of power for military maneuvers.

- Finally, the Taiwan military can continue exploring diverse power supplies and all-electric vehicle options. The military needs to demonstrate the resilience of its energy capabilities for mobility and maneuver, where they will be operationally employed, how the energy is delivered, and where the energy comes from in conditions consistent with potential PRC actions.

As for material solutions, some are in progress, including moving EHV transformers indoors and reducing the centralization of the grid. Several are part of Taipower's Design Plan for Strengthening Grid Resilience.[52] Additional resilience could be gained by integrating and adding mobile transformers and increasing local stockpiles of substation and transformer equipment.

- Expand on the intent to take twenty-four outdoor substations and transition them to indoor substations.[53] Indoor substations allow for the construction of firebreaks and fire suppression systems between transformer components that will limit the effectiveness of long-range fires on a per munition basis by making the same equipment less vulnerable to adversary effects.[54] Additionally, this change will make it more difficult for adversaries to identify critical nodes and real-time capabilities as more diverse power transmission pathways become available or are lost in conflict.
- Preserve legacy hardware during grid upgrades. A major portion of the grid resilience plan is the removal and replacement of some infrastructure that dates back to colonial Japanese installation. The equipment needs replacement due to age; however, the aging equipment should be retained or abandoned in place. It would leave an installed backup if needed. Legacy equipment may shorten Taiwan's timeline to secure an alternate pathway for electricity in a crisis if, rather than remove and replace, Taipower were to retain and replace. Part of this mitigates supply challenges that have dogged Ukraine's repair and replacement of electrical grid components, as they compete for components with concurrent grid projects in other major economies.
- Mobile substation infrastructure could provide a more survivable alternative to restore complete or partial capacity to a destroyed transformer or substation. Taipower has some mobile

> substations of unknown quantity and capacity. A mobile substation periodically relocating, even within the footprint for a fixed substation facility, presents a transportable target the PRC would have to spend resources on to affect, including intelligence, surveillance, and reconnaissance (ISR), command and control (C2), and fires resources, all giving Taiwan time to resist. Mobile substations may also add cost-effective redundant capability, before, during, and after the available hardened indoor facilities are completed. Mobile substations are available up to 230 kV and 65 megavolt-amperes, which exceeds the utilization at all but the largest transformers.[55]

Mobile substations and emergency utilities should be demonstrated in conjunction with other ministerial resilience and readiness actions, where communication is framed by the PRC threat, to present a credible increase in civilian resilience and the military readiness capabilities of Taiwan. A power infrastructure resilient to long-range fires and blockades of critical components and fuel would contribute to deterrence by increasing Taiwan's ability to resist and overcome hostile PRC military action.

Conclusion

If the PRC opts to militarily disrupt the status quo with Taiwan, the PRC will bring the superior force, dictate the timing, and likely control the scope of the conflict. However, Taiwan controls the condition of the battlefield and can use the available time to present increasingly confounding challenges to the PRC. Even as it invests in capabilities to project power, Taiwan needs to invest in the foundational services that enable power projection operations and civilian resilience. The publications that outline how the PRC would most likely employ the PLA against Taiwan show, regardless of the PRC's approach, Taiwan's energy infrastructure will be under assault.[56] The JFSC is the first step in multiple PRC approaches, and frustrating the objectives of the JFSC and injecting uncertainty into its potential effectiveness induce variables at higher risk for all later phases of PRC planning. If Taiwan can decrease the certainty of success in lower-risk (for the PRC), long-range ballistic and cruise missile strikes, it increases the variables and risks the PLA has to consider for later, higher-risk landing actions. Also, where Taiwan can take a critical target that takes the PRC one missile today and turn it into a two- or four- or eight-missile target with delays and induced uncertainty of ISR and C2, it multiplies the required PRC resources. In this way, *every power line, pipeline, road, railway, or runway becomes a mark of resistance and thereby deterrence*. By changing the planning, design, and messaging baseline to the possible conditions of the JFSC, Taiwan makes it less likely to occur.

Previously, rhetoric and communication relating civil development and requirements to PRC aggression likely would have been inflammatory; however, for power infrastructure especially, the Russia-Ukraine conflict provides an opportunity. Russia, denied rapid triumph in objectives in March of 2022, began denying Ukraine access to electricity on the eve of winter through targeting transmission infrastructure in October.[57] This assault on Ukraine's energy infrastructure aimed to demoralize Ukranian resistance and disrupt Ukraine's economy. Russia's tactics against Ukraine provide Taiwan a rational, nonescalatory case for preventing similar targeting by the PRC in case of conflict. the same for their own people. Statements showing Taiwan is trying to increase its resilience to natural disasters underscore that the civil infrastructure and services are ready for a violence-inducing operating environment.

Developing deterrence by resilience begins with an examination of what is available in peace, what is required in the expected conflict, and what capabilities can be expected to meet those requirements in the operating conditions the adversary will present. The fragility of power distribution and dependence on fuel storage and distribution are key capabilities that need to persist through PRC actions. Therefore, Taiwan should leverage the current time to make the infrastructure more survivable in ways that directly affect the PRC's ability to readily deny them. While of modest cost, these changes, especially around power infrastructure, would suggest a whole island of organized resistance that would continue to give the PRC pause.

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Chapter 9

Taiwan Civil Guard

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Abstract

This chapter recommends the standup of a Taiwan Civil Guard (TCG), an all-volunteer and community-based organization, funded by the Taiwanese government. The fastest and most cost-efficient way to deter the People's Republic of China (PRC) from invading Taiwan is by enhancing deterrence by resilience. A TCG force could not only help unify and prepare Taiwanese civilians prior to crisis but also equip Taiwanese society with the capabilities to wage irregular resistance against a PRC invasion. Taken together, these steps would help raise the costs of a PRC invasion while reducing PRC confidence in its perceptions of a successful campaign to forcefully unify Taiwan.

Chinese Language Abstract

本文建議成立臺灣民防隊（TCG），這是一個由志願者和社區為基礎所組成的組織，並由臺灣政府資助。最迅速且最具成本效益的阻止中國入侵臺灣的方法就是通過提升抵抗能力來增強嚇阻，民防隊不僅可以在危機發生前將臺灣民眾聯合起來準備應對危機，還能使臺灣社會具備對抗中國入侵的不對稱能力，綜合這些措施，將增加中國入侵的成本，同時降低他們對於成功用武力統一臺灣的信心。

Introduction

Taiwan's current approach to fighting a PRC invasion relies on the Ministry of National Defense's (MND) capability to use Taiwanese military and reserve forces. Such an approach, however, is likely insufficient to definitively deter a PRC invasion. According to a 2022 US Department of Defense annual report to Congress, PRC forces outnumber Taiwan force assets in every facet of warfare. Moreover, Taiwan's military struggles with acquiring assets at a scale large enough to match the military forces of the PRC.[1] A 2023 RAND study on Taiwan's ability to resist a large-scale military attack notes that Taiwan must be able to rapidly improve its defense force and uphold a strong political and military front to unify resistance against a Chinese attack while also holding out long enough for US and international partners to intervene.[2] But relying on others to intervene in time risks projecting a weak deterrent. As the deterrence literature shows, strategies of extended deterrence are difficult to pursue.[3] The people of Taiwan must therefore prepare for the worst-case scenario, one where the US and its partners are unable to respond quickly, or at all, leaving Taiwan to defend itself.

For these reasons, this chapter argues that deterring the PRC from launching a military campaign against Taiwan necessitates a whole-of-society approach, an approach best accomplished through deterrence by resilience, by cultivating a Taiwan civilian populace prepared to survive any scenario from natural disasters to an invasion. To do so, Taipei should invest in and train Taiwanese civilians who are not in the MND or the military reserves to prepare for a conflict or crisis by creating a Taiwan Civil Guard. The TCG's mission would be to protect Taiwan's civilians by organizing, advising, and training them to survive a natural disaster, a capability transferable to a potential conflict on the island. Such a move is possible in that Taiwan already has a robust natural disaster team in the National Fire Agency (NFA) and National Police Agency (NPA), whose responsibility is to provide emergency services to protect property and civilians. In this regard, a TCG can aid the NFA and NPA in keeping civilians safe during a crisis, and in wartime, the TCG can help make poisonous the quills of a porcupine defense.

The Limits of Taiwan's Reserve Force

Currently, Taiwan's military and reserve forces are unlikely to survive a prolonged conventional fight against the PRC without drastic improvement or changes to defense and government policies.[4] Taiwanese defense spending is a mere $19.1 billion compared to the PRC's budget of $224 billion, as of 2023.[5] The sheer volume of the PRC's defense budget stresses the importance of Taiwan investing in creative, asymmetric strategies to deny PLA confidence in a successful invasion. In this regard, Taiwan can neither rely on monetary assets alone nor match the PRC's strength militarily.

Indeed, if the PRC decided to invade Taiwan, it would strike with speed and an element of surprise.[6] Taiwan's military would respond to such an attack by calling upon reserve units to fight the PRC as swiftly as possible. However, the millions of people on the island would be in panic, trying to care for their families in an isolated warzone, and face immense suffering from the lack of medical facilities, electricity, and food; this would challenge Taiwanese morale.[7] Building a TCG could mitigate the effects of this panic and provide hope and guidance to the masses by empowering them to fend for themselves. Doing so could also improve the morale of Taiwan's military and reserve forces by providing them with greater peace of mind that their friends and families could protect themselves in a coordinated and collectively supported manner, allowing the Taiwanese military and reserve forces to focus on the fight.

Although Taiwan already has a civil defense system, the prolonged absence of war has hollowed out the effectiveness of this system. According to the Civil Defense Act, the Ministry of the Interior (MOI) is the lead for civil defense affairs, with each county and city expected to have a civil defense corps to maintain local social order by assisting rescue operations in case of natural disasters during peacetime and supporting evacuation efforts and military tasks during wartime.[8] However, reports show that Taiwan's Civil Defense Act is not effective due to a lack of organized training, funding, and tasks apportioned to these civil defense teams.[9] For instance, out of the $812,697 allocated for Taipei's civil defense, only $31,274 was spent on training civil volunteers with the remaining spent on year-end banquets and social gatherings.[10] Consequently, the main function of the civil defense brigade has devolved into social dinner parties and other activities unrelated to their original charter.

Investing in Civil Resilience

The current Russia-Ukraine war illustrates how civil defense measures can pay significant dividends in resisting invaders' objectives. When Russian missiles hit Ukrainian buildings, Ukrainian firefighters put out fires and rescued people in an orderly manner. Ukrainian firefighters, civil affairs personnel, and others immediately entered conflict zones, counted mortalities, cleared roads, and worked as quickly as possible to restore order and maintain civilian safety. As a result, there was no infighting among civilians when receiving foreign aid, food, and daily necessities, with cities still functioning despite the calamities and limited resources.[11]

The success of Ukraine's civil defense measures demonstrates the positive effect of the Ukrainian government's efforts to develop these capacities and resilience, so that non-combatants stepping into new roles could support themselves and protect their livelihoods and families. Contributing to this success: websites the Ukrainian military set up to teach Ukrainians how to self-organize protests and execute ambushes. Such activities created opportunities for the Ukrainian military to work with local guerrilla forces to pinpoint Russian centers of gravity.[12] Additionally, Ukrainian civilians used their knowledge of the local terrain to fight alongside Ukrainian military units and gather intelligence.[13] By mobilizing their whole society to oppose the Russian invasion, Ukrainians have stood strong against a stronger adversary and inspired the international community to provide greater assistance.

If the PRC were to defeat Taiwan's conventional forces quickly in a fait accompli, Taiwanese society would be thrown into confusion and disarray. As things currently stand, Taiwan's civilian population may be unable to resist PLA forces if Taiwanese civil and military leaders were defeated. In this regard, Taiwan's situation is more dire than Ukraine's. First, unlike the conflict in Ukraine, the United States and other international partners would have little time to respond.[14] Second, Taiwan has neither NATO partners nor contiguously bordering countries for citizens to take refuge in if under attack. Third, Taiwan does not possess the same civilian-military collaboration or civil resilience as the Ukrainians did preconflict. And so, while the will might be there—with recent polls showing that 72.5 percent of Taiwanese would be willing to take up arms in the event of an attack from the PRC—the capability to effectively apply it is not; civilian resilience and a whole-of-society defense cannot be developed quickly during conflict and requires, instead, formation and development before a crisis.[15]

It would be advantageous for Taiwan to learn from the Russia-Ukraine conflict and rapidly develop and build civilian resilience in preparation for conflict. Doing so could change the PRC's assessment of Taiwan's preparedness and plant the belief that an invasion of Taiwan would not be swift but rather an extended and costly endeavor. In this regard, Taiwanese civilians would be more prepared to respond to an invasion and would be perceived as a more realistic threat. Moreover, enhancing Taiwanese civil society's ability to resist a PRC invasion could engender more international sympathy and support, thereby generating greater risk in the minds of PLA planners regarding the likelihood of success.

Finally, unlike other options to strengthen deterrence in the Taiwan Strait, a TCG would provide little risk. The creation of a TCG would not escalate tensions in the Taiwan Strait but instead provide options for multilayered disaster response efforts for the Taiwan authorities as well as additional tools for Taiwanese to prepare for any crisis, whether armed conflict or not. In this regard, the intent of a TCG is purely defensive in nature, focusing on strengthening Taiwanese civil society. It would rely on community leaders, the NFA, the NPA, and nongovernmental organizations (NGO) to organize, train, and equip the local community with tactics for surviving both natural disasters as well as kinetic strikes on the island. The result would be a whole-of-society response and a level of resilience currently unavailable in Taiwan: a Taiwanese populace confident, united, and prepared to resist and overcome any disaster.

A Framework for a Taiwan Civil Guard

If Taiwan authorities invest in civil resilience to build deterrence capabilities against the PRC, funding and resourcing must follow. The TCG, like the NFA and NPA, could fall under the MOI and be organized for each administrative district. For example, Taipei residents would be a part of the TCG-Taipei group, and Tainan residents would be a part of the TCG-Tainan group. Furthermore, Taiwan's MOI could work with the MND to reformulate the *Civil Defense Manpower Mobilization Plan* and revise the scale and tasks of the civil defense teams in each region, based on wartime needs and factors such as size, population, infrastructure, and defense plans. If Taiwan can build a strong foundation of civil deterrence, its authorities can formulate lower-level management systems, training plans, and other needs. This transparency and preplanned approach will minimize chaos and panic that may ensue if the PRC were to invade Taiwan.

To gain the support of the general civilian population for this whole-of-society approach to homeland defense, brochures should be distributed nationwide to inform the public on what to do in the event of an invasion. Distributing specialized information on, for example, medical and logistical aspects and showing how to support homeland defense operations in wartime can also prove to be beneficial.[16] In 2022 and 2023, the *All-Out Defense Handbook* and the *All-Out Defense Contingency Handbook* were released by the Civil Defense Mobilization Agency under the MND to inform the civilian population on what to do in a possible crisis scenario where Taiwan is attacked. This was a good start: it raised public awareness, got local governments and civil defense groups working together, and sent a message to the public, to allies, and even to potential adversaries: "We're not just waiting to be invaded—we're preparing." At the same time, most people did not read the handbooks, there wasn't much follow-up—no mandatory training, no nationwide campaigns—and some of the content (like military identification charts) felt too technical or abstract for everyday people. Such efforts should be continued, but hands-on training for civilians should be conducted to reinforce these handbooks and develop the skills needed to prepare for conflict. The TCG would fill this need and use government and NGOs funding to train and equip Taiwanese civilians.

Developing Resilience

Developing resilience through a TCG would require clear mission sets; adequate funding, training, and recruitment; manning and resources; and consideration of outside partnerships with concerned foreign citizens.

Mission clarity. For the TCG to be successful, mission sets and key essential tasks could be divided among respective cells of the TCG. For Taiwan's military, the wartime mission is to prevent the enemy from taking control of mainland Taiwan. The TCG's wartime mission would be protecting civilians by moving them to safety and organizing them to survive.

TCG key tasks could also include protecting important key facilities in the communities as well as monitoring secondary landing sites, airdrops, and access points that the enemy may use. If enemy forces break through the regular troops' defense lines, TCG members can evade and provide guidance to civilians in conflict zones to ensure their safety. Depending on the city, district, or village, respective TCGs could also be focused on their specific terrain and key locations to defend their people and resources. The TCG should adopt the concept that the community is the battlefield and the battlefield is the training location. TCG members would be living in their battlefield and training locations, eliminating the requirement for people to stay in specific camps or bases to adapt to a conflict, reducing training costs and cultivating local-terrain expertise.[17]

Material support. A TCG will require leadership, funding, recruitment, and training. The TCG could be funded by national-level authorities, but leaders of cities, districts, and villages also could be empowered to organize preapproved exercises so that civilians can freely participate in their respective areas. This would enable civilians to practice tactics with their neighbors to build resilience and community trust. The TCG could also exercise with city and village leadership to help identify shortfalls in food storage, bunkers, and water resources, ensuring civilian leaders are able to resource the correct supplies needed for their districts. NGOs like Forward Alliance and Kuma Academy have trained thousands of Taiwanese citizens on tactics to survive a conflict in Taiwan. The Taiwan authorities could also partner with these organizations to expand their training footprint so more civilians can participate.[18]

Currently, there is no formal platform for these civil resilience citizens to continue to practice among their communities. These trained citizens should be seen as key personnel for nurturing civil resilience. Retired Taiwan military special forces could also supplement the city, district, and village leaders in directing the TCG and the local populace, counterattacking, subverting, and preempting PRC invasion forces. If the PRC invasion force was able to touch down in Taiwan, the civilian populace's willpower to survive and resist would be bolstered by irregular tactics.

International partnerships. Taiwan could also enhance the training of the TCG members and other civilians by utilizing the expertise of other nations that have civil defense organizations, such as Lithuania, Latvia, and Estonia. These three nations have developed cooperative relationships with their civilian resilience and military forces as they prepared their countries for times of war and crisis.[19] Lithuania has hosted civil-military coordination exercises and published manuals on how citizens can unite and resist during an invasion.[20] Estonia and Latvia have built a system of education that has taught civil resilience from a young age, training their youth on how to hike, survive in the wilderness, and fire weapons.[21] Taiwan could lean on the Baltic states for their expertise on how to better integrate civil and military leadership, while also learning how to distribute their resources and manpower to properly fund civil resilience. Taiwan could also learn from Nordic nations that have established total defense frameworks, using them as guidelines to build an integrated defense that could develop a shared security culture among the people.[22] Taiwan should request liaisons from the Nordic and Baltic states to help organize and develop the TCG at an accelerated rate, streamlining the organization and training needed to empower the Taiwanese. This would further highlight international support for a PRC-free Taiwan—and emphasize the messaging required to show the PRC that Taiwan is prepared to resist and survive.

Ongoing resourcing. For the TCG to be successful, it must be properly manned and resourced. The TCG should establish an open recruitment system and a clear selection and elimination mechanism. This would free the civil defense team from local favors and interests, becoming a national resilience organization that the public can participate in. If Taiwanese people who have not been conscripted or are not on reserve status want to participate in protecting their homeland, they should be recruited into the TCG. The TCG should be composed of any non-active military and non-reserve personnel who want to serve in the civil defense of Taiwan, regardless of age or gender. Everyone is capable of helping in civil defense, whether it be performing tactical combat casualty care (TCCC), posting messages on social media, or organizing and distributing food and shelter for those in need. The whole-of-society concept in Taiwan can also include youth in high schools, as Estonia and Latvia have done, cultivating civil defense in the younger generation to help prepare for future crises that may occur.[23]

When Taiwan encounters a natural disaster, TCGs near the disaster site can be mobilized for rescue efforts, allowing the standing troops to have more time to focus on war prevention and providing an opportunity to exercise TCG mobilization and coordination. Taiwanese civilians may be more apt to join the TCG knowing that they are protecting their community, potentially reaching a sufficient number of members needed to create a whole-of-society defense. The TCG could wear an easily removable armband instead of a uniform to quickly blend into the environment to avoid detection or persecution from the PRC if invaded. This action may also affect the decision calculus for the PRC, as they would not be able to quickly identify who is in the TCG, making it difficult to target resilience leaders. Improving the resilience of Taiwan's civilian population can also reduce the pressure on the national military's standing forces and disaster response teams.

Taiwan may also want to consider recruiting foreigners to be a part of the TCG.[24] In Ukraine, there are reportedly up to 20,000 volunteer foreign fighters performing combat and support operations in the

Ukrainian International Legion.[25] If Taiwan were to follow in the French and Ukrainian footsteps of creating a foreign legion, it could help provide further depth of resources for Taiwan's civil and military defense.

The TCG Foreign Legion could also offer citizenship and other incentives for joining, inviting foreigners to help support Taiwan in civil resilience. The current application to become a Taiwanese citizen has several requirements, such as living in Taiwan for five consecutive years, having a basic level of Chinese language capability, proof of funds, and so on.[26] The TCG Foreign Legion could open new avenues for individuals to gain citizenship in exchange for protecting Taiwan, giving them access to the benefits of being a Taiwanese citizen, such as opening a business, a high quality of life, visa-free access to 146 countries, and access to a robust healthcare system.[27] As of 2022, Taiwan has approximately 796,700 foreign residents, and a select number of foreigners could be offered citizenship after five years of service, without other requirements, and earn certain incentives such as food and pay for joining the TCG Foreign Legion.[28] With the approximately 169,000 Taiwan military members in addition to the 1.66 million reservists, the creation of the TCG Foreign Legion could provide further resources for Taiwan's civil and military defense while adding possible international support.[29]

Irregular Resistance

To further enhance Taiwan's deterrence capabilities, the TCG could train Taiwanese citizens in irregular resistance practices. Such practices would raise doubts in PRC planners on their ability to successfully control Taiwan. TCG training tasks would consist of weapons expertise, TCCC, survival and evasion, communication, drones, cyber, and acts of nonviolent resistance. The TCG would be trained, not as professional soldiers, but as members of a whole-of-society defense with specific skill sets that are irregular and outside the scope of the Taiwan military and reserve forces. An advantage of this approach is the use of independent networks, outside of the formal military, to conduct irregular activities such as disrupting, weakening, counterattacking, subverting, and preempting PRC invasion forces. If the PRC invasion force was able to touch down in Taiwan, the civilian populace's willpower to survive and resist would be bolstered by irregular tactics.

Developing Weapon Expertise

If Taiwan were to establish a TCG and train its civilians to carry weapons, it would inevitably have to amend gun laws and be supported by the Ministry of Home Affairs Police Department. In Taiwan, gun control is still quite strict, and the police's attitude toward the use of weapons by nonmilitary units is quite conservative. If changing Taiwan's gun laws is not achievable, Taiwanese authorities should still press to build weapon competency among its civilians so that if conflict were to occur, civilians would know how to operate weaponry and be able to defend themselves in addition to creating stockpiles of weaponry to hand out to civilians in case of an invasion.

According to multiple public opinion surveys, a large number of young people in Taiwan are willing to take up arms to defend the country, but they believe that they lack professional combat skills and cannot adapt.[30] However, the war of aggression against Ukraine has since heightened the awareness of risks among the Taiwanese people, and they have been actively signing up to participate in private military training. In 2022, Polar Light, a combat-skills training company in Taiwan that uses airsoft guns, guns using compressed air or gas, has quadrupled its membership as Taiwanese have become more concerned with learning how to handle weapons and prepare for conflict.[31]

This desire for preparedness could be nurtured by Taiwan's government and the TCG to train members and civilians on small arms tactics, urban warfare, and guerrilla tactics. Weapons training with airsoft demonstrates to the PRC that all of Taiwan is willing to resist invasion by taking up arms. To offset the costs of distributing weaponry for training, virtual reality training could be an option to train small-arms tactics. Training for warfare in urban and jungle environments cannot be innovated during conflict but must be invested in pre-conflict.[32]

First Aid and Tactical Combat Casualty Care

If deterrence fails, a full-scale conflict in Taiwan would include mass casualties on all sides. The 2023 *All-Out Defense Handbook* that the Taiwan military released indicated that civilians should carry first aid kits as part of their contingency bag, but for civilians to be truly proficient they must exercise those crisis medical skills.[33] Community leaders along with TCG trainers could hold TCCC exercises in their local areas for civilians to become capable of responding to medical situations, building a community of dependence and growing confidence in their skills. Civilians learning TCCC could be prepared to address natural disaster type injuries and wartime injuries as well.

Surviving

Survival and evasion tactics should also be part of the TCG training playbook, practicing the *All-Out Defense Handbook* literature and using lessons learned from urban warfare conflicts. Citizens could be trained how to capitalize on their surroundings, such as Taiwan's mountain range and natural island features, for food, clean water, or alternative power sources. Citizens in urban areas could use their subway systems for transit during conflict, prolonging their survival with prepositioned food and water, building more underground vertical farms in their metros as they have already done in Taipei. Taipei's 40-square-meter hydroponic farm uses high-tech equipment and LED lighting, produces 180 bags of lettuce a week, and is located underground in Taipei's Nanjing Fuxing metro station.[34] The TCG, partnered with the Ministry of Transportation and Communications, could work to hold evacuation drills with the populace to hide and navigate from conflict zones to reach predesignated safe zones via the metro system.

Communicating

In the event of a denied communication environment, the TCG could be trained to operate without guidance from the Taiwan authorities or TCG leadership. During the 2019 protests in Hong Kong, the PRC locked cell towers and various internet apps so protesters could not communicate and rally together in protest.[35] The TCG could adopt the same principles used by the protestors and communicate via messaging apps not reliant on the cell towers like they did in Hong Kong. In Ukraine, applications like Discord have also been used as a channel of communications, and the TCG may be able to do the same, ensuring that it is also protected via cyber security measures.[36] Amateur radio training and equipment could also help communications among TCG members, ensuring that they stay informed and aware of what is happening in conflict zones as well as understanding if or when they are compromised. TCG members could also be trained on resisting misinformation operations, as there is a high level of probability that the PRC will spread misinformation via various channels like on April 20, 2022, when news tickers on Taiwan television sent out messages of Taiwan being attacked by the PRC, causing mass confusion and fear.[37] To build civil resilience among Taiwan citizens, operating in a degraded communication environment can be rehearsed during peacetime.

Operating Drones

Training on low-cost drones in preparation for a crisis could be crucial to building Taiwan's deterrence against the PRC. In Ukraine, drones have been utilized as one-way kinetic weapons as well as intelligence gathering assets.[38] The TCG could do the same and use low-cost, commercial-off-the-shelf drones to resist an attack on Taiwan. Drones could also serve as communication nodes or provide situational awareness in a disaster zone. Ideally, these low-cost drones should be built and sourced in Taiwan, but 3D printers could be purchased by the Taiwanese government and dispersed to TCG members to proliferate drone usage among the citizenry, aiding the TCG and community leaders in surveying their areas of responsibility. Taiwanese authorities could also hold drone-building and -racing competitions to cultivate the skill sets needed for drone operation, further layering expertise and asset development options among civilians. If the PRC believes that Taiwan's whole society is capable of building drones in mass, it will add additional problems to the PRC invasion plan and add another layer of in-depth defense to Taiwan.

Cyber and IT Security

Another area of expertise that could be nurtured in the TCG is a whole-of-society cybersecurity strategy. If the PRC were to attack Taiwan, it could be in all domains, and Taiwan must be able to protect itself from cyber warfare. IT professionals in the TCG Cyber Division could defend Taiwan's power grids and communication networks. This could ensure the Taiwanese can still have running power and water while being able to communicate with each other. The TCG could also be tasked with ensuring their local areas are secured and protected from cyberattacks while also protecting civilians from misinformation being spread. TCG Cyber members could train during peacetime and engage with Taiwan power and communication firms to be able to provide red-team assessments and earn rewards for discovering vulnerable systems and building redundancy and alternate paths of connectivity to ensure systems are up to par. Hardening and layering Taiwan's communication networks will be critical to Taiwan's deterrence through resilience, ensuring authorities can continue to communicate to the whole population and international community precrisis and during conflict. Ensuring that the international community is aware of a conflict in Taiwan would be key to garnering global support against the PRC invasion forces.

Resisting

Last, the TCG could be trained and prepared to resist occupation. Not everyone in Taiwan may want to join in combat if Taiwan is overrun, and civilians should also learn how to resist through nonviolent methods. The Taiwanese can continue to dispute PRC occupation via protests, boycotting, or on social media, but in order to be effective, cohesive coalition of organizations, groups, and institutions must unify around common objectives.[39] The TCG can help citizens formulate these methods precrisis in order to have a unified voice against any type of aggression against the people of Taiwan, becoming the symbol of resistance and defiance against PRC rule. Even if Taiwan is overtaken, the TCG mission can still help citizens organize and protest PRC rule through boycotting specific economic resources to undermine the PRC's occupation. Boycotts could discredit the PRC and gain worldwide support by affecting trillions of USD of revenue worldwide in industries such as automotive, smartphones, computers, e-commerce, logistics, ride-hailing, and entertainment.[40] The TCG could help collate messaging to Taiwanese and the international community, rallying the people to continue to resist while also highlighting the unjust invasion of Taiwan to garner international support. TCG messaging can also help prevent misinformation campaigns that the PRC would most likely enact in Taiwan, ensuring that the Taiwan populace is able to rely on real-time, honest information without having the PRC shape the narrative of the people on the island.[41] These initiatives all require pre-conflict training, which the TCG can help provide with the support of partners and existing documentation from Gene Sharp's Albert Einstein Institution, which has been utilized in countries like Ukraine or Egypt.[42]

Conclusion

A whole-of-society defensive posture signals to the Chinese Communist Party that Taiwanese citizens have the will and capability to resist aggression. Taiwan will initially face the war alone until international support arrives, and like Ukraine, Taiwan's ability to resist an invasion will possibly allow for receiving international assistance to counter PRC incursion.[43] In the worst-case scenario, Taiwan will have to fight alone. If conflict were to break out today, Taiwan's military and reserve forces would go to the front lines with their families at home defended by the NPA and supported by the NFA. If Taiwan were to establish the TCG, it could appease their military fighting forces' fears for their families. The TCG, properly funded and equipped, could provide Taiwanese the skills needed to survive in conflict while providing a multilayered defense mechanism. If Taiwan established the TCG, its members, with volunteers from all over the country and the world, would have the goal of defending democracy against an unjust invasion.

To be clear, there are still some difficulties and limitations in establishing a TCG in Taiwan:

- The current "National Defense Mobilization Preparation Act" and "National Defense Act" are vague about the organization and mobilization of "irregular forces."
- The establishment of a TCG may require amendments to the law or the establishment of a special law, involving the boundaries between military, civil and police.
- Who will command? Ministry of National Defense? Local leaders? Ministry of the Interior? Cross-departmental coordination and training standards need to be clarified.
- Without a good institutional design, it may cause a waste of resources or confusion in command.
- Some in society may be concerned with the creation of a paramilitary/civilian armed group.
- "De-ideologization" needs to be properly handled so that the TCG can truly represent the whole people.

Successfully moving the idea for a TCG forward will require additional work and thought in each of these areas.

The fastest and most cost-efficient way for Taiwan to deter the PRC without having to wait for military assets to arrive on the island is by building its civil resilience. If Russia knew that Ukraine's whole society would resist to the end, would Russia still have invaded? The pursuit of freedom will come at a cost, especially when Taiwan faces such a powerful foreign enemy. If Taiwan is determined to not accept any form of reunification, then it will be necessary to invest more funding and resources to build a strong national-resilience force.[44] The rebranding of Taiwan civil defense into the TCG would send a message to the PRC that if attacked, Taiwan will ensure the survival of its people, prolong conflict, and resist until the last breath. Building civil resilience in Taiwan will make the "quills of the porcupine" poisonous, exponentially raising the cost of a PRC invasion and occupation while creating lasting effects that would challenge the PRC's prosperity and success.[45] Taiwan should build a TCG, but it must ensure that it is created in a methodical, institutionalized, and de-ideological manner.

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PART 4

US DETERRENCE

Chapter 10

First Strike Deterrence

A Bold Stance Against China's Threat of a Forced Unification with Taiwan

Glen Gibson

Abstract

Faced with a growing threat of conflict over a forced unification with Taiwan this decade, the United States must find new ways to deter China from embarking on such a dangerous course of action. One such opportunity includes decreasing China's advantages of time, distance, and initiative that collectively provide it the best chance of succeeding in a quick, fait accompli invasion of Taiwan. To do so, the United States can hold key amphibious vessels necessary for a cross-strait invasion at risk of a first strike in a bold, but credible and justified, option to counter these advantages and maintain deterrence. This chapter establishes the credibility and capability necessary for the United States to field a first strike option by: (1) addressing the necessary requirements of imminence and proportionality to justify a first strike, (2) assessing key escalation considerations, and (3) demonstrating a first strike option fits within a deterrence strategy framework and delivers deterrence value. In sum, holding critical components of an amphibious invasion at risk of a credible first strike improves deterrence this decade by outrightly denying China's ability to conduct an amphibious invasion or by necessitating costly changes to Chinese force structure or training.

Chinese Language Abstract

面對近十年內臺灣所面臨日益增長的的中國武力統一威脅，美國必須找到新的方法來阻止中國採取如此危險的行動。中國在時間、距離和主動權上的優勢為其提供快速且成功武統臺灣的條件，美國需要一個能夠減少這些優勢的機會，美國可以採取一個大膽但合理且具有可信度的選擇，也就是讓中國武統臺灣所需要的兩棲部隊處於受第一擊的風險中，以降低中國的武

統優勢並維持嚇阻。本文通過以下幾點來確立美國進行第一擊選項的可信度和能力：

針對發動第一擊的緊迫性和比例性進行闡述，以證明其合理。

評估局勢升高的關鍵考慮因素。

說明第一擊選項符合嚇阻策略的框架並且能夠實質達到嚇阻效果。

整體而言，使中國的兩棲入侵部隊處於受打擊的風險中，透過直接打擊兩棲入侵能力或迫使中國在軍力結構或訓練上進行代價高昂的改變，可以在近十年內改進嚇阻可信度。

Introduction

> *No government should ever believe that it is always possible to follow safe policies. Rather, it should be realized that all courses of action involve risks: for it is in the nature of things that when one tries to avoid one danger another is always encountered. But prudence consists in knowing how to assess the dangers, and to choose the least bad course of action as being the right one to follow.*
>
> —Niccolo Machiavelli

Tens of thousands of lives lost, militaries crippled, the global economy imperiled, and alliances pushed to their limits. This is not an unimaginable outcome of a war between the US and China, and nowhere is a conflict between the two great powers more likely than over the fate of Taiwan. Held as a core tenet to the Chinese Communist Party (CCP) in its goal for the Great Rejuvenation of China, unification with Taiwan, Xi Jinping has said, is "inevitable."[1] Though the CCP has long preferred to achieve unification without war, reduced incentives for Taiwan to agree make peaceful unification increasingly unlikely. Due to time constraints and an increasingly unstable status quo, a conflict between the US and China over the fate of Taiwan becomes increasingly likely.[2] To avoid such a calamitous outcome, an improved deterrence posture is critical and necessary now.

Yet, how can the US deter a China that places unification at the center of its national policy? In the face of such a deterrence challenge, the US must answer retired US Navy Adm John Aquilino's call to "seize the initiative" and take bold action commensurate with the seriousness of the action being deterred.[3] To that end, the US must consider improving deterrence against a forceful unification by fielding a limited first strike option against Chinese amphibious vessels in port.

This chapter begins by addressing China's advantages of time, distance, and initiative that are at the core of reducing the impact of US deterrence efforts in theater. Next, though this chapter does not advocate for the ultimately political decision to conduct an *actual* first strike, requisite attention is paid to justify a first strike in so far as such a justification is necessary to underpin the credibility of the *option* of a first strike as a deterrent. To do so, it overlays details of a Chinese cross-strait invasion against a core framework of three conditions authored by John Huntsman in his thesis, "Just Strike: A Commander's Guide to Preemptive Self-Defense," that justify a first-strike option.[4] Third, it analyzes escalation considerations related to both an actual first strike and the threatening of a first strike. Last, the chapter outlines how a first-strike deterrent option fits within a modern deterrence strategy and provides several positive deterrence outcomes that can be realized by a first-strike option. In sum, this chapter assesses the US can decrease the likelihood of a forceful unification this decade by justifiably holding key amphibious landing craft at risk of a preemptive strike.

The Tyranny of Time, Distance, and Initiative

Two major factors affect the United States' ability to militarily deter a Chinese invasion of Taiwan. The first is the quantifiable distance the US must send forces to engage China in a meaningful way during an invasion. The second is China's retention of the first-mover advantage. This places the US at the disadvantage of having to react to Chinese actions (initiative) from locations requiring days or weeks from which to transit (time/distance). Consequently, a key aspect of deterring China from invading Taiwan is to reduce this timeline.

While Taiwan has continued to purchase weapons systems and bolster its "porcupine" strategy to both deter China and make Chinese offensive actions more difficult,[5] there is likely a gap of some days or weeks where Taiwan will have to fight on its own with limited US involvement.[6] Even if Taiwan were able to hold out for one to three months as experts believe,[7] what may be left to save, or the difficulties in removing entrenched Chinese forces by the time a suitable US/

partner presence arrives, will complicate the calculus of a successful US/partner response. This inherent advantage is not lost on China in planning for operations, as one key result the People's Liberation Army (PLA) hopes to achieve is a quick win that makes the invasion as close to a fait accompli as possible before US forces have a chance to arrive.[8]

In addition to the tyranny of time and distance required to bring US forces to bear, China maintains an additional temporal advantage related to initiative.[9] Taking and maintaining the initiative are integral to the Chinese approach to conflict management. This allows China to move first and set the conditions of a conflict.[10] Since the desire to change the status quo lies with China's determination to unify with Taiwan, China maintains the advantage to determine when, where, and how such an attack may occur. Additionally, while US senior leadership publicly noted that a Chinese invasion is possible this decade,[11] and while scholarly articles argue it may benefit China to attack sooner rather than later,[12] the window between 2025 and 2030 is still quite large. Therefore, owning the initiative provides China a first-mover advantage and risks holding the United States in a prolonged state of heightened readiness that inevitably creates operational fatigue that impacts force readiness.

Given the disadvantages that time, distance, and initiative place on the US forces, what can be done to impact those facets of the operational environment? One such option is to reduce the time and distance requirement for US forces to interdict by moving relevant elements forward and closer to the Taiwan Strait theater of operations. In 2023, the US made improvements on this front via agreements with the Philippines to open four key Philippine military locations for use by the US.[13] However, even with additional basing rights, moving high-value military assets and human capital closer to the combat theater may play to China's advantage. China's robust rocket force underpins China's anti-access/area denial (A2/AD) capability meant to deny the US easy access to the theater and places any forward deployed forces under persistent risk. Indeed, "a fine deterrent can make a superb target."[14] In fact, China likely considers an attack on US forces in the region as a necessary prelude to a cross-strait invasion.[15] Thus any forces stationed closer and primarily tasked with intervening in a cross-strait invasion are at an increased risk of being targeted by Chinese preemptive actions. Additionally, with respect to deterring China this decade, "miliary construction, advanced capabilities and resources to persistently project and maintain forces west of the International Date Line" have been delayed and are not guaranteed.[16]

A second way to reduce the time and distance of a US response to a cross-strait invasion is increasing US force capacity for high-tech options able to pierce China's advance A2/AD environment. The US is attempting just that with the development and acquisition of hypersonic weapons and the production of the B-21 Raider.[17] Fielding these capabilities at scale could rebalance the military advantage by allowing the United States to fight from distance and with enough mass to negate China's A2/AD advantage in a contested environment. However, these assets will not be available in a sufficient amount capable of deterring or interdicting China's actions related to Taiwan until the 2030s. This suggests that, at least in the near term, a deterrence gap exists where US military capabilities may be insufficient to deter a People's Republic of China (PRC) invasion of Taiwan.[18]

To address this gap and mitigate the challenges of time, distance, and initiative, the threat of a credible, limited, preemptive strike against a critical component of a forced unification, the Chinese amphibious invasion force, demands consideration. A forced unification with Taiwan is likely to combine a blockade, joint fire strikes, and amphibious invasion.[19] However, because a blockade and joint fire strikes depend on Taiwanese political capitulation, take time to conduct, and would likely coalesce the international community against Chinese actions, they cannot be guaranteed to bring about unification.[20] The component of forced unification that would most likely result in success for the PRC is an amphibious invasion of Taiwan that captures key terrain and removes Taiwanese political control of the island.[21] Without a physical landing and invasion of Taiwan, China's other options of a blockade or joint fire strikes, if considered the primary method of force unification, not only require capitulation but also become open to negative world opinion and allow time for the US and allies to mass and interdict.[22] Therefore, because a forced unification is best accomplished by an invasion that harnesses the advantages of time, distance, and initiative, the United States must hold the key center of gravity to an amphibious invasion at risk, that is: the amphibious landing vessels required to transport an invasion force across the strait. The following sections argue that a preemptive first strike, specific to certain conditions, is a credible and actionable military option, that escalation can be controlled, and that implementing such an option would have deterrence value that helps fill the current deterrence gap spanning through 2030.

A Framework for Assessing a First Strike

Credibility and capability underpin any effective deterrence option.[23] Therefore, to realize the deterrence values of a first strike, China must believe the threat of a first strike is credible and that the US can undertake a strike against amphibious vessels in port. This section demonstrates that imminence and proportionality, the two key components to a credible preemptive strike, can be satisfied and that the US maintains the capability to execute a preemptive strike to meet these limited aims through the deployment of subsurface guided missile, nuclear submarines (SSGN).[24]

While preemptive strikes have fallen out of favor, they remain a plausible and effective military strategy when narrow in scope with clear strategic objectives and meeting conditions associated with imminence and proportionality. Employing a preemptive strike has undergone much criticism in the wake of the 2003 invasion of Iraq. In fact, preemption has been largely unsuccessful throughout history because the attacks did not achieve the tactical goals intended, and secondly, the notion of preemption was used as a reason to go to war (as opposed to preempting a war).[25] Yet, in the intervening years since 2003, the principle of preemptive action (and to an extent, preventive action) has received some academic resuscitation with tangible guidelines by which a commander can critically assess the use of preemptive action. While the use of a first strike against a nuclear-armed adversary would justifiably be reserved for the president, by assessing moral concepts associated to Just War Tradition and military concepts such as imminence, proportionality, and linking those to an existing capability to achieve limited aims, a commander may develop the idea as a potential course of action given specific conditions. More specifically, through satisfying three concepts provided by John Huntsman—the Credible Threat Condition, Temporal Necessity Condition, and Proportionate Strategy Condition—a first strike option can be understood as legitimate option to deter a PRC invasion of Taiwan.[26] The first two conditions, the Credible Threat Condition and the Temporal Necessity Condition, make up the two components of the imminence requirement. The third condition, the Proportionate Strategy Condition, ensures the outcome of the preemption is better than the alternative and, via such analysis, also ensures a valid capability exists to achieve the military aims.

Imminence Satisfied by the Credible Threat and Temporary Necessity Conditions

Condition 1: Credible Threat Condition. Huntsman defines the Credible Threat Condition as follows: "A commander must justifiably believe that an unjust aggressor is poised to attack. This belief is subject to the following: the aggressor has both the resolve and the capability to attack and therefore represents a credible threat; the aggressor is morally liable to defensive harm."[27]

First, the CCP's position toward Taiwan satisfies the credible threat condition of *resolve* as evidenced by three components: CCP statements, broadening conditions for the use of military intervention, and doctrinal commitments to actions that threaten US forces in theater. The CCP's political resolve to unify with Taiwan has grown over the previous decades and is underpinned by Xi Jinping's issuance of the Great Rejuvenation as well as the 2005 Anti-Secession Law. Over his term as president, Xi Jinping has vocalized the "inevitability" of a unification with Taiwan and directly linked unification to his China Dream.[28] Xi Jinping places unification at the highest levels of priority for the party (and therefore the nation), and failing to unify would result in a core tenet of China's Great Rejuvenation left unfulfilled. To highlight its commitment to other-than-peaceful unification options, the CCP has dropped "peaceful unification" from government documents associated with military spending and, following Taiwan's recent presidential election, rephrased their commitment to "resolutely combat" Taiwanese independence from its previous stance of "resolutely oppose."[29] Though Xi has also mentioned "peaceful unification" as his goal, interplay between the identified core interest of unifying with Taiwan, the legacy of Xi Jinping, and the rise of China as both a regional hegemon and global power in furtherance of the Great Rejuvenation undercut a commitment to a peaceful resolution. Ultimately, though publicly commenting otherwise, China maintains the political resolve to take military action, if necessary, to ensure reunification.

China has also broadened the conditions under which it would consider military action necessary. The 2005 Anti-Secession Law (ASL) states that in addition to an outright declaration of independence by

Taiwan, China may take forceful action to reunify in the event that "all possibilities of peaceful reunification should be completely exhausted."[30] It is this terminal element of the 2005 ASL that appears more likely than ever as options for peaceful unification are fading. Additionally, constraints and restraints related to a forced reunification have declined over the past ten years and give credence to the view that the window for peaceful unification is, in fact, closing.[31] Specifically, key political and economic incentives intended to draw Taiwan closer to China are collapsing. The 2024 (and third consecutive) reelection of a pro-independence Democratic Progressive Party presidential candidate, the continued growth of Taiwan's economy, and the mismanaged integration of Hong Kong via the "one country two systems" solution combined to make an agreed upon and peaceful unification unlikely. This geopolitical positioning between Taiwan and China may become close to suggesting all possible peaceful unification options are exhausted and thus meeting the criteria for nonpeaceful unification per the 2005 Anti-Secession Law.

In addition to political resolve toward forceful unification, Chinese military resolve, as assessed through tactics, doctrinal writings, and China's military theory of victory, also supports the Credible Threat Condition. Together, these factors indicate the PLA maintains the resolve to take early, if not preemptive, action against US forces as part of a Taiwan invasion. First, war-gaming outcomes assessed China is more likely to succeed in a cross-strait invasion if the US is delayed in massing forces or their use of bases in Japan are impeded.[32] If "China's answer to the question of whether America will intervene is 'yes' or 'probably' then Chinese forces would almost certainly follow their own doctrine, which calls for a massive first strike against adversarial logistics and communications hubs."[33] Although US policy is purposefully ambiguous on its commitment to defend Taiwan, in practice US actions may be eroding the policy and making Chinese analysts assess that US intervention is more likely than not,[34] thus increasing the likelihood China would reach for preemptive action. In fact, it appears China has undertaken steps in preparation for such attacks.[35] Chinese doctrinal advocacy of surprise attacks as a core element of combat allows Toshi Yoshihara to arrive at some stark conclusions worth quoting in full: "Given the PLA's judgement that the system of systems is essential to American power projection and to sustaining operations, Chinese commanders likely see US command and control hubs and logistical centers as priority targets to be knocked out at the outset of a conflict.

The PLA's penchant for surprise and its demonstrated capability to launch rapid long-range attacks further reinforce the imperative to deliver the first blow."[36]

Therefore, not only does China maintain the resolve to undertake a forced unification, but such action may also entail direct attacks against the US to increase China's likelihood of success. As it relates to underpinning the credibility of a first strike, while the international community may balk at the legality or comportment with international norms of the US taking preemptive action on behalf of others, this concern becomes less relevant when the preemptive action is taken in self-defense. Combined, the actions and statements of China's political and military establishments satisfy the requisite Credible Threat Condition component of *resolve*.

As the second component of the Credible Threat Condition, China demonstrates the *capability* to undertake forced unification in two ways. First, the PLA has undertaken significant modernization efforts, which United States Indo-Pacific Command (INDOPACOM) assessed as significant enough to allow the PLA to launch a cross-strait invasion by 2027.[37] Second, the PLA Rocket Force (PLARF) maintains the capability to undertake an early or preemptive strike against US forces, which places those forces under persistent threat.

To match the CCP's political resolve to become a world class military by 2049, the PLA has undergone significant modernization and expansion. This effort resulted in fielding a navy larger than that of the US (in aggregate number) that includes three modern carriers and dozens of capital ships; an improved nuclear capability; vast improvements to its rocket force; and the fielding of fifth-generation fighter aircraft.[38] The US has assessed this growth and modernization as allowing the PLA to undertake an invasion of Taiwan by 2027.[39] However, even in 2023, wargaming activities indicated China was militarily capable of succeeding in a cross-strait invasion where the US or other allies did not come to Taiwan's aid.[40] This is not surprising given the overwhelming superiority, in both numbers and capability, China's military holds over Taiwan.[41] All indicators point to the PLA meeting Xi's 2027 goal to possess the capability to undertake the operation at his discretion, but lacking US involvement, China is likely ready now.

The PLA's modernization has also provided the PLARF with the capability to hold US Forces at risk in the Pacific. Chinese medium- and short-range rockets, such as the DF-16 and DF-17 with ranges up to 1,000 km and hypersonic glide vehicle warheads, provide China the reach to strike such forces.[42] In continuing Yoshihara's assessment, "The PLA would likely launch a barrage of missiles against major airbases in Kadena in Okinawa—the hub of American air power in the region—Iwakuni, and Misawa as well as against major command elements located at Yokota and elsewhere."[43] This is a key component in justifying potential US preemptive action. As noted previously, a first strike against China in defense of Taiwan may be justifiable, but international norms do not prohibit the US conducting a first strike in self-defense in response to a direct and credible threat from China.[44]

In addition to China maintaining the *resolve* and *capability* to threaten Taiwan and the US in a forced unification scenario, to satisfy Huntsman's Credible Threat Condition, China must also be "*morally liable to defensive harm.*" Based in just war tradition, China can be morally liable for defensive harm because it acts with agency and is unjustified in taking military action against Taiwan and the US (in support of its effort against Taiwan). Stated otherwise, China has a choice to either attack or not attack Taiwan (or the US) and therefore has agency in this decision making. Since China has demonstrated the political resolve and military capability, it signifies the agency to undertake a forceful unification and therefore is morally liable for those actions. Though China may not view its actions as unjust based on its interpretation that Taiwan is a part of China, the US, based on previous communiques and the Taiwan Relations Act, finds any use of force to unite Taiwan as unjust. Therefore, any violent actions toward Taiwan and the US to further that effort would also be unjust. China is morally responsible for its actions, and forceful actions against Taiwan or the US or both are unjust; therefore, China is morally liable for any defensive harm caused by a US first strike.

In summary, China has both the political and military *resolve* to undertake an invasion and the military *capability* and capacity to defeat Taiwan. Such resolve and capability also extend to possible preemptive strikes against US forces in the region as part of the invasion strategy. China is *morally liable* for defensive harm because these actions are unjust. However, the mere fact that China is poised to attack at some point in the future does not alone satisfy the notion of imminence. There must also be a temporal aspect satisfied wherein a commander's decision to strike first is constrained by an imminent decision point.[45] To address this aspect, we turn to Huntsman's second condition, the Temporal Necessity Condition.

Condition 2: Temporal Necessity Condition. Huntsman defines the temporal necessity condition as follows: "A commander must justifiably believe that his or her capacity to avert an attack is constrained by an imminent decision point: her last window of opportunity is closing. This window to preempt may be closing due to enemy action, anticipated action, or operational constraints. Regardless, the commander's decision to preempt or not preempt cannot be postponed."[46]

A first strike may be conducted with the noblest of intents, but the uncertainty inherent in the inability to perfectly predict an aggressor's actions before they are taken remains a common, and reasonable, restraint from utilizing a first strike. Indeed, there is always a chance an aggressor changes its mind at the last minute. Yet, establishing the credibility of a first strike option to deter China from a cross-strait invasion does not carry the same complications as initiating an actual first strike. For the purposes of assessing the credibility of a first strike option, Huntsman's second component of imminence, the Temporal Necessity Condition, can be satisfied by demonstrating the US has the credible *capability* to measure when the commander will be presented with the last window of opportunity and could therefore make an informed decision whether to strike or not.

In February 2022, the US openly showcased its imagery and signals intelligence collection capabilities that correctly foretold the imminent invasion of Ukraine by Russia through multiple lines of operation. This public demonstration of US collection capability highlighted how the US could provide relevant intelligence information related to the invasion in a manner that protected sensitive methods while also providing enough detail to effectively inform partner nations that Russia was feigning an exercise as a prelude to the invasion. The "U.S. intelligence community had penetrated multiple points of Russia's political leadership, spying apparatus and military, from senior levels to the front lines" and utilized that capability to spoil Russia's surprise invasion.[47] The US shared versions of the collected intelligence to both inform NATO allies and confront Putin to deter his invasion efforts. Though it did not deter Putin, the intelligence proved quite accurate.

The US used this intelligence sharing playbook again in February 2023. This time, supported by US intelligence information, Secretary of State Antony Blinken warned China's top foreign policy official, Wang Yi, against supplying arms to Russia.[48] In concert, the US government also provided allies and partners with the exact types of armaments China intended to provide and then broadcast conclusions of China's intentions to the public to further deter Chinese support to Russia.

This new paradigm of intelligence sharing has positive strategic effects by rallying allies and partners who, historically, have had to take the US at its word when confronted with the proverbial "trust us" related to US intelligence estimates of perceived threats. Additionally, on the heels of incorrect intelligence leading to a long war in Iraq and other intelligence failures in Afghanistan, the accurate and timely sharing of detailed intelligence was a welcome event for allies and partners. As a *New York Times* investigation found, "the shift toward disclosures is driven in part by lessons of the past, and startling technological changes that have made more information about wartime activities accessible than ever before, something intelligence officials say allows them to release more information without endangering secret sources."[49]

This novel approach to intelligence sharing is also a boon to employing the threat of a first strike as a deterrent. The fact that credible and robust US intelligence collection operations were publicly demonstrated and communicated means China cannot ignore that such penetration is possible and that the US may have or could gain access to timely information related to a planned Chinese invasion of Taiwan. The United States' plausible capability to access sensitive sources related to China's political and military leadership places the US in a credible position to satisfy the second component of imminence, the Temporal Necessity Condition.

Moral-Risk Satisfied by the Proportionate Strategy Condition

Condition 3: Proportionate Strategy Condition. Huntsman defined the proportionate strategy condition as follows: "To strike first, a commander must justifiably believe that preemption is part of a moral-risk proportionate strategy—that the moral risk of preemption is not disproportionate to that of non-preemption."[50]

Huntsman's first two conditions, the Credible Threat Condition and the Temporal Necessity Condition, combine to satisfy the imminence requirement for a preemptive strike. However, simply being at risk for an imminent attack does not justify a first strike. The outcome of a first strike must not be worse than the outcome of not conducting a first strike. This proportionality assessment contains two aspects: (1) A first strike must show a better outcome than the outcome of the action being preempted, and (2) assuming an aggressor would retaliate to the first strike, the result of the first strike must be better than the result of the potential retaliation. If the expected result of a first strike is better than not conducting a first strike and better than the results of a retaliation to a first strike, then the Proportionate Strategy Condition is satisfied.[51]

Results of a Status Quo Confrontation

The first data point for comparison is the results of inaction (no first strike) which involves assessing the status quo assumption of how a military confrontation over a cross-strait invasion may transpire. In 2023, the Center for Strategic and International Studies (CSIS) published a thorough and unclassified war-gaming assessment of a cross-strait conflict, resulting in tangible outcomes to use as a baseline. The study conducted twenty-four iterations spanning the following scenarios: base-case; pessimistic (favors China); optimistic (favors US/Taiwan); and "Ragnarok" (US severely impacted in Japan). For comparison, we use the optimistic scenario and the pessimistic scenario as the lower (better) and upper (worse) bounds of average losses, respectively (see table 10.1).[52]

Table 10.1. Losses associated with status quo confrontation (no first strike)[53]

Scenario	*Overall Outcome*	*Naval Losses*	*Aircraft Losses*	*Personnel Killed*
Optimistic	PRC loss: 2	US: 8 PRC: 129	US: 200 PRC: 18	US: 1,300 PRC: 1,000
Base Case	PRC loss: 2 Trending PRC: 1	US: 17 PRC: 138	US: 270 PRC: 155	US: 7,250 PRC: 9,800
Pessimistic	Clear PRC win: 4 Trending for PRC: 3 Trending against PRC: 7 Indeterminate: 4	US: 14 PRC: 113	US: 484 PRC: 327	US: 7,350 PRC: 13,300

The second set of data for comparison is calculated from the losses associated with a first strike combined with the losses associated with a Chinese response to a first strike. For the first computation, we assess the losses from a cruise missile strike delivered by SSGNs against eleven specific amphibious vessels. For the second computation, we dispel the likelihood of a nuclear response and focus on the outcome of a conventional retaliation against US forces in Japan, Guam, and cyberattacks against the homeland as a part of a proportional Chinese response.[54]

Identifying an Attack Vector and Target Set for a First Strike

Among US capabilities to conduct a first strike against this target set, the SSGN platform provides several key advantages over surface or airborne options. First, each SSGN could be armed with as many as 154 Tomahawk precision-guided cruise missiles, making it unparalleled in delivering mass at range. Second, though surface ships can launch Tomahawk variations (in reduced quantities) with a range akin to those launched from an SSGN (1,500 km),[55] operating on the surface makes them vulnerable to Chinese anti-ship systems. The inherent improved survivability by operating subsurface cannot be overappreciated. Trackable targets and fixed locations in the Indo-Pacific are becoming increasingly vulnerable.[56] Third, though stealth airborne platforms such as the B-2 Spirit could theoretically enter China's A2/AD bubble and fire joint air-to-surface standoff missile-extended range (JASSM-ER) missiles from a range of roughly 500 miles, the use of the B-2 has two drawbacks. One, the 16 JASSM-ER capacity of the B-2 requires as many as 10 B-2 aircraft (half of the US inventory) to theoretically ensure destruction of the intended targets. This is a high number of valuable aircraft to risk. Second, the B-2 is also a nuclear-capable platform that risks being misidentified as nuclear armed. Thus, the mass, range, and survivability of the SSGN makes it well suited to conducting a strike against military amphibious targets in port.

In addition to these tactical and operational benefits, the suggestion of the SSGN as the primary attack vector is underpinned by the availability of the platform and capability now despite planned retirements. As further detailed below, two SSGNs can succeed in a strike against the suggested target ships. Taking into consideration the intended retirement of two of the four SSGNs in 2026 and the final two in 2028, this platform can credibly threaten a first strike of this type until at least 2028. To meet the requirements for the basis of this chapter, where the US seeks to improve deterrence through 2030, this would require the Navy to extend the service life of at least two SSGNs through the end of the decade, which the Navy is in fact considering. In response to delayed production of their replacements, the Navy is considering service life extensions of several Ohio-class submarines, including SSGNs.[57] This is largely due to the vertical launch cell capacity gap that occurs if the SSGNs are retired before the equivalent capacity is available via the Virginia-class and their Virginia Payload Module (VPM).[58] Beyond 2030, with four VPM-equipped Virginia-class submarines equaling the capacity of one SSGN,[59] the Navy would have to extend one SSGN until January 2031 when the first four Block 5 Virginia-class subs are planned to exit post-shakedown periods and one more SSGN until October 2032 when the next four Virginia-class Block 5 become available.[60] Such a service life extension is not exceptional as the Navy has recently extended the service life for three SSBNs due to delays in delivery of the new Columbia-class submarines.[61]

In designating targets for a cruise missile strike, we maintain a narrow focus that restricts targets to the minimum necessary to preempt a cross-strait invasion. This provides a limited target set that, by nature, improves the probability of success and seeks to reduce the likelihood of escalation. Unsurprisingly, amphibious transport is the key requirement of an amphibious invasion and thus a center of gravity for any amphibious operation. For China, this requirement is also a key vulnerability as China does not maintain a large military amphibious landing force. According to 2024 estimates, China maintains eleven principle amphibious assault ships (three Landing Helicopter Dock [LHD] Type-075 and eight Type-071) and forty-nine landing ships (twenty-eight Landing Ship Tank Type-072 and twenty-two Landing Ship Medium Type-073/074) with a total troop transport capacity of 15,600 personnel.[62] For perspective, CSIS war gaming resulted in Chinese failure even when disembarking 30,000 troops in Taiwan. Thus, shuttling a requisite volume of personnel in a timely manner to Taiwan will require continued use of China's entire amphibious fleet. China is making efforts to increase overall amphibious lift by employing civilian roll-on/roll-off (RORO) ships in military movements to mitigate their capacity problem in the near term.[63] However, we dismiss ROROs as legitimate targets due to their civilian designation (Law of Armed Conflict concerns related to discrimination) and their questionable ability to successfully deliver Chinese forces in a contested environment (or if Taiwan were to self-destruct its own ports, which are required for offloading).[64] Therefore, the target set for a cruise missile strike should be limited to military amphibious ships. However, as detailed in the following section, Results of a First Strike, the target set can be further reduced from the sixty total amphibious vessels to eleven specific ships, which falls within the capacity of SSGNs to strike effectively.

Additionally, striking only military amphibious ships supports the need for a preemptive strike to limit escalation. Limiting strikes to military amphibious ships only curtails China's ability to conduct an amphibious invasion and is specifically intended not to degrade other aspects of Chinese military power that may cause unintentional and undesirable escalation. Put another way, striking other Chinese military capabilities such as PLA Rocket Force, PLA Army, or conventional combat PLA Navy assets impacts China's homeland defense and other regional aspirations. Considering a successful first strike must result in a better outcome than not conducting a first strike, US first strike actions to subvert a Taiwan invasion must be as narrowly focused as possible.

Results of a First Strike

The results of a SSGN strike against Chinese amphibious vessels are calculated as follows. China sails sixty military amphibious vessels with a total personnel transport capacity of approximately 15,600 landing troops and an operating contingent assessed at approximately 10,000 sailors for a total of 25,600 personnel.[65] However, as war gaming conducted by the AY24 Air War College Taiwan Deterrence Warfighting Advantage Research team discovered, not all sixty ships required targeting to degrade already low-density assets to a point where they no longer provided enough lift to sustain delivery of the required landing force on Taiwan. Striking the eleven most capable ships—three LHD Type-075 and eight Landing Platform Dock (LPD) Type-071—reduces the troop-carrying capacity of the amphibious fleet by 8,800 personnel (more than half of the total amphibious capacity) and significantly degrades the success of an amphibious invasion.[66] Several war gaming iterations determined two SSGNs maintained enough cruise missile capacity, if fully loaded out, to strike these eleven specific ships while considering various Chinese defense capabilities. The war gaming outcomes resulted in the loss of eleven ships and approximately 2,430 personnel.[67] Importantly, Chinese losses are not as high as otherwise possible, because the strikes were timed before the ships were loaded with soldiers for the ground invasion.

Results of a Chinese Response to a First Strike

Three options of a Chinese response to a US first strike were used to approximate US losses: (1) a nuclear strike, (2) conventional strikes against targets in Guam and Japan, and (3) a cyberattack against the US homeland. Though comments made in 2005 caused a stir that China was backing away from its longstanding "no first use" position that China would not be the first to use nuclear weapons "at any time or under any circumstances,"[68] experts agree that the use of nuclear weapons in a conflict with the US is low.[69] As a 2016 RAND study noted, "It is unlikely that nuclear weapons would be used: Even in an intensely violent conventional conflict, neither side would regard its losses as so serious, its prospects so dire, or the stakes so vital that it would run the risk of devastating nuclear retaliation by using nuclear weapons first."[70] Additionally, though ships at pier with closely located support facilities could reasonably be considered a strike on the homeland, they are distinct in their reduced criticality and importance. Strikes of amphibious craft that have no immediate value outside of a cross-strait invasion are comparatively less escalatory than striking components of China's nuclear deterrent or command and control apparatus or purely civilian targets. To wit, a leaked classified Chinese document from 2012 provides four concrete instances when China would consider using a nuclear weapon, none of which are satisfied by a limited strike against amphibious vessels.[71]

If experts believe China would be hesitant to use nuclear weapons in a larger conflict, it is increasingly unlikely a limited strike on naval vessels in port would result in a nuclear response from China. We assess a nuclear response from China as equally low across all scenarios and, therefore, its effect on loss calculations as constant. Therefore, associated losses were not factored into final tabulations. In lieu of a nuclear response, conventional attacks against US assets in Japan or Guam or a cyberattack against the US homeland or territories appear most likely and proportional. Likelihood was assessed based on Chinese capabilities and proportionality as previously defined. Calculating losses due to a proportional response that does not escalate (though escalation is addressed later) establishes a baseline to compare losses of a first strike against those of a status quo confrontation. The first assessment is of a strike against US amphibious ships stationed in Sasebo, Japan. The second is an attack on Guam that is considered part of the US homeland and is home to several US strategic assets. The last is a cyberattack against the continental US.

Attacking US ships in Japan provides the most proportional option as the US maintains five amphibious ships in Sasebo, on the southern side of the southernmost main island, Kyushu. Sasebo falls within the 1,000 km missile ring of China, which allows for the use of DF-16 and DF-17 missiles from the mainland, with the latter employing a hypersonic glide vehicle (HGV) making it particularly hard to intercept, as well as Tomahawk-like Hong Niao series cruise missiles. Using the same math as previously applied in calculating potential Chinese losses during a US first strike, the result is the loss of five ships and 1,170–1,300 sailors.[72]

When assessing potential losses due to a strike on Guam, the US military elements (a Naval port at Apra Harbor, the Marine Corps' Camp Blaz, and Andersen Air Force Base) are likely targets. Guam is within the strike radius of China's long-range DF-26, which carries a conventional warhead twice as large as a Tomahawk cruise missile as well as air-launch DF-21 missiles with HGVs. Apra Harbor provides limited target sets as it is home to only four submarines. However, Camp Blaz is home to a permanent contingent of 1,300 Marines and a rotating force up to 3,700 additional Marines.[73] In total, loss of personnel on Guam could be minimal due to the removal of the submarines and bomber aircraft to safe locations as tensions rise. However, the infrastructure is target rich. A reasonable assessment concludes attacks on Apra Harbor and Andersen AFB reduce their operational capacity and take them offline for some period. In keeping with the methodology used in the CSIS scenario, an attack on Camp Blaz could result in the death of approximately 400 (one third) of the Marines permanently stationed. In total for Guam, likely losses are assessed at 400 military members, but there are critical losses in operations from Apra Harbor and Andersen AFB for some period.[74]

Finally, while quantifying the effects of a cyberattack is beyond the scope of this chapter, the extent of previous Chinese actions in cyberspace, coupled with the recent discovery of Chinese cyber threat actors, namely Volt Typhoon, that enable future "disruptive or destructive cyber-attacks against US critical infrastructure" capture the threat China poses in this domain.[75] A February 2024 security advisory note from the Cybersecurity and Infrastructure Security Agency stated, "Volt Typhoon actors have successfully infiltrated the networks of critical infrastructure organizations in the continental and non-continental US and its territories, including Guam" and include the communications, energy, transportation, and water/wastewater systems.[76] A cyberattack against Guam, impacting such systems and aimed at reducing the capacity at military facilities on the island, would potentially reduce US force projection capabilities from Guam similarly to a kinetic weapon but would not result in an appreciable loss of life.

The Proportionate Strategy Condition analysis is summarized in table 10.2 by condensing and comparing the likely outcomes of a status quo confrontation over Taiwan to a US first strike and possible proportionate responses by China.

Table 10.2. Comparison of losses between a status quo confrontation and a first strike[77]

Scenario	*Overall Outcomes*	*Naval Losses (Avg)*	*Aircraft Losses*	*Personnel Killed*
Optimistic	PRC loss: 2	US: 8 PRC: 129	US: 200 PRC: 18	US: 1,300 PRC: 1,000
Base Case	PRC loss: 2 Trending PRC: 1	US: 17 PRC: 138	US: 270 PRC: 155	US: 7,250 PRC: 9,800
Pessimistic	Clear PRC win: 4 Trending for PRC: 3 Trending against PRC: 7 Indeterminate: 4	US: 14 PRC: 113	US: 484 CHN: 327	US: 7,350 PRC: 13,300
US First Strike/ China Response	N/A	US: 5 PRC: 11	N/A	US: 1,180-1,700 PRC: 2,430

With a 5:1 value of US lives lost and a 3:1 value in US ships lost in a status quo confrontation versus a first strike, the outcome is not close. Assuming a proportionate response by China and a successful US first strike that prohibits a cross-strait invasion, the losses to both China and the US are significantly less than if a forceful unification of Taiwan transpired as current war games and experts presume, with large naval and air battles and attrition on both sides. Therefore, a first strike in the context of a forceful unification scenario satisfies Huntsman's Proportionate Strategy Condition.

Managing Escalation

The preceding section relating to losses in a hypothetical first strike and subsequent Chinese response assumed a proportional Chinese response. However, proportionality is not guaranteed; therefore, consideration of a first strike must also take escalation into account. There are two aspects of escalation to assess: (1) the escalatory nature of making a first strike (a matter of actual action) and (2) the escalatory nature of adding a first strike option to a US deterrence posture (a matter related to the threat of action).

Escalation Considerations of an Actual First Strike

Conducting an actual first strike against amphibious craft would be an act of war and one that could precipitate escalatory actions leading to exactly the wider conflict a first strike intended to forestall. However, Chinese writings on "war control" (how China refers to escalation management) outline a penchant for limiting military actions. Additionally, escalatory options available to China may not be any different than those undertaken in a status quo conflict over Taiwan.

Chinese writings "warn against a 'blind expansion' of political goals when military operations are succeeding, and 'inappropriate recklessness' when 'it is no longer possible to achieve the fixed military goals.' "[78] Other assessments of Chinese thinking on escalation also concluded that Chinese decisions to escalate involve calculating the likelihood that China will attain its goals if it continues its current course.[79] Additionally, Chinese thinking on escalation also appears underpinned more by its impact to Chinese economic growth than by existential considerations associated to the outbreak of nuclear war.[80] Collectively, indications suggest a limited strike against amphibious vessels that prevents China from achieving its "fixed military goal" of a successful invasion, and which also bears less economic impact than a larger military confrontation, reduces the likelihood of escalation as compared to a status quo confrontation where China retains initiative and prospects of success.

However, even though Chinese thinking appears to trend away from escalating in situations such as the first strike scenario outlined herein, China may still choose to do so. While the entirety of escalatory options is impossible to assess, such options are also just as likely to be a part of a status quo confrontation and should therefore not impact the United States' decision to take first strike action. Chinese escalation may entail attacking US surface ships, destroying US installations in the Indo-Pacific, blockading the South China Sea, taking counter-space actions, and other actions. It is not hard to imagine these same actions taken by China should the US intervene in a forced unification scenario where the US did not take preemptive action. Yet, in conducting a first strike, the US introduces an opportunity that does not exist in the alternative. That is, by curtailing its ability to invade, China has, broadly, three choices in response. First, cease all military hostilities, which results in the least losses to any belligerent (best case); respond proportionally against the

US (assessed earlier as a better outcome than a status quo confrontation); or escalate (assessed as equally likely in a status quo confrontation). Additionally, in all three outcomes, Taiwan is increasingly protected from forced unification.

Ultimately, the benefits of an actual and successful first strike are not outweighed by risks associated with potential Chinese escalation. Such responses are either already baked into the equation of a status quo confrontation or they are not likely to occur based on Chinese thinking on "war control." Thus, escalation considerations in the event of an actual first strike should not curtail fielding a first strike option.

Escalation Considerations of First Strike Option

The second aspect of escalation to consider is China's response to a decision to threaten action by a first strike option. The practical application of instituting a first strike option involves two components: First, the provocative nature of the US publicizing the consideration of a first strike option since achieving deterrence value requires the deterrent to be known; and second, the posture enhancement of publicly shuttling two or more SSGNs into the theater. To alleviate escalation concerns for the former, the US must implement a proactive communication strategy. For the latter, several examples over the past twenty years of increased US presence in theater provide instances for comparison.

Simultaneous to revealing a first strike as a realistic and credible option, the US must begin a strategic communications campaign designed to highlight key factors leading to such a decision and why its aims are justified. However, because of the severe nature of threatening a first strike, the communications should also include conciliations that soften the narrative and prevent undesirable escalation, lest the "deterrent threats come to be perceived as a general policy of hostility."[81] A full analysis for effectively communicating deterrence is beyond the scope of this chapter; however, a strategic communications campaign aimed at controlling escalation that also adds clarity to what is being deterred may include aspects of the following points:

- The US remains committed to a peaceful resolution of the cross-strait issue.
- However, the US perceives China as preparing for a forceful unification, and such activities appear to include preemptive

strikes against US forces to delay possible US entry into a conflict.

- In response, the US maintains both the capability and resolve to defend itself and, should it choose to do so, counter an invasion of Taiwan in its earliest stages in a manner that minimizes the following:
    - loss of life
    - impacts on the global economy
    - impacts to military capacity and capability
    - impacts to objectives beyond the China/Taiwan unification issue
- The US is open to discussing economic concessions between the two nations as a point of conciliation to ease cross-strait tensions.

The second escalatory component associated with a first strike option is the military posture enhancement of moving SSGNs into theater and how China may respond. Recent examples in the Indo-Pacific include previously using SSGNs in signaling activities, bomber overflights, hypersonic weapons development, freedom of navigation operations (FONOPS), and Terminal High Altitude Area Defense (THAAD) deployment. Overall, Chinese responses to these actions included public rebuke, economic retaliation, and military activities in and around the Taiwan Strait but have remained beneath direct confrontation with the US military.[82]

The most applicable past action by which to estimate a Chinese response is the 2010 surfacing of three SSGNs at three separate locations in the Indo-Pacific. While the US Navy did not confirm the signaling was in response to China's unannounced antiballistic missile test, a spokesperson did state there was an expectation that China would "stand up and take notice."[83] In response, China did not take any escalatory actions, only releasing a statement calling for "peace, stability and regional security."[84]

Other options most analogous to SSGN deployment, such as US development of A2/AD penetrating hypersonic missiles or increased FONOPS and bomber activity near Chinese interests, resulted in a consistent response of developing counterforce options. Due to these military operations and enhancements in theater, China began developing hypersonic weapons, improving its antiship ballistic missile capabilities, and fielding a "broader array of air and maritime assets throughout the area, while other force modernization efforts enhanced China's overall A2/AD capabilities."[85] These actions may appear to be increments up the escalation ladder; however, they are also one component of how a first strike option provides deterrent value (see next section). Based on previous responses to the same or similar activities, the visible addition of SSGNs to the theater are not likely to bring about escalation considerations by China to a degree that should deter the US from taking such action; in fact, such actions may be welcome.

Realizing the Deterrence Value of a First Strike Option

Michael Mazarr identified several considerations for a successful deterrent strategy that are satisfied by a first strike option: (1) It should contain assurances and not just threats, (2) it must take the aggressors' perceptions into account, and (3) it must take the aggressors' motivations seriously and apply a deterrent that is both credible and capable of being employed.[86]

A first strike option is a comparatively aggressive deterrent option that must be paired with assurances to provide China a legitimate choice other than escalating the matter further. Due to the severity of holding the critical components of a Chinese fleet at risk, the offsetting assurance should be equally impactful. The US embargo against high-end microprocessors may be a suitable piece of any assurance package associated with deescalating cross-strait tensions. The current export control regime significantly impacts China's ability to import microprocessors manufactured by US companies that power the future of high-tech development, including artificial intelligence. Coupling the embargo with China's current inability to manufacture the necessary semiconductors domestically may set the Chinese high-tech industry a decade behind the US.[87] Offering easements related to the semiconductor embargo is a large carrot that should be paired with a comparatively large deterrent stick of a first strike option to decrease tensions around a forced unification with Taiwan.

Mazarr's second consideration involves measuring a deterrent's possible effectiveness beyond objective calculations of what an aggressor may gain or lose when being deterred. Simple military overmatch does not guarantee an effective deterrent. Instead, a deterrent should be tailored for a particular aggressor and situation that is being deterred and take the perceptions of the aggressor into account. It is beyond the scope of this chapter, and likely beyond anyone except Xi Jinping, to know what would deter the CCP from a cross-strait invasion. However, Chinese thinking on deterring others provides insight into what may also deter China.

In general, China takes a broader view of deterrence (what the Chinese term *weishe*) and includes coercion and compellence into the single term that results in “offensive deterrence” characterized by “displaying or threatening the use of armed power, in order to compel an opponent to submit.”[88] Additional Chinese definitions of deterrence include conditions associated with making an enemy “accept our will” or designed to “contain an enemy’s hostile actions.”[89] In fact, compellence and coercion are often considered a larger contributing component to deterrence than dissuasion.[90] By way of comparison, a first strike, while a classic deterrent by denial option when held in potentiality, becomes compellence when released. In a brewing crisis where an amphibious invasion appears increasingly likely, the threat of a US first strike limited to amphibious craft necessary for a cross-strait invasion becomes very much akin to the Chinese concept of offensive deterrence. As Zhao Xinjin of PRC’s National Defense University noted: “The characteristic of offensive deterrence is to use preemptive strike to deter the other side” and to “use war to stop war by using a small war to contain a large war.”[91] In this way, a first strike option may translate well to Chinese leaders as a recognizable deterrence option.

A third consideration, according to Mazarr, includes a combination of taking the aggressor seriously and demonstrating the capability and credibility of the deterrent. These were previously assessed; in summary: the Credible Threat Condition accounted for the seriousness and commitment of the CCP to a cross-strait invasion while the totality of satisfying all three conditions accounted for capability and credibility of a first strike option from a military perspective.

Finally, with a first strike option as a credible deterrent, the US would expect to see tangible deterrence value. Though it is difficult to directly measure ways deterrence may manifest, the following Chinese responses may be discernible.

- The mere threat that Chinese amphibious vessels may be disabled prior to launching an invasion may preclude China from undertaking military action. While this would be inaction on

China's part, the continued inaction is itself an indicator of successful deterrence, though it cannot necessarily be attributed to one single deterrent.

- China may begin construction of additional LHD-075 and LPD-071 vessels to increase their amphibious lift and offset the vulnerability to a first strike.
- China may increase its defenses against a cruise missile strike by building and emplacing additional missile defense systems.
- China may alter its training and gray zone activities in ways that seek to distinguish those activities from an imminent invasion.

The first measure would be considered successful deterrence, though, as noted, could not be attributed directly to a credible first strike option. The last three measures would also improve deterrence this decade by taking time to complete, thus lengthening the timeline in which China may feel secure in undertaking a cross-strait invasion.

Conclusion

The world is now marked by what the US calls great power competition and a fight over "what comes next" in the struggle over the world order.[92] In 2014 and continuing in 2022, the world watched as an undeterred Russia took bold steps to undermine the current world order by invading Ukraine. Similarly, today the world watches while China boldly increases preparation and rhetoric for a forceful unification with Taiwan that may lead to a conflict resulting in unparalleled destruction and loss of life. If the US intends to uphold the current world order and deny aggressors their ability to strip nations of their rights to self-determination, while concurrently protecting against worst outcomes, the response must be equally bold.

In offering a first strike option specifically designed and tailored to deter a Chinese invasion of Taiwan this decade, this chapter has demonstrated the US can rationally and justifiably hold Chinese amphibious vessels at risk. Through this bold, yet credible, deterrence by denial approach, the US maintains the ability to negate an invasion before it begins; reduces China's time, distance, and initiative advantages; and creates potential to avert a greater conflict.

Notes

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41. "Military and Security Developments Involving the People's Republic of China," 185.

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43. Yoshihara, "Chinese Views of Future Warfare in the Indo-Pacific," 179.

44. See Colin Gray's analysis regarding preemption, prevention and precautionary military actions. Colin Gray, *The Implications of Preemptive and Preventive War*

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48. Julian Barnes and Adam Entous, "How the U.S. Adopted a New Intelligence Playbook to Expose Russia's War Plans," *New York Times*, February 23, 2023, https://www.nytimes.com/.

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51. Huntsman also offers a method for assessing the impacts on non-moral attributes of a first strike, such as those related to economic or political outcomes. While these are certainly aspects the United States must undertake when considering a first strike, they are not exclusive to a first strike. Any evolution of a kinetic fight with China, no matter how it begins, would be fraught with economic and political turmoil for the United States, China, and the world. However, though political and economic considerations are important, they are beyond the scope of this chapter. Thus, this chapter remains confined to the military approach and moral cost in analyzing the threat of a first strike as a deterrence option.

52. Since this chapter's justification for a first strike relates to an assessment that China's best operational approach involves maximizing time, distance, and initiative to their advantage, the pessimistic scenario appeared most useful as it incorporated time delays and a reduced capacity in a US response, among other factors, that decreased US capacity/capability in the fight. While CSIS introduced the pessimistic variables based on possible US and Japanese political decisions, the same impacts on US timeliness are also possible if China takes preemptive actions against US forces in Japan. Whether these limitations are political or due to Chinese preemptive actions, the CSIS conclusion that such operational impacts on aircraft and naval availability had "particularly pronounced" and "significant notable effects," respectively, is still valid and further supports the assertion that the best theory of victory for China is to impact US ability to project power quickly, which would entail impacting forces stationed in Japan.

53. United States and Chinese loss assessments were specifically identified by Cancian et.al., or where they were not, the author utilized the computations Cancian et al. employed to arrive at a best guess. Deaths on land were computed at 50 percent of casualties; deaths at sea were assessed at 50 percent of a ship's operating contingent. In table 11.1, since most aircraft losses were on the ground, no losses in life were attributed to lost aircraft.

54. A proportional response is used as a baseline for comparison as China does subscribe to International Humanitarian Law (IHL) and the Additional Protocols of the Geneva Convention, which define and call for proportionality in war. However, this essay grants that a proportional response is not guaranteed and thus assesses escalation concerns. See the IHL Database maintained by the International Committee of the Red Cross, https://ihl-databases.icrc.org/.

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PART 5

MODERNIZING THE TAIWAN AIR FORCE

SPECULATIVE ESSAYS

Chapter 11

SAM and Jam

Maneuver Warfare for Taiwanese Air Defense

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Abstract

Taiwan is facing an existential threat in the form of a People's Republic of China military that has modernized and grown at a rapid rate and is increasingly conducting aggressive military exercise directed at Taiwan. The Taiwan Air Force (TAF) as it currently exists would struggle to challenge People's Liberation Army (PLA) air superiority in a conflict. This chapter discusses three primary lines of effort using a budget of $2 billion, the amount allocated for potentially supporting Taiwan defensive efforts by the April 2024 Emergency National Security Supplemental Bill. Although this exact amount of funding may not be available from the United States in the future and much of this funding would specifically come with requirements to require American-made systems, setting a ballpark budget of $2 billion allows for a realistic exercise in creative force planning. This chapter argues that feasible investments could be made that would significantly bolster the survivability of Taiwan's air defenses, specifically: procuring additional surface to air missile batteries, mobile ground-based jamming capabilities, and enhanced fuel logistics and distribution capabilities. If employed together, these lines of effort would enable the TAF to execute a maneuver-warfare-style air defense to increase survivability and reduce the ability for the PLA to gain and maintain air superiority over Taiwan.

Chinese Language Abstract

臺灣正面臨來自中華人民共和國的生存威脅，該軍隊已經快速現代化並壯大，並且越來越頻繁地針對臺灣舉行挑釁性的軍事演習。目前臺灣空軍（TAF）很可能無法在衝突中對中國人民

解放軍（PLA）的空中優勢構成重大威脅。本章將利用20億美元預算（即2024年4月緊急國家安全補充法案為支持臺灣自衛而撥款的金額）來討論三項主要措施。並非所有這些資金最終都能到位，而且可能需要採購美國設備，但預計20億美元的預算可以為軍事規劃提供現實的方案。本文關注三條主要措施，這些措施旨在透過採購更多的地對空飛彈系統、機動地面干擾能力以及增強燃料後勤與分配能力來提高臺灣防空系統的生存能力。如果這些措施能夠協同使用，將使臺灣空軍能夠執行機動戰式的防空作戰，以提高生存能力並削弱解放軍獲得與維持對臺灣空中優勢的能力。

Introduction

This chapter identifies recommendations for the modernization of the Taiwan Air Force to increase survivability in a conflict with the People's Republic of China (PRC) given a budget of $2 billion dollars and a timeline of three years. The recommendations are designed to fit within the current construct of Taiwan's military and the mission set aligned to the TAF by the Taiwan Ministry of National Defense. Moreover, the recommendations are designed to enhance the TAF's ability to defend the island against varying degrees of hostile actions that could be taken by the PRC. Table 11.1 summarizes our recommendations.

Table 11.1. Possible TAF force modernization costs

System	*Cost per Unit*	*Number of Units*	*Total Cost*
Tien Kung-III	$190M	5	$950M
Dispersed Missile Reloading Depots and Support Equipment	n/a	n/a	$1M
Mobile Changbai Radar	$10.5M	16	$168M
TK-III C2 Node	$15M	2	$30M
Inflatable TK-III Decoy	$75,000	10	$750,000
Realistic TK-III Decoy	$700,000	5	$3.5M
EC-130H EW Suite with Truck	$50M	14	$700M
5,000 Gallon Fuel Truck	$250,000	500	$125M
25,0000 Gallon Fuel Bladder	$25,000	1000	$25M

Background

Before the 1990s, the TAF was more technologically advanced and capable than the People's Liberation Army Air Force (PLAAF) of the PRC. During that decade and into the twenty-first century, the PLAAF made a concerted effort to modernize both its force design and capabilities. The PLAAF placed a greater emphasis than the TAF did on modern airpower assets to compete with other nations in the global superpower arena. As this modernization of the PLAAF occurred, the TAF lost its competitive advantage, putting the island at additional risk of reunification by force. Currently, the TAF operates three primary fighter aircraft platforms, the French Mirage 2000-5, the indigenously made F-CK, and the US F-16. The TAF also primarily relies on two ground-based air defense systems: the indigenous Tien Kung-III (TK-III) and the US-made Patriot. In contrast, the PLA operates eight different fourth-generation fighter aircraft and the fifth-generation J-20 fighter. Overall, the PLA fighter fleet greatly outnumbers the TAF fighter fleet. The PLA also has at least seven different missile systems that threaten Taiwan's air defenses, ranging from short-range ballistic missiles to air-launched cruise missiles.[1]

Future Efforts

After reviewing the threats posed by the PLA's advanced capabilities, we assess the TAF needs to focus on preventing the PLA from gaining and maintaining air superiority in Taiwan's air space and surviving a joint firepower strike campaign. To do this, we recommend an increased emphasis on mobile ground-based air defense capabilities. Due to the advanced capabilities of PRC systems and the sheer number of assets it maintains, TAF systems with large footprints or static components do not offer the flexibility or mobility required to survive and effectively counter the PLA. Additionally, Taiwan's reliance on imported fuel products, its consolidated and vulnerable bulk storage locations, and its lack of significant strategic reserves pose a significant threat to TAF operations.[2] Because of this, the TAF requires a larger number of small, agile systems and a survivable logistics support system that can complicate the targeting process for the PRC during a Joint Firepower Strike Campaign and allow the TAF to secure its airspace against a large number of technologically advanced PLA assets.

To increase the TAF's survivability against the PLA and PLAAF writ large, we recommend spending \$1.15 billion on additional TK-III surface-to-air missile (SAM) capabilities, \$700 million on advanced ground-based jamming and electronic-warfare capabilities, and \$150 million on increased fuel dispersion and distribution capabilities.

\$1.15 Billion on Additional TK-III SAM Capabilities

By 2026, Taiwan is on track to have up to an estimated eighteen domestically produced Tien Kung-III batteries across the country.[3] Unlike PAC-3, which has a demonstrated record of success in conflicts such as Ukraine and has an interception rate of 75 percent to 88 percent, TK-III has never been used operationally, nor are figures regarding its accuracy publicly available.[4] However, TK-III's reported purchase price is approximately one-sixth that of a PAC-3 system, and its maintenance cost is approximately one-eleventh that of the PAC-3.[5] Therefore, we recommend that additional production of five TK-III batteries at a cost of \$950 million be prioritized over acquisition of any additional PAC-3 batteries.

Purchasing additional TK-IIIs will provide several additional benefits beyond the obvious increase in targets that can be engaged: increased overlapping coverage will ensure that coverage can persist while one battery relocates after firing; batteries can afford to have narrower fields of view on their radars, which can provide increased situational awareness due to having a smaller area of responsibility; more batteries provide increased opportunities for cooperative targeting; and the TK-III's indigenous production provides Taiwan with a hedge against potential delays in the delivery of US-origin materiel such as has hampered Ukraine's war efforts. Furthermore, the TK-III's backwards compatibility with TK-I and TK-II missiles, TK-III's shorter break down time compared to the PAC-3, the TK-III's longer max effective range compared to the PAC-3, and Taiwan's recent decision to increase TK-III missile production to ninety-six per year all make the TK-III a more attractive SAM choice as Taiwan creates a more robust and survivable integrated air defense system (IADS).[6]

Areas where multiple TK-III and Patriot batteries cover similar areas, particularly around Taipei, Taichung, and Kaohsiung, provide system operators with increased flexibility to shoot and scoot while still maintaining air defense coverage in a sector. Similarly, increasing the density of air defense assets allows for improved delegation of target sets. For example, PAC-3 batteries around Taipei can focus on targeting fast, high-altitude targets (such as ballistic and hypersonic missiles) that they are more capable of intercepting than the TK-III, while TK-IIIs can focus on slower, lower altitude targets (cruise missiles, unmanned aerial vehicles [UAV] , and other aircraft). All of Taiwan's Patriot batteries appear to be along the west coast, as are all but approximately three TK-III batteries, located near Yilan, Hualien, and Taitung.[7] Due to mountainous terrain on the eastern side of the island, these are likely the only feasible deployment sites, and there are almost certainly significant gaps in radar coverage due to terrain. The deployment of an additional TK-III battery to a new site in Hualien or Yilan could address some of these gaps and enable the TAF to more effectively target cruise missiles and aircraft targeting greater Taipei from the east, where they could be launched by PRC surface action groups.

TK-III systems could focus on missile defense around critical infrastructure and leadership bed-down locations if necessary. However, the sheer number of missiles that the People's Liberation Army will probably employ against each target will mean that even if Taiwan's SAMs successfully engage some incoming missiles, they are unlikely to neutralize all weapons allocated to a target, and the SAMs themselves will become targets and be quickly destroyed.[8] Therefore, TK-IIIs should be assigned a sector to defend but only activate their radars for the minimum amount of time necessary to engage a target before breaking down the system and relocating. Targeting focus should be placed on PLA fighters and special mission aircraft (SMA). In particular, focus should be given to targeting PLA UAVs, such as the Yilong-2 and BZK-005, which could be used to find, fix, and potentially finish dynamic targets on Taiwan. The PLA will likely focus on targeting Taiwan's IADS, so maximizing shot efficacy will be critical because modeling indicates that Taiwan will suffer up to a 75 percent attrition rate among its SAMs radars following initial engagements.[9]

Because the PLA will probably be able to find and fix TAF SAMs almost immediately after their radars are activated, the doctrinally advertised break-down times for a PAC-3 and TK-III (one hour and thirty minutes, respectively) are almost certainly too long to effectively escape PLA targeting.[10] To best ensure survivability, PAC-3 and TK-III operators must be able to begin relocating within minutes of firing. All publicly available information indicates that most PAC-3s and TK-IIIs are currently located at fixed sites.[11] If the TAF has not already done so, it must dispatch engineers to fields and other open areas to determine their suitability as contingency SAM deployment sites based on factors such as gradient, lanes of fire, and soil composition. Determining the feasibility of alternative locations as weapons deployment sites is critical to rapid assembly, operation, and subsequent movement of these systems in a conflict.

To improve batteries' ability to reconstitute after firing, dispersed missile reloading depots could be constructed within several kilometers of potential TK-III field deployment sites. Four missiles, or one launcher's worth of missiles, can fit within a standard 20-foot CONEX box.[12] These in turn can be hidden inside a prefabricated steel warehouse or even a berm covered with a tin roof. These structures are extremely cheap to produce, with an 800 square foot warehouse costing around $10,000 to make and a covered berm likely costing only several hundred dollars.[13] It would also be impossible to determine the contents of the warehouses through synthetic aperture radar or electro-optical imagery, so barring PLA human or signals intelligence collection indicating the location of these dispersal sites, the PLA would probably have to collect imagery of a reload underway to target these sites. Assuming reloading takes roughly the same amount of time as the Patriot, the process takes about one hour per launcher and can possibly be reduced to approximately half an hour.[14] To do this, the minimum required equipment to complete a reload is a six-ton forklift and a twelve-ton boom crane, which respectively can cost approximately $60,000 and $50,000.[15] Commercially acquired cranes and forklifts can likely be dispersed to local construction sites or other areas when not in use if they are unable to fit inside the concealed area with the missiles. One million dollars should be allocated to construct dispersed missile storage sites and bolster Taiwan's current missile reloader capacity with commercially acquired cranes and forklifts.

Operational mobile Changbai radars are critical in the employment of the TK-III. Given the radars will potentially be heavily targeted by the PLA and are projected to suffer an attrition rate of up to 75 percent, it will be vital to have radars that can backfill destroyed systems, especially as current reporting on the TK-III does not indicate that Taiwan owns extra mobile Changbai units.[16] Using the cost of the PAC-3's AN/MPQ-65 radar as a basis in lieu of numbers for the Changbai, each system likely costs around $10.5 million to produce.[17] Similarly, there are no indications that Taiwan possesses redundant systems for the TK-III's command vehicle, the only manned component of the

TK-III during engagements. Again, using the US's Integrated Air and Missile Defense Battle Command System, which is the command and control (C2) backbone of the United States' new air defense platoon, to estimate the cost of the TK-III's C2 node, each unit costs around $15 million dollars.[18] A potentially limiting factor in reconstituting TK-III C2 capabilities would be a shortage of qualified personnel as casualties are incurred, assuming that each TK-III battery typically only has two or three crews for its command vehicle, which is how Patriot command vehicles are usually manned.[19] To accommodate attrition of these systems, sixteen additional mobile Changbai radars for a total of $168 million and two additional C2 nodes for a total of $30 million should be acquired.

Finally, decoys, ideally paired with digital radio frequency memory (DRFM) jammers outlined below, should be deployed to TK-III garrison and field deployment sites. Complete inflatable TK-III decoys of all its component vehicles can be commercially purchased for approximately $75,000, based on a quote provided by a US producer of inflatable Patriot decoys. However, depending on the quality/type of PLA imagery and the skill of the PLA imagery analyst, it may be easy for the PLA to identify these decoys. Therefore, the TAF should also invest in more realistic decoys consisting of the Mercedes-Benz Actros or a similar make and model chassis that many TK-IIIs utilize, with to-scale metal decoys of the system's component parts mounted on the chassis. A complete decoy set of this type would likely cost approximately $700,000, and especially when paired with a DRFM jammer configured to look like a mobile Changbai, it could be difficult for the PLA to differentiate between these decoys and real TK-III systems even with synthetic aperture radar and infrared imagery. It is recommended that five realistic decoys be acquired for $3.5 million and ten inflatable decoys be acquired for $750,000. As a note, it is important that whenever possible, the decoys are configured doctrinally to mimic real systems.

$700 Million on Advanced Ground-Based Jamming and Electronic Warfare Capabilities

Highly mobile defense systems that can remain unpredictable are essential in degrading PLA air superiority. Paired with traditional defensive counterair (DCA) assets, including fighters and tactical SAMs, electronic warfare (EW) systems could act as force multipliers and improve the survivability of TAF assets. The war in Ukraine has showcased the value in shifting operational goals from gaining air superiority to simply denying it to the opposing force. Despite having a technological and size disadvantage in terms of airpower, Ukraine's ability to implement mobility and dispersion across antiair and area-denial platforms has increased its capability and balanced the airspace.[20] By focusing on targeting of PLAAF C2 assets—namely the KJ-500—these EW systems could disrupt adversary air targeting solutions, complicate the air picture, and introduce fog into the common operational picture. Because Taiwan will have the benefit of fighting in a defensive posture, PLAAF assets will have to operate within range of these ground-based systems. While traditional airborne jammers may be cost prohibitive and not highly survivable on Taiwan's current air assets, ground-based jammers can provide similar effects in locations with limited terrain. DRFM jamming is a highly disruptive form of deception jamming that has been used by the USAF and its near peers for decades, but there are no existing electronic protection procedures that can completely defeat DRFM jamming.[21] While DRFM jamming can be less effective against active electronically scanned array (AESA) radars than mechanically scanned radars due to AESA radars' frequency agility, with adequate computational power, DRFM can probably still exploit radars such as the AESA used on the KJ-500. Because of the capabilities offered by the KJ-500, complicating the common operational picture for the C2 asset will also create a measure of confusion for all other PLAAF assets.

As with other strategies outlined in this chapter, the proposed employment of these EW capabilities will be based around a mobile ground system. While ground-based jammers traditionally can be located and subsequently targeted if given enough time, an EW system mounted to one or two heavy duty trucks, such as heavy expandable mobility tactical trucks (HEMTT), could employ a "jam and scram" tactical doctrine, giving DCA assets protection in critical phases prior to shutting down and moving to avoid being targeted. The trucks would also carry a power generation system—a critical element of an effective jamming system. Based on the power generation system employed by the Patriot missile battery consisting of two 150-kilowatt generators mounted on a HEMTT truck, we assess adequate mobile power generation is feasible.[22] Special Operations Forces are already employing mobile DRFM jammers, proving that small, portable jammers can be effective against close targets and SAMs.[23] To keep the proposed system affordable and high-powered enough to target C2 and ISR, the proposed system is the EW suite from the USAF's retired EC-130H. This highly capable system is being replaced by a new Compass Call aircraft, potentially opening the door to use presidential drawdown authority to send the retired systems to Taiwan.[24]

$150 Million on Increased Fuel Dispersion and Distribution Capabilities

To enable the maneuver warfare style tactics we recommend, the Taiwan Air Force will have increased fuel requirements to keep mobile SAM and jamming systems moving. However, Taiwan only receives petroleum products through two ports, both on the island's west side. Due to their location, both ports are extremely vulnerable to blockade actions that could disrupt energy importation during conflict with the PRC. Since 98 percent of Taiwan's oil is imported, these ports are a critical vulnerability only further degraded due to the fact that a large portion of their bulk storage capability is in unhardened facilities at these very ports.[25] Although the TAF maintains standard bulk fuel storage at both air bases and commercial airports, we do not consider either of these locations particularly survivable if the PRC chooses to target them.[26] Because of this lack of survivability, our final line of effort includes significantly increasing the TAF's fuel dispersion and distribution capabilities by purchasing additional fuel trucks and bladders. It is important to note that trucks that run on diesel, including the trucks that the Patriot and TK-III systems are built around, will also run on jet fuel (JP-8/NATO F-34), which opens the door for a multiuse fuel to be distributed to assets across the island.[27]

With air assets relying on the fuel located at the air bases, we recommend that the TAF air defense capability draw fuel from the commercial airports for military use if a crisis occurs. Once a PLA invasion is deemed imminent, the TAF should then reallocate the commercial jet fuel reserves stored at commercial airports for military use. Dispersion of this fuel has two major benefits, the first being increased survivability and the second being a shorter logistics tail for the mobile air defense systems. By prepositioning fuel products closer to the weapon systems, the logistics burden of keeping assets fueled and in the fight is decreased. Taiwan's commercial airports currently store 250,000 barrels (10.5M gallons) of jet fuel, which is more than enough to enable the recommended scheme of maneuver for SAM and mobile jamming.[28] We recommend the TAF purchase 500 fuel trucks, each with 5,000-gallon capacity, from on-island manufacturers. We estimate the per-unit cost to be $250,000 based on the cost of the R-11 refueler used by the USAF, which makes the total purchase estimate $125 million.[29] Although the R-11 is a 6,000-gallon truck, it is the closest match to our recommendation in the US military's inventory, which is why it was used to estimate the cost. By purchasing from local sources, these efforts will increase money flowing into the island economy. Additionally, by purchasing from fewer distributors, the TAF would be increasing its truck redundancy, which would allow for cannibalization of parts throughout the campaign if spare parts start to become unavailable. These 500 trucks would allow 2.5M gallons to be continuously road mobile, increasing maneuverability. Similar to both the SAM systems and the mobile jamming, the maneuver tactics utilized by the fuel support troops require training and continuous adjustment as the conflict impacts the battlefield.

The second key to increasing fuel dispersion and storage for the maneuver warfare of the TAF air defense is purchasing additional fuel storage bladders. We recommend $25 million dollars be spent on 1,000 bladders, each with a 25,000-gallon capacity. Although the remaining eight million gallons pulled from the commercial jet-fuel stores could fit in 320 of these bladders, we recommend purchasing additional bladders to increase the flexibility and survivability of the overall infrastructure. More bladders means that more dispersion is possible, and by purchasing more bladders than what is required to store all the fuel, the TAF will be able to keep empty bladders on hand as replacements as wear and tear occurs. Additionally, we recommend the TAF pre-position empty bladders and move the fuel between sites without having to move the bladders themselves. At the relatively low price point of $25,000 per bladder, this increased redundancy and flexibility comes at a low cost.[30] The overall dispersion plan of the fuel trucks and bladders should mirror the dispersion plan of the air defense assets to keep the logistics tail as short as possible.

Using the Patriot System as a reference, we estimate that each SAM battery, both TK-IIIs and Patriots, would require 650 gallons of fuel daily to enable the suggested maneuver-warfare tactics.[31] This equates to approximately 25,000 gallons daily to keep all of their current systems plus the additional recommended systems continuously operating. The mobile jamming systems recommended will be built around the HEMTT truck chassis, so our fuel estimate for these systems is 250 gallons per day for both mobility and power generation. In total this adds 3,500 gallons to our daily consumption. To make the planning math simple, we estimate 30,000 gallons total daily fuel consumption for our SAM and jam maneuver recommendation. Just by leveraging the 10.5M gallons pulled from the commercial airports and dispersed, the TAF would have around 350 days of supply to keep assets mobile. Even with a fair amount of loss resulting from battle damage, this is more than enough fuel to assume that fuel will not be the limiting factor for this plan. Additionally, the dispersed fuel would remain available to support other TAF or Taiwanese military operations as needed.

Summary

Despite the superior size and capabilities fielded by the PLA, if armed with the proper tools and tactics, the TAF can deny the PRC from achieving its desired end state. Approximately $2 billion in focused investments—potentially with some support from American foreign military grants—could be used to purchase highly mobile and survivable assets that complement Taiwan's indigenously produced systems, which would allow Taiwan to obtain an asymmetric advantage over the PLA. We assess that investments in TK-III air defense systems, ground-mobile jammers, and fuel dispersion and distribution capabilities will enable the TAF to maximize its efficacy and lethality to deter and, if necessary, gravely harm the PRC in a potential conflict.

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Chapter 12

Taiwan Air Force Modernization

Solutions for Self-Defense

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Abstract

This chapter evaluates the Taiwan Air Force (TAF)'s existing capabilities and considers how to maximize a $2B increase for greatest effect. Due to military qualitative and quantitative disadvantages, the TAF must utilize asymmetric capabilities to exploit vulnerabilities as the People's Republic of China (PRC) progresses through expected military phases preceding the Joint Island Landing Campaign. Recommendations include mitigating the effects of People's Liberation Army (PLA) joint fires through procurement of additional Tien Kung 3 missile batteries, robust short-range air defense such as the Skynex artillery system, and high-fidelity decoys to increase the survivability of air defense and aircraft assets. To offer a reliable counterstrike capability, the authors recommend that the TAF consider rapidly procuring a diverse fleet of one-way attack drones for use during the subsequent island blockade and arrival of PRC landing forces. Additional low-cost options are presented to fortify the TAF's command and control architectures. These solutions increase the expected cost of a PRC invasion and thus provide both deterrence and, should deterrence fail, vital self-defense capabilities.

Chinese Language Abstract

本文評估中華民國臺灣空軍現有的能力，並考慮如何最有效的地運用20億美元的額外經費來極大化其效用。由於武器數量與質量上的劣勢，中華民國臺灣空軍必須利用不對稱戰力，在解放軍聯合登島戰役前的各個階段，打擊解放軍的弱點。本文的建議包括透過購買額外的天弓-3防空飛彈系统、堅韌的短程防空系統（像 Skynex火炮系统）以及逼真的誘餌來降低解放軍

聯合火力打擊的影響，以提高中華民國臺灣空軍防空和飛機等資產的生存能力。而為了提供可靠的反擊能力，本文建議空軍考慮盡快採購一支多樣化的自殺式無人機機隊，以便在解放軍聯合火力打擊之後的島嶼封鎖和登陸部隊抵達期間使用。本文也提出其他低成本的選項來強化空軍的指揮和控制架構。這些解決方案增加了中國入侵的預期成本，從而提供了威懾嚇阻能力，並在威懾嚇阻失敗時提供至關重要的自衛能力。

Introduction

Taiwan's armed forces cannot match the People's Liberation Army qualitatively or quantitatively. Therefore, Taiwan must use asymmetric capabilities to exploit potential vulnerabilities as the PRC progresses through several military campaigns, culminating in the Joint Island Landing Campaign.[1] These events may proceed linearly or may be executed concurrently. Should President Xi Jinping mobilize the PLA and prosecute the invasion of Taiwan, those expected phases are as follows:

- Pre-invasion activities
- Joint Firepower Strike Campaign
- Joint Island Blockade and strait crossing
- Arrival of landing forces

To first survive and then strike key vulnerabilities during a PRC invasion, Taiwan must procure equipment and posture itself in a manner that is dispersed, redundant, and survivable. Common attributes of this team's recommended courses of action are acquiring systems that are "numerous, distributed, and mobile."[2] Bolstering Taiwan's integrated air and missile defense (IAMD) network is vital as success in later phases depends on minimizing losses taken during the Joint Firepower Strike Campaign. Other significant investments for increasing survivability during the PLA joint fires include high-fidelity decoys and threat emitters to saturate the target environment. Along with air defense investments, attritable-asymmetric-attack options are the next major recommendation, primarily in the form of one-way attack unmanned aerial vehicles (OWA-UAV). Finally, several low-cost options exist for the TAF to increase the resilience of its command and control (C2) and communications networks, which will be critical to keeping it in the fight once the assault begins. The table below displays the systems this team recommends the TAF consider and the suggested budget distribution.

Table 12.1. Recommended TAF Purchases

System	*Cost*	*Portion of Budget*
TK-3 Missile System	$170M per battery $1M per interceptor	$1.2B for six batteries and 300 interceptors
Skynex Air Defense System	$96M per system $7M per truck	$400M for three systems
One-Way Attack UAVs	$5–30K per drone	$150M for up to 30,000 UAVs
High-Fidelity Decoy	$30–100K per decoy	$200M
Communications Fly-away Kit	$25–50K per kit	$50M

Mitigating PLA Joint Fires

The PRC has a vast array of conventional ballistic and cruise missiles that can reach Taiwan and even targets far beyond. Current estimates put the People's Liberation Army Rocket Force (PLARF) at over 3,000 cruise and ballistic missiles.[3] The PRC would likely be limited based on its number of launchers; the DOD assessed the PRC had 1,350 launchers in 2024. The PRC, however, has been drastically increasing the number of launchers and could field more by 2027.[4] These ballistic missiles (as well as even more numerous multiple launch rocket systems) will likely be used in a mass wave attack to cripple Taiwanese C2, military infrastructure, and fielded forces to enable a rapid PRC seizure of Taiwan. The war in Ukraine and Russia's inability to decapitate the Zelensky government will likely reinforce to President Xi that a stronger initial wave of missiles is required before the arrival of other air, maritime, and ground forces.

The TAF inventory includes advanced fighter jets such as F-16Vs (retrofitted under Taiwan's Peace Phoenix Rising upgrade program).[5] However, these essential air defense and counterstrike forces will only be useful if not destroyed before taking off. The TAF must invest further in IAMD units to mitigate the expected effects of the PRC Joint Firepower Strike Campaign. Taiwan has two options to defend against incoming ballistic missiles: the Tien Kung 3 (TK-3) and the Patriot (PAC-3) missile systems. Taiwan will have an estimated eighteen TK-3 batteries by 2026 and currently has nine Patriot batteries.[6] Each system consists of a fire control radar, six or eight missile launchers respectively, and various support equipment. Taiwan indigenously produces the TK system, which costs roughly one-sixth of the Patriot battery. At a price of roughly $170M per TK-3 battery, Taiwan could leverage $1.2B to purchase six additional batteries along with the necessary missiles.[7] This purchase would increase the number of TK-3 systems by 33 percent and give the TAF twenty-four operational batteries by 2027. Although the Patriot is assessed to be more effective than the TK system, current missile production is roughly 650 interceptors per year, and all are currently being sent to Israel and Ukraine.[8] A total of twenty-four TK batteries with twenty-four missiles per battery and nine Patriot batteries with thirty-two (or more, if a PAC-3) missiles per battery gives the TAF nearly 1,000 missiles ready to engage a PRC salvo without reloading.

Ukraine has managed to keep its air defense systems intact against a significantly stronger Russian Air Force due to a combination of ingenuity and tactical prowess. The Ukrainian army has been able to move their surface-to-air missile systems (SAM) regularly to avoid targeting. Videos from SAM operators demonstrate their hiding of the system in forests, moving out to shoot, then immediately "scooting" to a new hiding location.[9] However, a Patriot battery takes roughly one hour to reload and set up.[10] Because it has similar equipment, the TK battery likely takes a similar amount of time. This set up time, when compared to more mobile Ukrainian tactical SAMs, makes it more difficult to conduct "shoot and scoot" tactics with the TK-3. Increased mobility training and pre-staged TK assets would make this tactic much more feasible for the TAF.

Taiwan has twenty-four Skyguard artillery systems, with twenty-four Sky Sentinel radar units and fifty 35 mm GDF-006 cannons, for Short Range Air Defense (SHORAD).[11] According to RAND, Taiwan needs more SHORAD and greater mobility to enhance survivability.[12] Unfortunately, the Skyguard artillery systems are no longer in production. Instead, a newer system named Skynex has replaced Skyguard. Germany contracted Swiss company Rheinmetall to supply Ukraine with several Skynex systems, which have been highly effective at destroying drones and are estimated to cost roughly $96M each.[13] Taiwan could increase its SHORAD by purchasing three new Skynex systems and their associated trucks, which are about $7M each. Rheinmetall might provide munitions or pass data to Taiwan's National Chung Shan Institute of Science and Technology (NCSIST) to inform their munition plants. Taiwan could also purchase $91M in advanced hit efficiency and destruction (AHEAD) munitions for its 35 mm cannons for 150,000 rounds to have a contingency stockpile for a possible invasion.[14] The AHEAD rounds are useful for shooting down aircraft, unmanned aerial vehicles (UAV), cruise missiles, and air-to-ground missiles. If the Swiss government is unwilling to sell the more advanced Skynex system, then the TAF should still consider purchasing the older Skyguard system from the plethora of countries that continue to operate them. These systems could be co-located with SAMs such as the TK-3 and Patriot to counter precision-guided munitions, drones, and cruise missiles that are targeting the TAF SAMs. This process of weapons control and target pairing would enable a more ammo- and cost-efficient attrition of PRC assets when compared to launching $1M (Patriot or TK-3) interceptor missiles to defend against a mass UAV attack.

Raising the Cost of Invasion: OWA-UAVs

A way to match the mass of a superior adversary is to procure and operate a large and diverse fleet of UAVs. Evident in the ongoing Russian invasion of Ukraine, liberal use of OWA-UAVs enables striking adversary personnel, equipment, and infrastructure for little cost and at greatly reduced risk to the operator. The British think tank Royal United Services Institute estimates that Ukraine expends some 10,000 OWA-UAVs per month in the ongoing conflict.[15] Former US Deputy Secretary of Defense Kathleen Hicks delivered public remarks in 2023 regarding Air Forces Central Command's Task Force 99, which is charged with developing small UAVs for use in that theater. She emphasized OWA-UAVs' benefits: "small, smart, cheap, and many."[16] OWA-UAVs can be easily dispersed, making them extremely survivable during the Joint Firepower Strike Campaign relative to Taiwan's F-16, Mirage, and Indigenous Defense Fighter aircraft. Following PLA joint fires, these UAVs can be used to conduct strikes against PLA maritime and surface targets, greatly raising the expected cost of prosecuting an invasion of Taiwan.

The United Kingdom recently sold Ukraine 10,000 UAVs for $159M (approximately $15,900 per unit).[17] Taiwan needs to produce more to sustain a counterstrike capability during the blockade and landing phases of the PRC invasion. Taiwan's NCSIST is already researching and developing OWA-UAVs of varying sizes, which are sometimes referred to as loitering munitions. Being able to source this equipment indigenously provides excellent benefits in terms of affordability and the speed with which they can be procured and maintained. Their products include the very light class of "Fire Cardinal" with its 1.3-meter wingspan, to the medium-sized Chien Hsiang "Rising Sword" (2-meter wingspan), to the larger Albatross II with its 8.3-meter wingspan. Unit price is difficult to find, but similar class aircraft produced in other countries suggest the smaller UAV types could be produced for approximately $5K per unit, with the larger models approaching $30K. It is vital that Taiwan rapidly source a diverse fleet of OWA-UAVs for effects on PLA forces during attempted blockade and landing operations.

Target Saturation: Decoys and Other Means

Two ways to fool PRC intelligence systems searching for Taiwanese assets are electromagnetic spectrum and realistic look-alikes. Ukraine has been able to trick the Russian Air Force into wasting valuable missiles by creating decoy High Mobility Artillery Rocket Systems using army logistic trucks and wooden boxes.[18] Many countries, such as China and Russia, use decoys. These decoys could be inflatable rubber SAMs or timber trucks disguised as fuel trucks. Some of these cheap decoys are easily detectable, but high-quality, high-fidelity decoys certainly do exist. Decoys can be properly shaped, painted with a metallic coating that reflects radar imagery, and even have engines that fake a realistic heat signature.[19] These fake systems can be everything from radars to tanks, aircraft, and even missiles. They range in cost but are roughly $100K for high-fidelity systems. Although seemingly expensive, they are significantly cheaper than a $1M Chinese missile or the $70M F-16 they replicate. Each decoy complicates and elongates the PRC targeting cycle as they attempt to discern real from fake to avoid wasting their expensive missiles. Additionally, these decoys work exceedingly well with critical systems such as the TK-3. As the SAM shoots and scoots, a decoy could be left in its place. This tactic would trick quick PRC retaliations and obfuscate the number of SAMs Taiwan truly has available.

Additionally, high-altitude balloons can function as distractions to clutter the airspace. While the PRC has begun testing high-altitude balloons for intelligence, surveillance, and reconnaissance missions and swarm attacks to overwhelm air defense systems, a similar methodology can be used to overwhelm the initial missile barrage and disguise ground targets while costing at most a few thousand USD.[20]

The PRC could also geolocate targets based on their electromagnetic spectrum using direction finding.[21] Airborne or space-based systems that collect signals intelligence can triangulate lines of bearings to understand where targets are generally located when they emit. Both the Patriot and TK systems use a single fire control radar system that is required to complete engagements. Taking down this system denies the use of the battery.[22] Therefore, making these systems and their various components more difficult to locate and target is crucial to ensuring their survivability. The US military uses threat emitters to replicate the radio-frequency signal of adversary SAM systems. Although the system cannot engage targets, it jams the electromagnetic spectrum with erroneous information. These systems cost roughly $30K each.[23] Buying multiple threat emitters for each Patriot or TK system would complicate the PRC targeting even further. Instead of searching for roughly forty batteries across the island, the PRC must sort through 200 potential locations to find the true targets. These low-cost systems could enable the highly effective Taiwanese fighters and SAMs to survive the initial PRC rocket attack and drastically complicate its targeting efforts. Additionally, decoy emissions from an emitter could complicate PRC risk calculus and push PRC aircraft away from the island as they attempt to stay outside of a fictitious SAM engagement zone.

Low-Cost Solutions: Redundancy for C2 and Navigation

Highly survivable and resilient TAF air and missile defense forces are useless to the island's defense if they cannot communicate, see a common operating picture, or link with a C2 structure organizing the wider defense. Excess modernization funds can be put towards low-cost solutions that enhance C2 and communication capacities for dispersed forces, acting as a force multiplier to enable greater synergistic effects across various weapons systems.

On the C2 front, the US committed $75M in early 2024 to upgrading Taiwan's Link 16 network.[24] Link-16 is the standardized communication system used by the US, NATO, and other allies for sending and receiving real-time data links across various systems in the battle space, building a joint common operating picture for anyone connected to the network.[25] Dispersed systems of sensors and shooters with limited ammunition and the need to only take shots that count will heavily rely on a reliable and expeditionary communications system that enables covert, real-time collaboration in the Link-16 construct. Additionally, the ability to pool all the sensing data into a common operating picture means that shooters can track, target, and engage enemy missiles or aircraft without relying solely on their radars. This approach enables defense forces to remain mobile, choose the right and economical munition for each target, and increase survivability in a high-threat environment. This layered and survivable defense has proven itself in Ukraine, and similar employment in Taiwan during phase 2 of the invasion could complicate PLA targeting, suppression of air defenses, and strike operations while enabling limited Taiwanese freedom of action during key periods and protecting key assets and locations.[26]

Recent advances in communications and computing equipment have led to the development of technologies that fill the need for expeditionary, resilient, and layered C2 and communication suites. Communications fly away kits (CFK) enable small units of operators, such as those who would be operating systems such as the TK, OWA-UAVs, and Skynex systems, to tap into a wide variety of available networks to enable Link-16 access and communications across a battlespace with adjacent units and to a command node.[27] CFKs are widely produced by communications and defense contract companies, and industry leaders working with Taiwanese companies could easily develop indigenous CFKs for employment by TAF units. A small portion of the $2B budget could advance indigenous research and development and purchase domestically sourced CFKs for TAF units, which would be crucial to future operations.

There is evidence that Russia has been jamming global positioning system (GPS) signals in Ukraine, thus hindering precision-guided munitions and UAVs that rely on navigation signals to operate.[28] While Ukrainian forces have found alternative navigation signals, the PLA will likely attempt jamming across Taiwan to deny TAF operating capabilities. As an alternative, the US has been developing an anti-jam, anti-spoof GPS signal called M-code that uses spot beaming to increase the power delivered from the satellite to the receiver. There are currently twenty-three satellites capable of transmitting M-code signals.[29] In initial production, the US has produced Military GPS User Equipment (MGUE) receivers. Space Systems Command (SSC) has just concluded a three-year loan period for allied countries to begin integrating MGUE into military platforms.[30] While receiver costs have not yet been disclosed, there is potential for SSC to transfer MGUE to Taiwan for use in critical systems that can thwart PLA jamming and spoofing.

Conclusion

Taiwan cannot decisively defeat the PLA, but it will not need to. Taiwan must exercise a whole-of-government effort to prepare both military and society for the defense of the homeland and to deny the PRC from achieving its strategic objective: a successful forceful reunification of Taiwan with China. With respect to resisting a kinetic campaign with the PRC, a successful avoidance strategy is anticipated to be the least costly to the international community and far preferable to the people of Taiwan.[31] These recommendations leverage geographic advantages and asymmetric capabilities to increase the expected cost of invasion and therefore ideally deter PRC military action. Should deterrence fail, these recommendations adequately prepare Taiwan's armed forces to stop the PLA where it is most vulnerable during the Joint Island Landing Campaign and guarantee Taiwan's survival.

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Chapter 13

Death by One Thousand Cuts

Defeating a Cross-Strait Invasion

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Abstract

This chapter examines Taiwan Air Force (TAF) modernization ideas with a $2 billion budget and three-year timeline to deter and, if necessary, defeat the People's Republic of China (PRC) from a cross-strait invasion. The chapter assesses novel, low-budget capabilities, such as cloud-seeding, to more exquisite, combat-tested technology like the Nulka missile decoy weapon system. Each capability was chosen to achieve a specific effect within each phase of a cross-strait invasion. These effects range from complicating the PRC's intelligence, surveillance, and reconnaissance (ISR) platforms to providing fires and maneuver to Taiwan forces during an amphibious assault. In so doing, this chapter aims at contributing practitioners' perspectives to the scholarship surrounding Taiwan deterrence.

Chinese Language Abstract

本研究探討了中華民國臺灣空軍現代化構想，以20億美元的預算及三年的期限來阻擋，並在必要時擊敗中華人民共和國的侵略。該研究評估了新穎、低預算的選擇，如人工降雨（也稱人造雨），以及更精緻、經過實戰測試的技術，如 Nulka 導彈誘餌武器系統。每種能力的選擇都是為了在解放軍入侵台灣臺灣的每個階段達到特定的效果。這些效果包括混淆解放軍的情報、監視與偵測 （ISR）飛機以及在兩棲攻擊期間為中華民國臺灣空軍提供火力和機動的能力。因此，本文的目的是為圍繞台灣臺灣威懾嚇阻的學術研究貢獻實踐者的觀點

Introduction

Our TAF modernization proposal seeks to execute a $2 billion budget within three years to ensure that Taiwan has sufficient self-defense capabilities to deter, disrupt, or delay the People's Republic of China (PRC) from a cross-strait invasion. We believe that China will learn from Russia's miscalculations in Ukraine and, if it chooses to use force, will attack Taiwan decisively to take the island as rapidly as possible. The capabilities we analyzed are broken down into three phases: Pre-Invasion, Joint Firepower Strike, and Joint Island Landing Campaign. We look to achieve military effects in each phase to deter, disrupt, and delay PLA forces from gaining air superiority in a conflict with Taiwan. Our aim is to demonstrate how Taiwan can survive the initial strike and recover to a level that will allow it to rejoin the fight while delaying a Chinese land invasion and denying PLA air superiority. This will ultimately allow time for potential allies to decide and act in the defense of Taiwan.

Table 13.1. Recommended Taiwan acquisitions

Acquisition Recommendation	*Cost and Quantity*
Cloud Seeding	$6.4M for 152 generators and $.05/acre
K-SPAN Rapid Erectable Structure	$10M for 5 machines
Chaff Artillery (Mk 36 SRBOC)	$30M for 72 batteries
Nulka Missile Decoy & Mk 41 VLS	$260M for 8 Mk 41s & initial missile reserve
Pseudolites	$280M for initial test and evaluation
E-ADR Rapid Airfield Recovery	$36M for 12 kits
Puma and Switchblade Attack Drones	$175M for 300 Pumas & 1,000 Switchblades
L3 Harris VAMPIRE	$40M for 14 sets
TOTAL	**$896M**

Pre-Invasion

To disrupt an imminent Chinese attack, we propose obscuring the view of collection assets from overhead ISR by using cloud seeding. Cloud seeding has been used in commercial applications to increase precipitation by introducing particles to existing clouds and, in turn, increasing the probability of rainfall.[1] The particles are commonly silver iodide and can cause rainfall to begin almost immediately but can take up to thirty minutes. Cloud seeding increases cloud coverage by 10–15 percent, which would ideally complicate the ISR picture obtained by the PRC.[2] It can also conceal the movement of mobile assets. The two primary ways to utilize cloud seeding are via ground-based generators to cover an area with limited coverage or flares with silver iodide ejected from aircraft onto existing clouds to promulgate their coverage.[3] The state of Nevada is incorporating this technology to increase snowfall in the winter; it can be purchased as a ready system from the Desert Research Institute.[4] A single generator is advertised to cover 12,800 acres (about twice the area of Chicago O'Hare airport). We recommend the TAF buy eight generators for each of the nineteen airfields that have over a 7,000-foot runway. Afterwards, it is about $0.05/acre to continue these operations. We recommend that the generators be placed at all cardinal directions and subcardinal directions around each airfield and used upwind to obscure the airfield. During airfield repair or deception of airfield repair, we recommend cloud seeding thirty minutes to one hour prior to operations beginning to prevent overhead satellite imagery from determining whether an airfield is under repair or whether engineers are employing a deception tactic. The initial acquisition of this system would cost $6,080,000, and each additional generator is $40,000.

Relatedly, we recommend the TAF seek to procure equipment to build K-Spans to aid in the concealment of aircraft, weapons, and air defense systems. K-Spans can serve as a convenient aircraft shelter or warehouse. These buildings are extremely versatile and can be built to many different dimensions to accommodate a wide range of uses. Additionally, these warehouses can be used for war reserve materiel (WRM) or anything else needing protection from intelligence collection and environmental impacts. K-Spans can be built with end walls and roll-up doors or utilized as simple pass-through shelters for aircraft. Their construction is remarkably simple and quick to erect with a printed steel roof supported by concrete walls that can have varying heights and thicknesses. Most recently these structures have been built in United States Indo-Pacific Command (USINDOPACOM) as storage for WRM on or near airfields.[5] The concrete end walls are intended to provide blast protection for any facilities or aircraft next to them. An adversary must expend a separate munition for each facility to destroy all the materials or equipment inside. A potential pre-strike recommendation is that some K-Spans could be left empty as decoys. To build a K-Span, the TAF would first need to procure an Ultimate

Building Machine, which is manufactured in the United States by MIC industries and costs approximately $2 million. To allow for redundancies and the ability to produce K-Spans at separate locations at the same time, it would be ideal to have at least five machines on the island, costing $10 million. The material to build each K-Span costs anywhere from $200,000 to $500,000, depending on the size and additional requirements such as electrical or doors. These materials can be sourced from a country's industrial base and locally produced in Taiwan.[6] A single facility can be built by a team of twenty personnel, and it can be completed in as little as two months.

Joint Firepower Strike

Should a strike occur, the TAF needs to be prepared for, and able to respond to, damaged airfields. Anticipating mass attacks, the TAF could invest in the expeditionary airfield damage repair (EADR) kit, the latest airfield repair concept developed by the US Air Force that also allows for the creation of decoy runways. This kit has reduced equipment from its predecessor and is designed to be easily maneuverable in austere and contested environments. Consisting of just six pieces of heavy equipment, the EADR kit can be operated by fifteen to twenty personnel. It can repair five craters of varying sizes in about four hours and support over 3,500 passes of aircraft after two hours of cure time.[7] The process of repair has six steps: debris removal, upheaval marking, pavement breaking, excavation, backfill, and mat placement. The process is akin to an assembly line, so as each step is completed on a crater, it moves on to the next and so on until all required repairs are completed. For airfields that would be returned to flyable strength, all the steps would need to be completed. If the intended airfield was to be turned into a decoy, then the team would complete all steps up to pavement breaking and then move directly into mat placement. Once the mat is placed, the airfield would have the exact same look as a fully repaired runway and would be completed in only forty minutes per crater; a crew of fifteen could create a decoy runway in as little as 150 minutes. The cost for this system is estimated at $3 million per kit, which includes all heavy equipment and smaller containers with materials like the fiberglass mat. The request from the TAF should be one kit for each of its twelve airfields, bringing the total cost to $36 million. All equipment needed to make up an EADR kit is produced by the US; however, many of these items are commonly found and are even produced locally in Taiwan, providing a cost advantage as well as a reduction in the overall procurement cost of the kit.

After an attack on the island of Taiwan, the TAF should disrupt the People's Liberation Army's Rocket Force (PLARF) ballistic missile strikes by employing advanced countermeasures in a layered approach. One recommended countermeasure is to use chaff to distract radar-homing missiles from their targets.[8] Although the PLARF has advanced rocket systems, the TAF can employ chaff to cause the missiles to miss their intended targets. The PLARF's rockets have advanced radar, so the chaff employed must be illuminated against Doppler, also called jammer plus chaff. A specific system is manufactured by Lockheed Martin, the Mark 36 Super Rapid Bloom Offboard Countermeasures Chaff and Decoy Launching System (SRBOC). The SRBOC launches both infrared and radar chaff and is equipped with an electronic warfare (EW) suite that can detect when missiles are in-bound and ready for launch.[9] Although this weapon system was developed for use from naval vessels, we believe it can be modified to be launched from a land-based location, which would also extend its intended range. We believe the land-based version of the SRBOC would have a greater range on the ground because it is launched from a 130 mm artillery cannon. This size of artillery can range up to seventeen miles; however, the precise and optimal use of the cannon for chaff would have to be field-tested.[10] The cost of a four-battery SRBOC is $800,000, which includes four launchers that carry six missile tubes and twelve to thirty-six rounds of decoy munitions. First produced in 1999, these naval cannons are relatively cheap. SRBOC systems could be used to protect high-value assets, such as mobile cruise missile launchers, mobile HIMAD systems, or mobile radars. Upon detection of an inbound missile, the SRBOC will need to be programmed to launch its decoys during the anticipated terminal phase of an inbound ballistic missile to create a "blanket" of chaff. The cost for this increase in survivability for responding forces is approximately $30 million.

To complement the SRBOC, the TAF could procure the Nulka decoy system developed by Lockheed Martin and BAE systems for $150 million; this system successfully defended US Navy assets from Houthi missiles in 2016.[11] The TAF could purchase eight Mark 41 vertical launching systems (VLS), which hold eight cells each, for $110,000,000.[12] This combined $260 million investment will give the

TAF sixty-four missiles for a 24/7 alert status. The Mark 41 VLS has a rapid reload capability that can be fired multiple times. For example, by firing ten salvos the Mark 41 VLS and Nulka can complicate nearly half of the PLARF's inbound ballistic missiles, significantly increasing survivability of high-value assets (assuming 1,000–1,500 ballistic missiles targeting Taiwan during the Joint Firepower Strike). The concept of employment for the Nulka is like the SRBOC; however, the munition and payload launched can hover in mid-air to track inbound missiles away from their target.[13] In so doing, the Nulka employs an active EW package and can fly on a preprogrammed path.

The PRC has noted that the US and friendly force reliance on space is a major vulnerability. Efforts to terrestrially augment space systems could be key to survivability during electronic warfare. Assured positioning, navigation, and timing (A-PNT) will be critical to augment degraded or denied GPS signals for allied assets. The US Army is developing its A-PNT program, consisting of pseudo-satellites, or "pseudolites," and mounted and dismounted PNT systems with antijam antennas. Pseudolites are small satellite-like transmitters capable of augmenting GPS satellites but reside terrestrially in either tents, vehicles, buildings, or low-flying aircraft. This system will provide redundancy for allied systems in significantly degraded environments and while also mitigating jamming techniques. A-PNT can also be a solution for areas that typically struggle receiving a GPS signal, providing extra coverage in the rough terrain in Taiwan and helping the friendly force. Currently, Ukraine is finding similar GPS augmentation devices like those on UAVs extremely successful while also providing PNT coverage over operating areas when required.[14] This specific program is still under test and evaluation, however, and the US Space Force is offering $40 million in small grants called the AltPNT Challenge to commercial firms to fill the gap for the rest of the joint force. Taiwan could either procure the A-PNT system directly from the US or buy the technology and build it indigenously from one of the many commercial firms competing in the challenge. The cost to procure the materials for testing is approximately $280 million.[15] Currently, there are no released ranges of the A-PNT components' coverage, so the number of systems to procure could fluctuate once figures are published.

As the PLA firepower strike furthers, the TAF will need to combat the joint invasion with a lethal, highly mobile force that can operate away from the central nodes that are expected to be destroyed during the initial missile strikes. Another recommendation from our team to counter these PLA efforts is the joint employment of AeroViroment's PUMA LE and Switchblade 600 (SB600) drones. The SB600 is a loitering munition that employs its armament in a kamikaze-type attack with an effective loitering time of forty-five minutes and a range of up to 40 nm, providing an effective defense to counter a cross-strait invasion. The predecessor to the SB600 is the Switchblade 300 drone, which has been employed in Middle East conflicts since 2011, providing successful counter-vehicle offensive operations. The SB300 has an effective range of 20 nm with twenty minutes of loiter time, carrying a smaller operable munition (an anti-tank guided missile warhead).[16] While effective for counter-vehicle operations, these figures do not meet the TAF's needs to successfully target amphibious assault vehicles or naval vessels prior to encroaching on the Taiwanese ADIZ. For this reason, the SB600 provides higher capability and a more robust payload to enable a greater mass on naval and marine landing targets. The SB600 capabilities and operating strategy need to be reworked to better combat People's Liberation Army Navy threats.

To create the drone network, we would also employ the AeroVironment PUMA LE drone. This is a larger drone that can be shoulder launched and stall recovered, providing electro-optical and infrared sensing, tracking, and targeting. The PUMA has a loiter time of up to six hours and a range of 32 nm. The unique aspect of the PUMA drone is that it can sync with the SB600 to direct and target attacks.[17] The PUMA drone provides ISR and targeting, which would be instrumental in identifying naval targets and marine landing craft for the SB600 drones to destroy. Both systems are produced by AeroVironment, one of the leading US producers of Group 1 drones. The SB600 costs approximately $100,000 per unit, and the PUMA LE is roughly $250,000 per unit. Our group advises that Taiwan needs at least 1,000 SB600s and 300 PUMA LEs for force augmentation. These forces would be employed in small teams along the west coast of Taiwan to create a "porcupine" defensive network and would target to destroy cross-strait naval and marine landing vessels in synchronized attacks with more traditional antiship systems. The benefit of these small teams is that they are incredibly hard to engage during the PLA's initial strikes. The total cost for the proposed drone network system acquisition would be $175 million, excluding training and manning of the system.

Joint Island Landing Campaign

If the PLA were successful in a joint firepower strike, Taiwanese forces would need to be prepared for a land invasion. A survivable maneuver element that would provide the TAF with a tactical approach to combat PLA assets is the Vehicle Agnostic Modular Palletized ISR Rocket Equipment.[18] The VAMPIRE is a low-cost, highly accurate missile system that consists of a sensor and missile launcher that can be installed in the back of a pickup truck or any vehicle with a bed, making it highly mobile. It has a proven track record as a superior counter-drone system during its employment in Ukraine and has a WEBCAM MX-10 sensor to provide ISR coverage, allowing a single operator to track, laser designate, and target. The entire package fits on just one pallet and can be installed in two hours with only two personnel. The VAMPIRE can be covertly positioned across the island of Taiwan in garages, warehouses, and military facilities. Upon invasion, the system can be prepared for agile "shoot and scoot" warfare. The system is $2,800,000 per unit and can employ the AGR-20 Advanced Precision Kill Weapon System rockets, which cost approximately $27,500 each. Taiwan can procure 14 VAMPIRE systems for $40 million and 1,400 rockets (totaling $38,500,000) to defeat PRC drones, small aircraft, and landing forces invading Taiwan.[19]

Conclusion

One new asset type would not be enough for Taiwan to prevent PLA air superiority, which is why this chapter proposes several systems to be employed throughout the three phases of preinvasion, joint firepower strike, and amphibious assault. The total cost for acquiring these systems is approximately $895,860,000. While our proposal does not reach the allocated funding of $2 billion, it provides a buffer for inflation, depending on how quickly the systems are purchased, and the option to increase the number of systems to purchase. The remaining funds also allow for other necessary equipment or structural fortification that the TAF may need for existing aircraft and air defense systems.

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Conclusion

Toward an Integrated Deterrence Posture in the Taiwan Strait

Dr. Robert S. Hinck and Dr. Jared M. McKinney

Although global communities face a number of serious, complex challenges, the most consequential remains the question of China's rise. As the *2022 US National Security Strategy* states, China is "the only country with both the intent to reshape the international order, and, increasingly, the economic, diplomatic, military, and technological power to do so."[1] The trajectory of China's rise will indeed come to define how international cooperation unfolds with competitive efforts playing out along a multitude of dimensions, some constructively and others not. China's relationship with Taiwan will most likely serve as the crucial litmus test for China's aspirations. Unfortunately, to a greater extent today than at any previous time since the mid-1950s, deterrence in the Taiwan Strait is significantly in doubt, unleashing the very real possibility of major armed conflict.

In this regard, alarmists are correct to ring the bell. As the historical record shows, changes in the global order are often accompanied by great power conflict.[2] Nevertheless, conflict is seldom preordained. Humans have agency to shape and structure their social worlds, for better or for worse. Confronting this challenge, this volume explored constructive ways to manage tensions with the goal of strengthening deterrence in the Taiwan Strait without contributing to the escalation of conflict. As argued throughout, successful deterrence in the Taiwan Strait begins with Taiwanese capabilities and will to resist Chinese aggression. In this sense, the bulk of essays focused on creative, actionable steps Taiwan can take to strengthen its own deterrent effects. Indeed, we believe that the essays here demonstrate practical, reasonably inexpensive, and low-risk actions that would increase the likely costs of a Chinese invasion of Taiwan and decrease perceptions of success.

Yet, one piece of the deterrence puzzle remains. In our globally interconnected world, successful deterrence rests not solely in the hands of a few powerful nations but in the ability of a multitude of nations to band together for collective security. Revitalizing deterrence in the Taiwan Strait suggests, then, some further consideration of how such efforts can coalesce into an integrated framework. In this regard, US leadership is needed.

While there is no guarantee that the US will intervene on behalf of Taiwan in conflict against China, the US remains not only Taiwan's primary partner but also the major stakeholder in global peace concerned by the consequences a Chinese assault would bear. As the *2022 US National Defense Strategy* (NDS) states, the US is committed to peace in the Taiwan Strait and the current international order. Moreover, the US NDS is specifically intended to operate with allies and partners to form an integrated deterrence posture to maintain peace and stability. Understanding how the recommendations presented within this volume contribute toward integrated deterrence thereby offers an appropriate bookend and a starting point for continued conversation on ways to strengthen deterrence and prevent catastrophic war over Taiwan.

Integrating Integrated Deterrence

The 2022 US NDS states that integrated deterrence is the centerpiece of US strategy. Defined as the seamless working "across warfighting domains, theaters, the spectrum of conflict," and including "all instruments of U.S. national power" as well as "our network of Alliances and partnerships," integrated deterrence is to be "tailored to specific circumstances" and "applies a coordinated, multifaceted approach to reducing competitors' perceptions of the net benefits of aggression relative to restraint."[3] As this lengthy description suggests, integrated deterrence draws all of the approaches to deterrence discussed in this volume to create a holistic strategy in pursuit of American national interests. It represents a far broader view than previous US approaches to deterrence.

In many ways, integrated deterrence can be read as responding in kind to China's deterrence strategies. Even the name is eerily similar to earlier language developed in China.[4] The 2022 NDS called for a holistic US response to combat the PRC's whole-of-government pursuit of "coercion, malign behavior, and aggression."[5] Like Chinese strategists, integrated deterrence takes seriously the role of perceptions, stating that the US will pursue initiatives that "seek to shape perceptions . . . by sowing doubt in our competitors that they can achieve their objectives or conduct unattributed coercive actions."[6] Communication too plays a role, with a section on the importance of information in deterrence, which requires "working to ensure that messages are conveyed effectively" with deterrence dependent "in part on competitors' understanding of U.S. intent and capabilities."[7] Finally, the 2022 NDS called for the application of tailored deterrence, including specific efforts taken to deter Chinese aggression by enhancing US denial capabilities through new technologies and operational concepts, development of resilient systems that can withstand contested environments and informational attacks, and collaboration with allies and partners in the Indo-Pacific.[8]

Although criticisms of integrated deterrence remain, the pursuit of a multi-layered, whole-of-government approach, in partnership with US partners and allies, can overcome such challenges. For instance, building layered networks and interactions among US allies and partners would contribute toward a positive form of power; one that goes beyond simply deterring aggression via maintaining the status quo to that of strengthening cohesion across and within affected nations. Moreover, the aggregation of such network ties across national sectors of industry, military, economies, technology, societal organizations, and diplomacy would increase collective combat capabilities, generate greater resilience, and enhance enduring economic and technological advantages vis-à-vis China. Finally, collaborative efforts in these areas would combine to shape the perceptions of the security environment by raising the potential costs of Chinese aggression against a more capable and unified front while indicating that aggression is less promising relative to peaceful engagement within the current international system.

Ultimately, for integrated deterrence to succeed, it needs to be enacted. While perhaps grand in its scale—some think too grand[9]—the US and its allies and partners can begin aligning their various instruments of power over time, although in the case of promoting deterrence in the Taiwan Strait, doing so sooner rather than later is necessary. In this light, the ideas presented throughout this volume can be read in part as examples of actionable first steps (ways and means) to enliven the idea of integrated deterrence. This is why the volume's recommendations run across different levels of strategy, as depicted below.

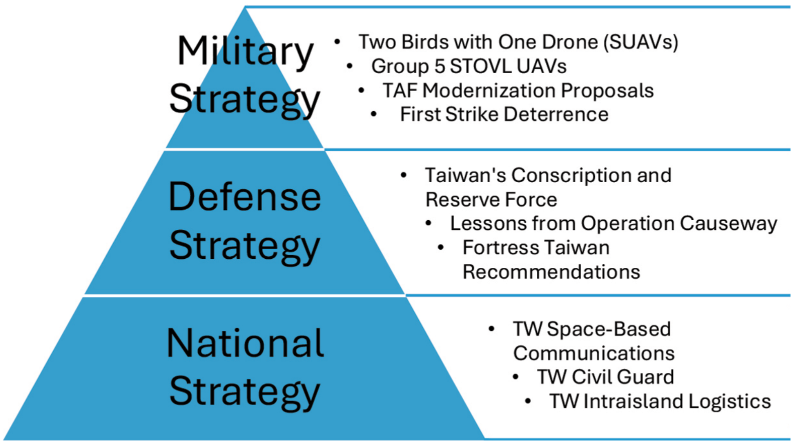

Figure C.1. Chapters by level of strategy

Integrating Combat Capabilities

Chapters 5 and 6 offered proposals linking industry, innovation, and combat capabilities. Mark Jacobsen argued for integrating US and Taiwanese drone industries and policies, including collaboration across universities, police, and civil organizations to open additional markets to promote technological development. This effort would extend across conflict theaters, allowing for the testing and development of drone technologies and concepts in Ukraine and US bases in the Indo-Pacific. In a related argument, Reiss Oltman proposed that the Taiwan Air Force (TAF) acquire a fleet of Group 5 short takeoff and vertical landing (STOVL) unmanned aerial vehicles (UAV). These systems, which are between six and fifty times more affordable than a single F-16V, would give the TAF a capability that enabled both peacetime and wartime operations and create a whole new threat vector for an invading force.

Integrating People Power

Chapters 7 and 10 point to new ways to raise the costs of an invasion by leveraging creative usage of Taiwan's people. Whereas Tiffany Basham focused on doing so within Taiwan's conscript and reserve forces, Wang and Shin suggested the creation of a new Taiwan Civil Guard (TCG). Both proposals stressed the importance of generating greater will and capability to resist through local/regional systems of deployment, development of asymmetric fighting concepts, and better skill utilization. Moreover, both offer examples of how to build redundancy and resilience within human networks to support resistance operations as well as combat information operations. However, Wang and Shin go one step further by suggesting ways to integrate resistance networks transnationally, suggesting that a TCG collaborate with Baltic and Nordic nations or form a foreign legion to enhance training and expertise or both. In this regard, we see the potential of quasi-public diplomacy efforts that may help break Taiwanese isolation and force China to consider the ramifications of an attack that could draw in people from across the globe.

Integrating Networks for Combat Resilience

Chapters 8 and 9 focused on Taiwan's communications and energy networks' vulnerabilities and addressed solutions to mitigate them. In doing so, both draw attention to the importance of macro-level networks in sustaining Taiwanese capabilities. On the communication front, Nicholas Stockdale proposed fusing civil-military cooperation across US and Taiwanese society to invest in and build out a nonterrestrial communication network that could withstand Chinese attack. This reflects a whole-of-society approach through its proposed collaboration with multiple private sector companies in constructing nonterrestrial network infrastructure; such an effort would align multiple stakeholders and contribute to Taiwan's war-fighting capabilities while adding a layer of space deterrence to further complexify Chinese war planning. In a similar strategic vein, albeit applied in a different context, Austin Whelan recommended Taiwan improve its physical energy infrastructure by developing a national energy policy that accounts not only for national disasters (which in the future may be exacerbated by climate change) but security threats as well. Ensuring that legacy hardware is maintained, not jettisoned, and creating indoor and mobile substations can all help enhance network redundancy and decrease targetability of Taiwan's energy grid. Moreover, combining improvements to Taiwan's physical infrastructure with a communication campaign messaging Taiwanese resilience could increase confidence in Taiwan's willingness and capability to resist an attack.

Integrating US Strategy and Policy

Chapter 10 showcased the power of international perceptions. Glen Gibson's assiduous analysis of the normative requirements of a limited US first strike capability on Chinese amphibious assault assets, and accompanying feasibility assessment, pushes risks onto the PRC despite—or even, because of—America's longstanding policy of strategic ambiguity.

Praxis: Integrating Analysis of Past and Present

Finally, chapters 1 through 3 and part 5's three speculative chapters on modernizing Taiwan's Air Force highlight the benefits of tying theory with practice. Unlike academic theory, military strategies offer few opportunities for formal testing of hypotheses. The importance then of considering both the historical record of when and why deterrence succeeds or fails with examples of actual war gaming and discussion of historical planning into what an invasion of Taiwan would entail yields crucial insight into the role of perceptions, strategy, and campaign planning. These chapters, taken together, should spur continued conversation into what forms of aid Taiwan needs and how such capabilities fit into national and transnational strategy formation to strengthen integrated approaches to deterrence. In recognition of the operational thinking on display in the three speculative chapters on TAF modernization and the Fortress Taiwan war game report, a criticism might be made: Is it a mistake for this volume to tip its hand with respect to what might be done in the US and Taiwan? Would it be best to keep such chapters compartmentalized and obscure?

A misreading implied by the question must be addressed immediately: the chapters in this volume represent academic analyses in the tradition of professional military education. They seek to stimulate new—and better—thinking on ways to create and communicate deterrence, but that is all; these are ideas, not policies or plans. Contributing these ideas to public discourse is important for four reasons. First, if we do not present good ideas, bad ideas will come to dominate discourse. By "bad" we mean unstrategic, in the sense that such ideas are not sensitive to risk, time, and resourcing. Unfortunately, as the Introduction argued, such bad ideas have indeed tended to dominate public discourse up to this point. Second, public presentation allows us to test the various proposals in the marketplace of ideas. One of the reasons the Industrial and Scientific Revolutions began in the West—and not in China—was the thriving "market for ideas" stimulated by competing centers of power and the printing press.[10] If the volume's authors have gotten things wrong, they are open to being convinced otherwise. Third, Congress plays a key role in authorizing weapons sales to Taiwan, and franker communication of the strategic conundrum Taiwan faces—and how to mitigate it—is needed. Congress has authorized foreign military financing and presidential drawdown authority that could be used to support deterrence in the Taiwan Strait. This is a major shift in the US's approach, and it is appropriate for there to be a public discussion about how to optimize the impact of these funds. Finally, this volume should sow doubt in the PRC's confidence that it can easily achieve its objectives in Taiwan. The frank assessment of the US military in 1944 was that invading Taiwan (Formosa) would be prohibitively difficult. Many of the challenges posed by such an invasion have remained stable despite time's passage, something smart strategy can further exacerbate.[11] And although new technologies might enable a better offense, they can definitely enable a better defense.

In Sum

Taken together, this volume of essays not only demonstrates how we can make integrated deterrence practical with respect to Chinese aggression toward Taiwan but also offers a model for approaching integrated deterrence across levels of strategy. A comprehensive—or integrated—approach to deterrence would require military, defense, and national implementation in both Taiwan and the US. While there is no "one" right answer, there are—we believe—"right answers," and they should be pursued simultaneously.

For modest cost and effort, Taiwan and the US can strengthen the balance of power in the Taiwan Strait and reduce the risk of war. And even if war were to occur, the chances of catastrophic defeat can be lessened. The way to do this is to avoid fantastical discussions of declaring strategic clarity, threatening nuclear war, or doubling defense spending and instead simply pick the low-hanging fruit of the deterrence tree. This is both more likely to succeed and more in line with the actual US commitment to Taiwan.[12]

Taiwan's Air Force can become an Anti-Air Force. Taiwan's civilian energy infrastructure can be made more resilient, as can its space-based communication networks. With a Civil Guard, Taiwan's society can become more prepared to survive and resist. And with an invigorated reserve force, Taiwan can attain the mass required to defy the PRC. The US can seek to increase the value of the status quo by ensuring that its "small yard, high fence" export controls do not metastasize into a large yard that further excludes China from the globalized trading system.[13] And at the same time, the US can prepare to preempt, if necessary, a Chinese attack on forward-deployed US forces, thereby increasing the PRC's likelihood of decisive defeat. If Congress and the DOD allocate the foreign military financing and presidential drawdown authority resources wisely—insisting on Lee Hsi-ming's framework of "dispersal, mobility, and denial" (分散、機動、拒止)—then rapid progress can be made.

At the end of the day, the situation in the Taiwan Strait is different today because the military balance of power is more unequal now than it has been at any time over the last seventy years. This has created a deterrence gap in which PRC hostile action is possible (though not inevitable). The way to stabilize the situation is to close the deterrence gap. This volume has outlined various methods to do that very thing. Implementing these proposals, we believe, will contribute to peace and stability and reduce the risk that the present globalized international order will be shattered by the ravages of war.

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Abbreviations

A2/AD	antiaccess area denial
ACE	agile combat employment
ADIZ	air defense identification zone
AESA	active electronically scanned array
AFOTEC	Air Force Operational Test and Evaluation Center
AFRC	Armed Forces Reserve Command (Taiwan)
AHEAD	advanced hit efficiency and destruction
AI	artificial intelligence
ASAT	antisatellite weapon
AMD	air and missile defense
AMRAAM	Advanced Medium-Range Air-to-Air Missile
AODMA	All-Out Defense Mobilization Agency
ATO	authority to operate
C2	command and control
CCA	collaborative combat aircraft
CCP	Chinese Communist Party
CNA	Center for Naval Analyses
COA	courses of action
COG	center of gravity
COTS	commercial off-the-shelf
CSG	carrier strike group
CSIS	Center for Strategic and International Studies
DCA	defensive counterair
DE	directed energy
DEW	directed energy weapon
DIU	Defense Innovation Unit
DOD	Department of Defense
DPP	Democratic Progressive Party (Taiwan)
DRFM	Digital Radio Frequency Memory
DUV	deep ultraviolet
EADR	expeditionary airfield damage repair
EDA	electronic design automation
EDIPC	Economic Deterrence Interagency Policy Committee
EHV	extra high voltage
EM	electromagnetic

EW	electronic warfare
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FMS	foreign military sales
FONOPS	freedom of navigation operations
FPV	First Person View
GDP	gross domestic product
GEO	geosynchronous-earth orbit
GPS	global positioning system
GPU	graphic processing unit
GSO	geostationary orbit
HEMTT	heavy exapndable mobility tactical truck
HEO	highly elliptical orbit
HGV	hypersonic glide vehicle
HVA	high-value assets
IADS	intergrated air defense systems
IAMD	integrated air and missile defense
ICBM	intercontinental ballistic missile
IDM	integrated device manufacturer
IHL	International Humnitarian Law
INDOPACOM	United States Indo-Pacific Command
IO	information opeartions
IoT	Internet of Things
IP	intellectual property
IPC	Interagency Policy Committee
ISL	inter-satellite links
ISR	intelligence, surveillance, and reconnaissance
I&W	indications and warnings
JASSM-ER	joint air-to-surface standoff missile-extended range
JBC	joint blockade campaign
JCS	Joint Chiefs of Staff
JDAM	Joint Direct Attack Munition
JFSC	joint firepower strike campaign
JILC	joint island landing campaign
LEO	low-earth orbit
LHD	Landing Helicopter Dock (amphibious assault ship)

LNG	liquified natural gas
LPD	Landing Platform Dock (amphibious transport dock)
MEO	medium-earth orbit
MGUE	Military GPS User Equipment
MND	Ministry of Defense (Taiwan)
MOI	Minisry of Interior (Taiwan)
NCSIST	National Chung Shan Institute of Science and Technology
NDAA	National Defense Authorization Act
NDS	National Defense Strategy
NFA	National Fire Agency
NGO	nongovernmental organization
NPA	National Police Agency
NSC	National Security Council (US)
NSS	National Security Strategy (US)
NTN	non-terrestiral network
ODC	overall defense concept
OMFTS	operational manuever from sea
OWA-UAV	one-way attack unmanned aerial vehicle
OWS	operational wargame system
PLA	People's Liberation Army
PLAAF	People's Liberation Army Air Force
PLAN	People's Liberation Army Navy
PLARF	People's Liberation Army Rocket Force
PNT	positioning, navigation, and timing
PRC	People's Republic of China
PWSA	Proliferated Warfighter Space Architecture
RATO	rocket-assisted takeoff
RORO	roll-on/roll-off
RUSI	Royal United Services Institute
SAG	suface action group
SAM	surfce-to-air missile
SAR	synthetic aperture radar
SBD	small diameter bombs
SEAD	suppresion of enemy air defenses
SHORAD	short-range air defense
SMA	special mission aircraft

SME	semiconductor manufacturing equipment
SOCPAC	US Special Operations Command Pacific
SOF	special operations forces
SRBOC	Super Rapid Bloom Offboard Countermeasures Chaff and Decoy Launching System
SRR	short range reconnaissance
SSC	Space Systems Command
SSGN	subsurface guided nuclear submarine
STOVL	short takeoff and vertical landing
TAF	Taiwan Air Force
TASA	Taiwan Space Agency
TCCC	tactical combat casuality care
TCG	Taiwan Civil Guard
TDWAR	Taiwan Deterrence Warfighting Advantage Research
THAAD	Terminal High Altitude Area Defense
TI	Texas Instruments
TSMC	Taiwan Semiconductor Manufacturing Company
TTP	tactics, techniques, and procedures
UAS	unmanned aerial system
UAV	unmanned aerial vehicle
US	United States
USAF	United States Air Force
USV	unmanned surface vessel
UUV	unmanned underwater vessel
VLS	vertical luanching system
VPM	Virginia Payload Module
VPN	virtual private network
WRM	war reserve materiel

Contributors

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Capt Benjamin Basham is an active-duty Instructor Pilot flying the C-17A Globemaster stationed at Joint Base Pearl Harbor-Hickam, Hawaii. He earned his commission from the United States Air Force Academy in 2017 and earned a master of science in geological sciences from Ohio University in 2022.

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Capt Phillip Beasley is a logistics readiness officer in the United States Air Force, District of Columbia Air National Guard. He earned a bachelor's degree at Kent State University, Ohio, a master's degree from Indiana Wesleyan University, Indiana, and is a 2018 graduate of the Air Force Officer Training School at Maxwell Air Force Base, Alabama. He is stationed at Joint Base Andrews, Maryland, and has deployed in support of US Central Command. Additionally, he has supported multiple domestic operations in the US National Capital Region.

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Glen Gibson is a special agent with the Air Force Office of Special Investigations. Since 2004, SA Gibson has conducted and overseen criminal, counterintelligence, and fraud investigations for the Department of the Air Force and deployed to Iraq in support of Operation Iraqi Freedom. Throughout his investigative career, SA Gibson has learned that solving complex problems requires a bias for action. This has resulted in a consistent, if not sometimes unhealthy, desire to question assumptions and think boldly outside of the box.

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Dr. Mark Jacobsen (Lt Col, USAF, Ret.) is the Director of Research and Development at TILT Autonomy. He was previously the Deputy Director of Air War College's Center for Strategy and Technology, where he helped lead Blue Horizons, a program that educates Air Force and Space Force officers to become intrapreneurs and lead positive, disruptive change. He flew the C-17A Globemaster III before earning his PhD at Stanford University, then spent three years at the Defense Innovation Unit leading small, unmanned aircraft system (UAS) and counter-UAS programs. He also founded and led a nonprofit that aimed to use swarms of drones to break sieges and deliver humanitarian aid in conflict zones.

Andrew Lobo

Capt Andrew Lobo is an acquisitions management officer serving as the executive officer for Program Executive Office, Digital at Hanscom Air Force Base, Massachusetts. His experience in procuring homeland defense assets spurred his interest in the modernization of Taiwan's Air Force, focusing on how strategic enhancements to military assets can bolster national defense capabilities.

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Reiss Oltman

Lt Col Reiss Oltman is a maintenance officer with sixteen years of service. He has served in a multitude of roles in support of a wide range of aircraft, including the MQ-1B, MQ-9A, B-2A, A-10C, HC-130J, HH-60G, and the F-16C. Additionally, he has spent time in acquisitions serving as the lead logistician on seven diverse Acquisition Category (ACAT) II-III programs and was the program manager on the ACES HY system. In his last position, he was the squadron commander for the 79th Fighter Generation Squadron. He is currently an Air University Fellow and an instructor in the Joint Warfighting Department at Air Command and Staff College.

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Capt Madeleine Wawrzyniak is a C-146A instructor pilot assigned to USAF Special Operations Command at Duke Field, Florida. She has over 800 hours of combat and combat support time across US Indo-Pacific Command, US Africa Command, and US European Command. Her time operating in nonstandard aviation has led to an interest in unconventional approaches to military challenges.

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Bolstering Our Strategic Response

"Experts" insist that the risk of a Chinese invasion of Taiwan is low, while "Catastrophizers" warn of imminent conflict. These conflicting assessments result in contrasting recommendations. Whereas Experts recommend Taiwan focus on long-term resilience, Catastrophizers propose radical political solutions—such as the United States adopting a policy of "strategic clarity," upending more than half a century of history. This book explores the tension between these viewpoints, arguing that while Experts underestimate the risk of conflict, Catastrophizers propose solutions that are imprudent. To be strategic, responses to the threat of invasion must weigh resources, risks, and time. History and wargaming show that a series of modest adaptations—in Taiwan and the United States—can bolster deterrence and reduce the growing risk of conflict. This book features contributions from more than two dozen military officers showing how this can be done.

Air University Press

ISBN 9781585663354

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