Watching Over the Taiwan Strait

The Role of Unmanned Aerial Vehicles in Taiwan's Defense Strategy

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Cover Image: Satellite view of the Taiwan Strait. *(Source: Gallo Images/Orbital Horizon/Copernicus Sentinel Data 2019.)*

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Executive Summary

Unmanned systems are likely to transform the Taiwan Strait battle space in the coming years. Military systems enabled with advanced artificial intelligence technology could greatly augment the defense of the Republic of China (Taiwan), deterring enemy attacks or defeating aggression if deterrence fails.

The People's Liberation Army (PLA) has fielded a large and increasingly sophisticated force of unmanned aerial vehicles (UAVs) opposite Taiwan. UAVs would play critical roles in any Taiwan scenario, including intelligence gathering, electronic warfare operations, deception, and strike missions.

To maintain a sufficient self-defense capability, Taiwan's political and military leaders are seeking to harness their open society's innovative spirit and resilience, turning latent power into sources of national advantage. Unmanned systems have become an important component of Taiwan's indigenous defense development program.

Taiwan's national security and defense leaders rely on intelligence, reconnaissance, and surveillance (ISR) for indications and warning of PLA use of force and other forms of coercion. The Overall Defense Concept (ODC), Taiwan's current published defense strategy for dealing with Chinese attack, highlights the requirement for unmanned weapons systems and other asymmetric capabilities to augment the island's defense.

Taiwan's defense industry has made significant progress in the production of UAVs that can be deployed by military units in the field. Taiwan's military has or plans to deploy UAV types including:

- Small hand-launched aircraft for tactical ground units;
- Medium-sized aircraft for maritime domain awareness;
- Loitering anti-radiation aircraft for striking enemy radars; and
- Large long-endurance aircraft for surveillance and maritime interdiction.

We offer eight recommendations for the consideration of policymakers in Washington and Taipei:

(1) **Expedite a review of ISR systems currently available to support Taiwan's self-defense in accordance with the ODC and the Taiwan Relations Act.** Given the urgency of the threat, policymakers should address shortfalls that undermine Taiwan's ability to mount an effective and credible defense.

(2) **Integrate new systems into Taiwan's defense strategy.** Political and military leaders in Taiwan may consider how to best integrate emerging military and civilian UAV capabilities into the operational inventory to ensure they can field large numbers of tactical aircraft during a crisis. U.S. policymakers should support this effort through a tailored security assistance program.

(3) **Establish a secure common operational picture for ISR and "deterrence by detection."** The U.S. and Taiwan should negotiate the selective pooling of resources in a mutually beneficial manner. An integrated network of unmanned systems could enhance deterrence and reduce risks of miscalculation.

(4) **Test latent interoperability during joint exercises.** Interoperable UAVs could allow political and military leaders in the U.S. and Taiwan to communicate and exchange ISR in near real-time. To this end, the U.S. Indo-Pacific Command and ROC Armed Forces should integrate UAVs into future joint training and operational readiness exercises.

(5) **Plan together.** In the coming five to ten years, UAVs will transform the security situation in the Taiwan Strait. Military analysts from the U.S. and Taiwan should conduct joint studies on possible future scenarios based on the proliferation of unmanned systems on both sides of the Strait.

(6) **Operate together.** The U.S. and Taiwan should leverage UAVs in support of humanitarian assistance and disaster relief (HA/DR) operations. As defense and security ties deepen over time, both sides should consider how to execute *ad hoc* coalitions, including anti-submarine warfare missions, air and missile defense, and coastal defense operations.

(7) **Engage early.** The United States' export control laws are evolving. But it is early in the process. The Missile Technology Control Regime (MTCR) is undermined by current developments in the international community. Taiwan has the unique prerequisites (both in terms of internal export controls and UAV manufacturing capabilities) to be a U.S. partner in navigating this process today.

(8) **Establish a bilateral working group on UAV supply chain security.** It is imperative that the U.S. and Taiwan are able to ensure that their unmanned systems are not infiltrated by adversary military or intelligence operators. To this end, they could establish a bilateral working group on UAV supply chains that is tasked with studying potential threats and making recommendations for mitigating them.

Figure 1: The Taiwan Strait Area. *(Source: Project 2049 Institute.)*

Introduction

Taiwan, formally known as the Republic of China (ROC), stands watch over the world's most dangerous political and military flashpoint. Taiwan's survival as an independent country is uncertain. The Chinese Communist Party (CCP) sees the subjugation of Taiwan's democratically-elected government as its primary external mission. To that end, the CCP is channeling the wealth and might of the People's Republic of China (PRC) into preparations for a future war of conquest. If unchecked, the CCP's sweeping military modernization program and policies of territorial expansionism could destabilize the peace and security of the Indo-Pacific region.

In the foreseeable future, unmanned systems are likely to transform the Taiwan Strait battlespace. Military systems enabled with advanced artificial intelligence (AI) technology could greatly enhance Taiwan's defense, deterring enemy use of force or defeating aggression if deterrence fails. The right mix of systems in friendly hands could bolster strategic stability and contribute to the prevention of conflict. Yet, that is not the current trajectory; the PRC's rapid military buildup continues to upset the security situation in the Taiwan Strait. The same suite of technologies that could save Taiwan if applied to its defense could also seal its fate.

The Indo-Pacific region has flourished over the past 70 years because of the unquestioned primacy of the United States and the attendant willingness of East Asian countries to set aside the use of force as a tool of statecraft. However, the leadership of the CCP has repeatedly signaled that past practices and norms will not be honored as China rises. Xi Jinping is the General Secretary of the CCP, Chairman of the Party's Central Military Commission (CMC), and Chairman of the PRC state. He has publicly said that the CCP's collective vision for its future, something he refers to as the "China dream" and the "great rejuvenation," requires Taiwan's capitulation. From his perspective, China cannot rise and become a successful great power until Taiwan submits to Beijing's One China Principle and the island falls under PRC control. Chairman Xi has turned to the armed wing of the CCP, the People's Liberation Army (PLA), to ensure that if political and economic measures fail, China can take Taiwan by force of arms.

The determination of the CCP to make the annexation of Taiwan the central feature of its party-state policy is an event of first magnitude in global affairs. The CCP rules over the most challenging military power in Asia and the world's second-largest economy. If its Taiwan policy is carried into full effect, China will replicate those situations that in past experience have proved disastrous to the peace, prosperity, and security of all nations in the Indo-Pacific region. This would bring 70 years of progress and development to a tragic conclusion.

Taiwan remains the PLA's primary driver for strategic and operational planning and force modernization. Chinese military writings envision achieving victory through the flexible application of a maritime blockade, an air and missile campaign, and, if necessary, amphibious landing operations. Plans include the ability to deter, delay, and defeat intervening U.S. forces that China anticipates will come to Taiwan's defense. In preparation for this scenario, the PLA has invested resources into building up a powerful military infrastructure for use of force. One of its principal areas of investment has been in national and theater-level C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance), with a notable emphasis on unmanned systems.

The PLA has fielded a large and increasingly sophisticated force of unmanned aerial vehicles (UAVs) that could be assigned to a Taiwan campaign. UAVs will play a critical role in any Taiwan scenario, to include intelligence gathering, electronic warfare operations, tactical deception, and strike missions.[1] While military and dual-use satellites provide the PLA with greater theater-wide C4ISR capabilities, space assets have limits at the tactical level of warfare.[2] UAVs offer battlefield commanders exquisite intelligence and are considered crucial to the success of lower echelon (brigade, regiment, and company-level) operations. According to PLA experts, combat units would suffer heavy losses during the first wave of an assault against Taiwan and, to mitigate casualties, UAVs could be tasked with going across the Strait first to find and strike targets in Taiwan and the offshore islands, clearing the way for main force units to follow.[3]

Faced with the specter of an unfavorable and widening gap in military capabilities, Taiwan's political and military leaders are seeking to harness their open society's innovative spirit and resilience, turning latent power into sources of national advantage. President Tsai Ing-wen has lent her support to the development of a national defense strategy that could better position Taiwan to meet the gathering threat. Her administration is investing significant resources into an improved indigenous defense industry, while continuing to acquire advanced American systems needed to recapitalize aging equipment and provide units with advanced capabilities. Unmanned systems have become an increasingly important component of Taiwan's indigenous development program. Looking ahead, Taiwan may seek to acquire proven U.S. systems to provide its nascent unmanned fleet with interoperable capabilities.

American defense strategists at the Center for Strategic and Budgetary Assessments (CSBA) have developed a concept called "deterrence by detection," which is applicable to Taiwan. This operational concept envisions deterring Chinese aggression by using a network of non-stealthy, long-endurance UAVs to monitor key geographic areas like the Taiwan Strait.[4] UAVs operated by the ROC Armed Forces that are capable of contributing to a common operational picture could reduce the burden placed on finite U.S. aircraft. Taiwan's inclusion in an American-led regional security network could also have considerable political and military benefits. By rapidly deploying long-endurance UAVs networked with large numbers of indigenous unmanned systems for coastal defense and interdiction missions, Taiwan could enhance its contribution to broader strategic stability.

What is the current state of Taiwan's defense strategy and indigenous UAV programs? What shortcomings and gaps currently exist that Taiwanese leaders intend to overcome through future investments? What opportunities exist? How might Taiwanese UAVs be used to respond to future man-made and natural disasters? What information should be shared between the U.S. and Taiwan? In what ways could future UAVs equipped with interoperable systems give Taiwan an expanded role in a free and open Indo-Pacific strategy? In the coming pages of this report, we explore the role that UAVs play in Taiwan's defense strategy, and discuss their implications for the future of U.S.-Taiwan defense and security relations.

The Chinese Political-Military Challenge to Taiwan

A discussion on Taiwan's defense strategy naturally starts with a description of the threat. At the 18th Chinese Communist Party Congress in November 2012, Xi Jinping replaced Hu Jintao as the General Secretary of the CCP and became the most powerful politician in China. According to authoritative Taiwan military sources, Xi pledged to his CCP peers that he would continue the Taiwan policy of former Chairman Hu and ensure the PLA was prepared for a possible offensive war against Taiwan by the year 2020.[5] Reportedly, Xi did not commit to using the military option as soon as it was ready, but did make clear that he wanted all future options on the table, including invasion.[6]

On December 31, 2015, the PRC began a sweeping military reform and reorganization program. The stated objective of this program was to produce a joint force capable of fighting and winning China's future wars. According to the writings of PLA strategists and military theorists, the CCP's foremost modernization objective is preparing to conquer Taiwan while deterring, delaying, or destroying U.S. military actions to assist in the defense of the island. This mission is something authoritative Chinese military writings refer to as China's "Main Strategic Direction (主要战略方向)."[7]

Policy Statements and Provocations

On January 2, 2019, Chairman Xi declared on Chinese state television that the annexation of Taiwan was necessary for the fulfillment of China's "great rejuvenation." He stated that he would not renounce the use of force and said that "Taiwan independence will lead to a dead end."[8] In July 2019, the CCP released a defense white paper that reiterated Chairman Xi's speech, stating:

> Solving the Taiwan problem and achieving complete national unification is in the fundamental interest of the Chinese. It is obviously necessary for achieving the great Chinese rejuvenation … China must be unified and obviously will be … If anyone splits Taiwan off from China, China's military will pay any price to totally defeat them.[9]

These statements of policy have coincided with a significant military buildup and marked increase in the frequency and bellicosity of PLA exercises in the Taiwan Strait area. In September 2019, the ROC Ministry of National Defense (MND) released a national defense report that concluded:

> So far, the PRC has never renounced the use of force against Taiwan, and one of its major combat preparedness objectives is to invade Taiwan. For the past few years, the PRC has been procuring weapons and conducting combat training and drills specifically aiming for a Taiwan scenario. Now, it is capable of initiating joint blockades and joint firepower strikes against Taiwan, and is posing severe challenges to our defense preparations and defense operations.[10]

In November 2019, the ROC Minister of Defense Yen Teh-fa (嚴德發) testified before the Legislative Yuan, Taiwan's parliament, that China had carried out approximately 2,000 sorties of military aircraft over the Taiwan Strait during the past year. He noted that on one occasion, the PLA directed two fighters across the center line of the Taiwan Strait in an escalation of regional tensions.[11] He further stated that the Liaoning (CV-16), the PLA Navy's first aircraft carrier, had transited through the Taiwan Strait on no less than nine occasions since being commissioned in

2013.[12] Minister Yen concluded that MND expected the threat from China to worsen.[13] This statement was soon borne out by events.

Two weeks before Taiwan's January 11, 2020, presidential and parliamentary elections, the PLA sailed its second aircraft carrier, the Shandong (CV-17), through the Taiwan Strait.[14] In late January, after the elections, the PLA flew a formation of Su-30 fighters and Y-8 intelligence aircraft through the Bashi Channel south of Taiwan, prompting the ROC Air Force (ROCAF) to scramble fighter jets in response.[15] Two days later, a formation of H-6 bombers and KJ-500 airborne early-warning and control (AEW&C) aircraft flew through the Bashi Channel to airspace east of Taiwan.[16]

In February, the PLA carried out a series of large-scale air and naval exercises in waters southeast of Taiwan.[17] During the exercises, PLA bombers circumnavigated the island, and fighter aircraft crossed the Taiwan Strait center line, resulting in a tense aerial standoff with ROCAF F-16 fighters.[18] Shortly thereafter, a CCP-controlled propaganda outlet reported that the PLA was going to procure 1.4 million sets of body armor, and linked the announcement with a Taiwan invasion scenario. According to the report, the "PLA is striving to enhance its combat readiness and preparing for military conflicts, potentially against Taiwan secessionists and U.S. provocations."[19]

On March 16, 2020, an unspecified number of PLAAF J-11 fighters and KJ-500 airborne early-warning aircraft conducted maneuvers within Taiwan's air defense identification zone (ADIZ), briefly crossing the center line.[20] According to MND, this was the first time PLA aircraft had flown near Taiwan's airspace at night.[21] Later in March, it was reported that the PLA had conducted four drills that MND considered unusually threatening and provocative.[22] On April 10, 2020, PLA fighters, bombers, and early-warning aircraft reportedly carried out a large-scale military exercise near Taiwan. A PLA spokesperson was quoted by CCP-controlled propaganda outlet as saying the drills "were a part of preparations for the potential military struggle against the island of Taiwan."[23] Shortly thereafter, a formation comprised of the Liaoning (CV-16) and five other PLA warships passed through the Miyako Strait and sailed past Taiwan's east coast on its way out into the Pacific for exercises.[24]

On May 1, 2020, a commercial flight tracking system monitoring aircraft around Taiwan came under a sophisticated form of electronic intrusion, injecting a false return on radar to display a retrofitted F-16V test flight to make it look like the ROCAF jet had flown to Fujian, and then back to Taiwan. At the same time, other F-16 fighters and military helicopters operating from an airbase in central Taiwan were reportedly jammed.[25] At the time of this writing, PLA amphibious units had begun a summer-long series of landing exercises testing aspects of amphibious landing operations.

Table 1: Selected PRC Provocations (January-June 2020)*		
Date	*Incident*	*Details*
January	Post-election air exercises	PLA directed military aircraft near Taiwan after Taiwan's presidential and legislative elections.[26]
February	Air and naval exercises around Taiwan	PLA held a series of large-scale air and naval exercises in waters southeast of Taiwan.[27] PLA aircraft crossed over the center line of the Taiwan Strait.[28]
March	Maritime clashes	Chinese fishing vessels (possibly maritime militia) clashed with ROC Coast Guard cutters.[29]
March 16	Nighttime PLA flight near Taiwan	PLA directed military aircraft over waters near Taiwan during first nighttime training mission in area.[30]
March 18	Naval exercises near Taiwan	PLA sent four military ships through waters east of Taiwan.[31]
April	Air and naval exercises near Taiwan	The PLA conducted a large-scale military exercise near Taiwan and sent the Liaoning aircraft carrier and other warships to waters off Taiwan's east coast.[32]
May 1	Electronic jamming	PLA reportedly conducted electronic intrusion to distort radar pictures of a ROCAF F-16 retrofit program test flight.[33]
May 8	Air exercises	PLA Y-8 aircraft entered Taiwan's ADIZ before President Tsai's inauguration.[34]
May 14	Reported amphibious exercises	Reports emerged that the PLA planned to conduct major amphibious exercises in August simulating the seizure of Taiwan's Pratas Island.[35]
May	Amphibious exercises	Chinese propaganda outlets reported a PLA amphibious exercise in Guangdong, stating the military was "well positioned to deal with Taiwan secessionists and potential island disputes."[36]
January~ May	Sand dredging	Chinese vessels (possibly maritime militia) illegally dredged sand near the Penghu Islands 1,576 times.[37]
June 4	Amphibious exercises	Two PLA group armies across from Taiwan conducted amphibious exercises.[38]
June	Air exercises	PLA sent multiple aircraft into Taiwan's southwest ADIZ.[39]
*Note that this table is based on open-source reporting and incomplete. To date, the governments of both Taiwan and the United States continue to limit reporting on PLA activity.		

In spite of the COVID-19 (coronavirus disease 2019) pandemic, the PLA has intensified military activity around Taiwan in a bid to create new facts on the ground and alter the status-quo in the Taiwan Strait at a time when other countries are perceived as being distracted.[40] Recent PLA activity in the Taiwan Strait area is consistent with its application of grey-zone tactics against Japan around the Senkaku/Diaoyutai Islands, and in the South China Sea against the Philippines, Taiwan, and Vietnam. For example, PLA exercises have been conducted concurrently with fishing boat harassment of ROC Coast Guard vessels.[41] Whether or not the fishing boats are maritime militia assets remains undisclosed. However, given the nature of recent PLA actions across the Taiwan Strait, the implications of rising tensions in this case could be far more significant and destabilizing than what has been previously observed in other areas.

PLA Infrastructure for a Taiwan Campaign

The PLA maintains a large intelligence, surveillance, and reconnaissance (ISR) infrastructure to support operations directed against Taiwan. The CMC Joint Staff Department is responsible for Taiwan-related contingency planning, real-time emergency management, and control of a wide range of national-level PLA assets. The CMC Joint Staff Department would determine and assign forces to a Taiwan campaign command in the event of a crisis or conflict. The Joint Staff Department Operations Bureau probably manages the CMC national command and control center and oversees a specialized contingency office that appears responsible for coordination with civilian authorities during emergencies.

The PLA Strategic Support Force (PLASSF) provides the CMC and theater-level leaders with space-based imagery, signals intelligence (also referred to as *technical reconnaissance*), navigation and positioning data, meteorological and hydrological services, and other forms of strategic ISR support. The PLASSF national communications system links the CMC with theater commands. The PLA is enhancing the interoperability of the CMC's national-level backbone network and operational-level networks managed by the PLA Navy, Air Force, and the five theater commands. PLASSF communication units leverage fiber optic, microwave, and satellite networks, as well as airborne radio relay systems.

Figure 2: Notional PLA ISR Assets in a Taiwan Strait Crisis. *(Source: Project 2049 Institute.)*

Under CMC guidance and augmented by CMC-assigned units, the Eastern Theater Command (ETC) would comprise the core of a Taiwan-focused operations command.[42] During peacetime, ETC headquarters likely would coordinate operations and training in and around the Taiwan area. During higher readiness conditions, the CMC may assign selected PLASSF assets to a Taiwan campaign command. A dedicated battlespace situational awareness group may be attached to an ETC joint command center to manage fused ISR support to ETC leaders.[43] PLA Army, Air Force, and Navy service components in the ETC also maintain independent ISR capabilities, and all are equipped with UAVs. During the past few years, the PLA has developed more advanced UAV capabilities, including new systems able to combine ISR and strike missions. According to the Department of Defense:

> The acquisition and development of longer-range UAVs are increasing China's ability to conduct long-range ISR and strike operations. Multiple armed UAV types are under development, in testing, or in the initial phases of deployment. In addition, China successfully tested the AT-200, which it claims is the "world's first large cargo UAV."[44]

UAVs providing direct support to operational-level command authorities are likely medium-altitude long-endurance (MALE), and possibly high-altitude long-endurance (HALE), aircraft. In addition to ISR missions, Chinese UAV assets could provide targeting and battle damage assessment (BDA) as well as communications relay support. Based on a "system of systems" approach, ISR sensor data produced by ETC service components is presumably fed into the PLA Integrated Command Platform, a system intended to facilitate joint interoperability.[45] The ETC

Army headquarters in Fuzhou manages the PLA's largest enterprise dedicated to monitoring Taiwanese C4ISR networks. A specialized ETC Army intelligence and reconnaissance brigade was established in 2016 that reportedly is equipped with UAVs. These assets would likely play a critical role in an invasion scenario.[46] Most PLA group armies appear to maintain organic ISR assets, including tactical UAVs. An ETC Army electronic countermeasures brigade also may be equipped with UAVs for airborne jamming missions. During higher states of readiness, coastal defense units in Fujian, Zhejiang, and Guangdong may be assigned to the ETC Army.

The ETC Air Force headquarters in Nanjing oversee a network of ground-based radar brigades and regiments that provide air surveillance over the Taiwan area and beyond. At least two radar brigades are garrisoned opposite Taiwan and provide air surveillance within their respective sectors. Another unit provides airborne early-warning and electronic reconnaissance data. The ETC Air Force maintains a dedicated MALE UAV brigade in the Fuzhou area with elements deployed in various locations in Southeast China. This unit may be augmented with additional UAV assets that provide direct support to the PLA Air Force Staff Department in Beijing.[47] The ETC Navy (East Sea Fleet) headquarters oversees at least one Observation and Communications (OBCOM) brigade that provides maritime surveillance data to theater command authorities. Maritime militia units reportedly augment PLA Navy OBCOM assets. The ETC Navy also manages a radar brigade that provides air surveillance data within its assigned sector off the Zhejiang coast.[48]

The PLA Rocket Force (PLARF) oversees a corps-grade leader command (Base 61) headquartered in the Anhui provincial city of Huangshan. Base 61 coordinates the operations and training of at least five conventionally capable launch brigades opposite Taiwan. In higher readiness conditions, the CMC may assign these and/or other units to the Eastern Theater Command. The PLARF is believed to oversee at least one dedicated UAV regiment that could be assigned to a Taiwan campaign command.[49] UAVs have also been noted supporting China's border and coastal defense system.[50]

UAVs subordinate to the PLASSF and ETC Army, Air Force, and Navy provide critical situational awareness upon which the CMC would base decisions related to readiness and mobilization. CMC-directed changes to readiness levels would be transmitted through the Joint Staff Department and would drive duty officer manning levels at command centers.[51] The 2013 PRC Defense White Paper references an undefined, three-level readiness system and describes readiness work as preparatory activities, such as training and indications and warning (I&W), which are carried out during peacetime conditions and war.

Although speculative, the CMC could direct selected commands or units to elevate to Readiness Level Three in the event of ambiguous activities on or around Taiwan that threatens perceived CCP interests. Designated units ordered to Readiness Level Three could partially implement mobilization plans, expand intelligence and surveillance, expand command post manning, cancel leaves, and initiate logistical and equipment support activities. The CMC could elevate to Readiness Level Two in the event of perceived threats that are clear and direct. Designated units ordered to Readiness Level Two would expand mobilization, hold duty personnel in place, further intensify ISR activities, distribute supplies, and adjust operational plans. Readiness Level One

could be ordered in response to unambiguous war conditions, including an event in Taiwan that could trigger a CMC order for use of force.[52]

Triggers for Use of Force

With the foregoing in mind, an important question to explore in view of the PLA's force modernization is what events might trigger a Chinese launch of UAVs and other strike assets against Taiwan. While it remains unclear under which conditions the CCP leadership would order use of force against Taiwan, the PRC's Anti-State Splitism Law (反分裂国家法) records, somewhat ambiguously, the following:[53]

> The state must undertake non-peaceful actions and other necessary measures to safeguard state sovereignty and territorial completeness if "Taiwan independence" splitist forces under any name, or in any way, should cause Taiwan to be actually split-off from China; or if a major incident should occur that leads Taiwan to be split-off from China; or if the possibility of peaceful unification is totally dead.[54]

The U.S. Department of Defense maintains a list of potential, but uncertain, triggers for a PLA attack on Taiwan. The list includes the following:

- Taiwan formally declaring independence;
- Taiwan making undefined moves toward independence;
- Taiwan suffering from internal unrest;
- Taiwan acquiring nuclear weapons;
- Taiwan indefinitely delaying cross-Strait dialogue on unification;
- Taiwan suffering from foreign intervention into its internal affairs;
- Taiwan having foreign troops stationed on its soil.[55]

PLA military writings that appear to be indicative of doctrine leave unaddressed the specific "red-lines" that could trigger an attack order. Instead, they emphasize the inevitability of the future war, concluding:

> The joint attack campaign against the big island [Taiwan] will be organized and carried out when the unification of the state, and the completeness of its territory, suffer a serious threat and other methods cannot remove this threat. The campaign is strategic and decisive in nature … in the end, only by directly conquering and controlling the island can we achieve national unification.[56]

It appears that the CCP has deliberately left unstated when it would attack Taiwan in order to maximize its diplomatic freedom of action. The consensus opinion of the Department of Defense is that China is likely to defer an attack on Taiwan as long as the CCP perceives the costs of conflict as greater than the benefits *and* believes cross-Strait unification is still possible over the long-term.[57] Unfortunately, as the head of the Defense Intelligence Agency (DIA) hinted in his foreword to the *2019 China Military Power Report*, the perceptions and beliefs of the CCP leadership, and their strategic intentions, are still matters of some uncertainty.[58] Indeed, it is debatable whether or not CCP's intentions can be known at all; even the key decision-makers themselves probably do not know what they would do in any given situation. Nonetheless, Beijing's heated rhetoric, provocative behavior, and military buildup could support a belief that the CCP intends to launch an attack on Taiwan sooner rather than later.

For their part, PLA leaders seem to be working under the assumption that the CCP leadership could at any time decide to use force. They appear to have developed detailed military plans for launching a range of offensive operations against Taiwan. PLA writings indicate that these plans maintain a significant degree of elasticity, allowing theater command leaders to present the CCP leadership with multiple options from which they can select.[59] As time goes on, the PLA's reform and reorganization program, when combined with new weapons systems like strike UAVs, could serve to make the use of force more appealing and lower the threshold for conflict.

On May 1, 2020, the director of Taiwan's National Security Bureau (Taiwan's CIA-equivalent), General Chiu Kuo-cheng (邱國正), testified before the Legislative Yuan that "when the pandemic subsides, Beijing will want to diffuse the domestic pressure it faces over COVID-19, so it might shift the focus from China's internal problems to outside… therefore, Beijing is likely to make aggressive, threatening moves against Taiwan."[60] Changing events in China, then, may trigger a Chinese use of force against Taiwan in the foreseeable future irrespective of whether or not the ROC government has actually crossed any of the CCP's "red-lines."

Potential PLA Course of Action

If the CCP decides to use force against Taiwan, how might that decision manifest? Chinese military options range from coercive use of force at the low end, all the way up to all-out invasion and annihilation at the high end.[61] The strategic objective of coercive operations could be to manipulate the Taiwan public's sense of insecurity, while punishing or isolating the ROC government. Such operations could involve limited mobilization and choreographed military exercises directed at Taiwan, computer network attacks, and isolated kinetic attacks. Examples of kinetic attacks might include the sinking of Taiwanese ships by mines or torpedoes, or firing upon them from the air or surface. Taiwanese planes could be swarmed by UAVs or shot down, and small islands like Kinmen or Matsu could be shelled with artillery or subjected to missile strikes.

More aggressive operations could involve PLA special forces infiltrating into Taiwan to conduct attacks on elected leaders and military commanders, or sabotage missions directed at critical infrastructure targets. PLA writings envision the flexible application of blockade and strike operations to achieve political goals. These operations could seek to cut-off Taiwan's imports, weaken its defense capabilities, and force the ROC government to make compromises to its sovereignty. In addition, the PLA could launch island seizure operations against lightly defended outposts like Itu Aba or Pratas, or it could make amphibious landings against more heavily fortified islands in the Kinmen, Matsu, or Penghu groups.

If the CCP's political objectives were limited, it seems probable that Chinese military operations would be prolonged, but intermittent and characterized by low-intensity attacks, followed by pauses for political negotiations. On the other hand, a sharp burst of unrestrained and unrelenting physical attacks would signal that the CCP intends to invade Taiwan and was softening the island up as a prelude. It is also possible that during a political crisis, the CCP could launch a "bolt out of the grey" invasion of Taiwan, using a military exercise as cover for an amphibious landing campaign designed to achieve the element of surprise. Chinese military planning includes additional operations to deter, delay, and, if necessary, defeat American forces that Beijing anticipates could intervene and come to Taiwan's defense.

Warning Signs

Are Taiwan and the United States able to discern CCP intentions and make emergency preparations for potential Chinese use of military force before it occurs?[62] Early-warning is vital to Taiwan's defense. Without it, the ROC government could be caught off-guard and suffer devastation before it has time to activate continuity of government and critical infrastructure protection plans, mobilize reservists, and move critical units to bunkers, tunnels, and mountain hide-sites. For this reason, PLA writings focus heavily on the application of military deception in a Taiwan scenario, deeming it essential to gaining the initiative at the outset of hostilities.

Today, the PLA is probably capable of launching raids against Taiwan with little or no advanced warning. A single "Pearl Harbor" style UAV swarm strike, missile attack, or small island seizure operation is possible at any time, should the authorities in Beijing desire. Yet, preparations for large military operations could not be completely hidden from view. The more ambitious the PLA's objectives, the less likely that operational security could be maintained against Taiwan and U.S. intelligence collection efforts.

Early-warning intelligence relies on the monitoring of indicators, or pieces of evidence that could indicate preparations for an attack. Indicators could be unusual troop movements, training drills, or mobilization of reserve forces. Defined broadly, indicators are any reports that provide grounds for a belief that the PLA is making ready to commence hostilities or escalate a preexisting crisis to a state of war. They provide insight into China's likely course of action. An indicator is something that the PLA and civil authorities are known or believed to have to do prior to an attack. Lists of indicators, or warning signs, are known as indicator lists.

Table 2 is an example of an indicator list focused on a potential PLA amphibious invasion of Taiwan.

Table 2: Invasion Indicator List*

Category	*Indicator*	*Location and Details*
Readiness	Suspicious leadership meetings	CCP Politburo, CMC, Eastern Theater Command, Fujian Military District
	Establishment of leading small group/joint command for Taiwan	Beijing, Nanjing, Shangrao, and/or Fuzhou areas
	Field deployments: theater missiles	Fujian, Guangdong, Jiangxi, Zhejiang
	Field deployments: air defense units	Fujian, Yangzi River Delta, Pearl River Delta (S-400, S-300, HQ-9)

	Field deployments: PLA Army amphibious, PLA Air Force airborne, and PLA Navy marine brigades	Elements of the 71st, 72nd, 73rd, 74th and 75th group armies, 15th Airborne Corps
	Field deployments: fighter and UAVs	20 major airbases near Taiwan
	Mobilization of reserves and militia	Eastern, Southern, Northern, Central Theater Commands
	Amphibious assault drills	Zhoushan, Pingtan, Dongshan
	Ship and submarine sorties	Eastern Theater Command Navy (Ningbo) Southern Theater Command Navy (Zhanjiang)
	Air and sea traffic restrictions	Major cities (Shanghai, Hong Kong, Guangzhou, etc.)
	Maritime militia drills	Zhejiang, Fujian, Guangdong coasts
	Nuclear and/or directed energy weapon testing	PLASSF Base 21
Logistics	Stockpiling	Oil, gas, coal, food, water, medicine, weapons, animals, etc.
	Blood drives	Fujian and major PLA hospitals across China
	Defense industrial surge	Weapons, munitions, vehicles, aircraft, radios, parachutes, spare parts, etc.
	Port expansion surge	From Jiangsu to Hainan
	Road and rail expansion surge	Zhejiang, Fujian, and Guangdong
	Airport hardening and resiliency surge	Military and civil airfields within 500 miles of Taiwan
	Shipyard production surge	Amphibious assault ships, landing craft, minesweepers, etc.
	Fishing fleets and other commercial ships refitting program	Military radios, gun riveting, fire-fighting equipment
	Coastal fortification projects	Fujian's offshore islands
Recon	Intelligence ships and aircraft activities	Taiwan Strait area

	Emergency satellite launches	Jiuquan, Taiyuan, Xichang, etc.
	Orbital changes	For increased PLA coverage of Taiwan Strait area and beyond
	Human intelligence operations	Worldwide, with special focus on Taiwan and the U.S.
Propaganda	Broad propaganda campaign and social media injections	Strident themes
	Influence operations	Worldwide, with special focus on Taiwan, the U.S., and Japan
	Diplomatic messaging operations	Worldwide, with special focus on the U.S. and Japan
	Nuclear blackmail	Media and personal contacts
Subversion	Sabotage	Financial, electric grid, water/fuel supplies
	Abduction or assassination attempts	ROC President and other key leaders and their families
	Gang-related violence	Night clubs, prison breaks, police stations
	Violent protests, rioting, strikes	Near Presidential Office in Taipei
	Smuggling and infiltration	Taiwan (gun-running, intelligence agents)
*Note that this list is notional and does not include every indicator of potential invasion.		

In recent years, China's improved military capabilities have been accompanied by a raft of state security measures, which make countering foreign intelligence collection a top priority.[63] The result of Chairman Xi's policies has been for China to become a high-tech police state and a closed society. The PLA's growing mastery over the peacetime electro-magnetic battlespace further protects it from outside observation. Barring significant improvements in Taiwanese and American early-warning capabilities, it seems increasingly likely that the PLA will be able to confidently consider its prospects in launching a large-scale surprise attack. The next section of our report will address how Taiwan is positioning itself to keep that from happening.

Taiwan's Defense Strategy

What is the ROC's political-military strategy for deterring a potential CCP decision to use military force against Taiwan? In the event that deterrence fails, how does Taiwan envision conducting self-defense operations? Which UAVs and other unmanned systems are currently available or under development in Taiwan and how would they contribute to Taiwan's defense and security goals?

Taiwan's National Security and Defense Strategy

Despite the significant challenges it faces, Taiwan does not appear to have a published national security strategy.[64] However, the ROC government's strategic objective is presumed to ensure Taiwan's continued existence as an independent and sovereign state within its current constitutional framework. The development of a public security strategy is complicated by divisions within Taiwan's society over the long-term relationship with authorities in Beijing (e.g. maintenance of the status quo, unification or formal independence, as well as the pace of the current interactions). Taiwan relies on a variety of instruments — political, military, economic, and cultural — to guarantee its national survival.

Taiwan's Ministry of National Defense has principal responsibility for ensuring the country's defense against PRC use of military force. According to MND, Taiwan's defense policy "is aimed at utilization of comprehensive national power to establish national defense military force, to assist disaster prevention and relief, safeguard national security and maintain world peace."[65] In addition to countering coercive uses of force, Taiwan seeks to deny or complicate the PLA's ability to invade, occupy, and hold the island. The ROC can be classified as a "status quo" state because it is content with its existing territory and concerned only with preserving its security and maintaining its democratically elected government. Taipei advances its strategy by convincing Beijing that the costs of any conflict would outweigh the desired benefits.[66]

National security and defense leaders in Taiwan rely on ISR for indications and warning of a PLA use of force. Taiwan has a graduated system of readiness postures that are likely tied to those of the PLA. Taiwan traditionally adopted three general readiness phases.[67] In 2003, to facilitate the transition to a higher states of emergency preparedness, Taiwan shifted to a system of two general readiness conditions: normal and emergency. The ROC President and Minister of Defense, working through the Chief of the General Staff, would reportedly maintain tight control in any transition. During normal readiness conditions, Taiwan military units maintain a routine level of readiness.[68]

While maintaining a normal state of readiness, Taiwan's president and national security team could direct a "Phase One Alert" in response to an elevation in the PLA's readiness level, or increased PLA activity opposite Taiwan. In this event, Taiwan's armed forces would increase ISR activities, cancel leave, and heighten security of critical infrastructure. Elevation to a "Phase Two Alert" reportedly could be in response to PLA activity in known staging areas along the coast.[69]

Transition to the second general state of readiness could be implemented through a presidential "Combat Ready Order" in the event of unambiguous indications and warning of a CCP decision

to use force or in the event of an unintentional incident that could escalate into conflict. If sufficient grounds exist to believe that a PLA invasion is coming, the ROC President may issue an "Emergency Order" directing the government and military to execute their plans for full national mobilization and a temporary state of martial law, in accordance with the ROC Constitution.[70]

The Overall Defense Concept

The Overall Defense Concept (整體防衛構想, ODC) is Taiwan's public defense strategy for ensuring readiness to deal with a potential invasion. Developed by then ROC Chief of the General Staff, Lee Hsi-min (李喜明), the ODC was formally introduced in MND's 2017 *National Defense Report* and further detailed in the report's 2019 iteration.[71] In April 2019, President Tsai Ing-wen expressed her support for the concept.[72] The ODC seeks to achieve Taiwan's strategic goal of "resolute defense and multi-domain deterrence" in a resource-constrained environment. The ODC guides military force development and joint operations, emphasizing Taiwan's natural advantages, civilian infrastructure, and asymmetrical capabilities to deter or, if necessary, defeat PLA use of force, including amphibious invasion.[73]

While many aspects of the ODC are classified, it is known to be premised on two basic assumptions: (1) the CCP aspires to annex Taiwan; and (2) the worsening resource imbalance across the Taiwan Strait can be offset by seizing upon Taiwan's capacity for innovation. According to estimates by the U.S. Department of Defense, PLA expenditure last year topped U.S. $250 billion, dwarfing Taiwan's latest defense budget of $11 billion.[74] To mitigate budgetary constraints, the ODC stresses the effective allocation and management of Taiwan's resources. The objective of ODC is to deny the PLA the ability to successfully invade and exert political control over Taiwan. The ODC envisions Taiwan adopting an asymmetric defense posture and fielding forces capable of overcoming a stronger enemy. The ODC aims to shape Taiwan's force buildup and concept of operations. Force buildup outlines the elements and capabilities that maximize the ODC's advantages, whereas the concept of operations delineates how the strategy will be executed during an invasion.

The ODC's three tenets for force buildup are force preservation, traditional capabilities, and asymmetric capabilities. Taiwan's military must retain the ability to defend itself and strike back after a PLA air and missile campaign and cyber operations. Force preservation relies on mobility, camouflage, concealment, deception, electronic warfare, redundancy, rapid repair, and blast mitigation. Traditional weapon systems are effective at countering the PRC's grey-zone tactics during peacetime and periods of high tension. They are needed for patrolling Taiwan's territorial skies and waters while maintaining the capacity for deep interdiction. The high visibility of traditional systems positively impacts Taiwanese morale and improves public confidence in the military, while at the same time countering PLA coercion and complicating political warfare operations and decision making in Beijing. The essence of Taiwan's traditional capabilities is a low quantity of large, high-quality platforms such as advanced fighters, destroyers and submarines, and tanks. They are strategic in nature: focused not only on defense but also achieving political effects.

Asymmetric weapon systems, on the other hand, are less visible during peacetime, but essential during combat. They provide non-conventional warfighting capabilities that are aimed at

exploiting Taiwan's natural defensive advantages and the enemy's vulnerabilities during an invasion while delivering maximum tactical impact with minimal effort. Taiwan's asymmetric systems are envisioned as small, mobile, lethal, numerous, and capable of being widely dispersed. They must be cost-effective and easy to develop and maintain, yet resilient and sustainable. They must complicate enemy operations by being difficult to target and counter. The essence of Taiwan's asymmetric capabilities is a large number of small things.[75]

The ODC's objective is to enhance deterrence and, if deterrence fails, defeat a full-scale PLA invasion. The three pillars of its concept of operations are force protection, decisive battle in the littoral zone, and destruction of the enemy at the landing beaches.[76] Force protection enables Taiwan's military to survive and recover from the opening phase of a massive PLA strike campaign so that units can strike back as soon as the enemy is within range. The ODC seeks to bolster the military's ability to withstand pre-invasion bombardment using tactics similar to those of force preservation. Elements of force protection include mobility, camouflage, concealment, deception, dispersion, rapid repair, and blast mitigation.

According to the ODC, ROC military forces would be at their most lethal when the enemy is crossing the Strait and moving through prepared kill-boxes in Taiwan's littoral areas. At this stage in conflict, Taiwan's surviving warships and fighters will attack the enemy in joint actions with coastal defense cruise missiles (CDCMs), UAVs, and air defense units. The ODC seeks to make Taiwan's military ready to conduct joint fire strikes against the PLA with air, sea, and shore assets protected by a layered air defense system.[77] In addition, the ODC envisions blocking the enemy's advance using a layered defense of sea mines, pre-deployed obstacles, swarming fast-attack craft, and missile assault boats. As the enemy approached Taiwan's shoreline, land-based precision-guided munitions and ground forces would provide additional firepower.

Should coercive uses of force fail to achieve the desired political effects, the PLA could attempt to launch an amphibious invasion, physically occupy the island, and impose the Communist Party's will on a vanquished population. To enhance the ROC's ability to defend against the worst-case scenario, the ODC integrates Taiwan's many geographical advantages and civilian resources to augment contingency operations and provide redundancy for Taiwan's military. For example, mobilized civilian reservists can use drones to provide logistics support and localized reconnaissance for the military. Taiwan's reserve force will provide the last line of defense if the PLA succeeds in getting boots on the ground and survives ROC military counterattacks. The ODC envisions Taiwan's government making strategic use of national infrastructure investments that enhance Taiwan's economy and security during both peacetime and wartime. An example would be a government decision to place future offshore wind farms, structures for mitigating coastal erosion, and aquatic agriculture sites in front of those sections of the coastline that are most suitable for enemy amphibious landings.

MND's 2019 *National Defense Report* highlights the role of UAVs in the ODC's concept of operations. The ODC envisions fleets of future UAVs bolstering Taiwan's defense with strategic early-warning, tactical reconnaissance, target acquisition, and coastal fires.[78] According to the report, future UAVs will generate common operational and tactical pictures of militarily essential units and terrain feature data to bolster early-warning and C4ISR.[79] In the littoral zone, high-altitude long-endurance systems would carry out ISR missions supporting joint operations.[80] At

the landing beaches, armed UAVs would boost battlefield reconnaissance and strike capabilities.[81] In addition, ROC military writings envision future UAVs with air-to-surface weapons, electronic warfare suites, and specialized explosives for one-way strike missions.[82]

Since its introduction, the ODC has been tested in Taiwan's annual Han Kuang national defense exercises. In these military exercises, UAVs have been used to enhance Taiwan's joint operations capabilities, primarily in the areas of battlefield reconnaissance and target acquisition.[83] Both civilian and military UAVs have been used, with civilian UAVs providing short-range ISR support and military UAVs employed for missions that require longer ranges. UAVs have been used for surveillance during anti-aircraft, anti-landing, and close air support operations.[84] During joint exercises, UAVs have been deployed by the ROC Navy for battlefield reconnaissance to inform decision-making.[85] UAVs have applications in the ODC that have not been publicized in military exercises. In addition to reconnaissance and target acquisition, the ROC Navy envisions UAVs providing electronic warfare and maritime interdiction capabilities.[86]

Figure 3: Taiwan's Overall Defense Concept. *(Source: R.O.C Ministry of National Defense.)*

Taiwan's Indigenous UAV Programs

After two decades of research and development (R&D), Taiwan's defense industry has made significant progress in the production of UAVs that can be deployed by military units in the field.[87] This achievement can be attributed to the innovative and resilient culture at Taiwan's National Chung-Shan Institute of Science & Technology (NCSIST) Aeronautical Systems Research Division (ASRD), which is responsible for Taiwan's indigenous unmanned programs. The most prominent NCSIST UAV systems are designed for reconnaissance and strike missions. NCSIST also produces target drones and has programs underway that have the potential to expand Taiwan's suite of combat capabilities. The ROC appears to be investing in R&D and production of at least three UAV systems: Hung Chueh for the ROC Marine Corps and Army, Rui Yuan for the Navy, and Teng Yun for the Air Force. Development of other UAVs are underway, which may offer increasingly lethal capabilities in the years ahead.[88]

Hung Chueh "Cardinal" (紅雀)

The Hung Chueh is a series of hand-launched UAV systems developed by NCSIST. The prototype Hung Chueh I, which resembles the U.S. RQ-11 Raven, was successfully developed in 2009 and the upgraded Hung Chueh II was released in 2011.[89] They are designed for the ROC Marines, ROC Army Special Forces, and Taiwan police units.[90] Capable of staying airborne for 60 to 90 minutes, they carry cameras for video surveillance of target areas. They can land on runways, deploy parachutes for vertical landing, or be captured in arresting nets.[91]

Figure 4: Hung Chueh UAV. *(Source: National Chung-Shan Institute of Science and Technology.)*

The Hung Chueh II system is currently in service with the ROC Marine Corps.[92] Each Hung Chueh II unit is equipped with six aircraft, one ground control station, one antenna, and one set of maintenance and support equipment. They are currently designed for surveillance of offshore islands, field reconnaissance for battalion or company-level units, and exercises in the South China

Sea.[93] MND plans to establish Army and Marine training teams for Hung Chueh UAVs in Hsinchu, with a live-fire training range in Pingtung.[94]

In April 2014, the ROC Navy employed Hung Chueh UAVs in exercises around Taiwan's Taiping (Itu Aba) base in the Spratly Islands. The system transmitted images to the Navy headquarters in Taipei.[95] In 2015 and 2016, the ROC Marine Corps deployed five Hung Chueh UAV units with a total of 45 vehicles (including 15 spare vehicles).[96] From 2017 to 2018, Hung Chueh patrols reportedly identified 167 warships, oil tankers, cargo ships, and fishing boats.[97] In 2017, three Hung Chueh II UAVs crashed into the sea, leaving 27 still available for service.[98]

The "Fire Cardinal" (火紅雀) is a combat variant of the Hung Chueh II reconnaissance UAV.[99] Characterized by its "intelligent object-detection system," it can identify targets by analyzing them using its AI deep-learning function.[100] It is also believed that ground units can use multiple Hung Chueh UAVs to overwhelm nearby enemies' short-range air defenses.[101] Unlike conventional UAVs, the Fire Cardinal reportedly does not require human operators and can navigate, engage, and identify targets autonomously.[102]

Figure 5: Fire Cardinal UAV. *(Source: Wendell Minnick.)*

Rui Yuan "Albatross" (銳鳶)

The Rui Yuan's primary mission is to conduct ISR operations around Taiwan. In 2011, the initial Rui Yuan UAV entered service with the ROC Army Aviation and Special Forces Command Tactical Reconnaissance Group (TRG). By September 2013, 32 Rui Yuan UAVs were reportedly in service with the TRG and deployed to four bases in northern, central, southern, and eastern parts of Taiwan.[103] These UAVs are said to be capable of remaining airborne for 12 hours and patrolling a 373 mile (600 kilometer) radius at an altitude of 15,000 feet (4,572 meters).[104] In September 2017, the ROC Army's Rui Yuan TRG was redesignated as the Maritime Tactical Reconnaissance Group (MTRG) and transferred to the ROC Navy.[105]

Figure 6: Rui Yuan UAV. *(Source: Liberty Times.)*

A basic Rui Yuan unit consists of four aircraft, one launch and recovery section, one ground control station, a transport vehicle, and an information transmission system.[106] Pilots manage the take-off and landing of the aircraft, while operators provide parameters to the pilots and transmit collected information to the command center.[107] The Rui Yuan system is designed for day-and-night reconnaissance, target acquisition and tracking, battlefield damage assessment, communications relay, and artillery spotting.[108] Rui Yuan UAVs are reportedly deployed to bases in Pingtung and Taitung.[109]

After several years of trial and error, Rui Yuan UAVs appear to have become an increasingly reliable ISR asset. From 2017 to 2018, Rui Yuan UAVs identified 730 warships, oil tankers, cargo ships, and fishing boats.[110] On January 24, 2019, the ROC Navy revealed that Rui Yuan UAVs had been deployed to monitor a PLA Type 815 surveillance ship, Beijixing (AGI-851).[111]

The Rui Yuan UAV is said to have attracted the attention of potential foreign customers, although no foreign sales have been reported to date.[112] Rui Yuan UAVs require a short runway length of 985 feet (300 meters) for take-off. However, its use in ROC military training, exercises, and operational missions has thus far been limited by air traffic control restrictions.[113] The ROC Navy has reported a shortage of qualified operators due to the difficulty of recruiting and training new personnel.[114] As of May 2020, Taiwan had 26 Rui Yuan UAVs in service (six were lost in accidents), and all remaining aircraft had been upgraded to address mechanical issues.[115]

Chien Hsiang (劍翔)

The Chien Hsiang is a loitering anti-radiation UAV developed by NCSIST.[116] These systems are designed to strike radar-emitting targets.[117] Individual aircraft are launched from truck mounted cells. In August 2019, the Chien Hsiang system reportedly achieved an initial operational capability.[118] Notional wartime targets could include amphibious assault ships, destroyers, air surveillance radars, maritime surveillance radars, and surface-to-air missile (SAM) radars.[119]

Figure 7: Chien Hsiang UAV and Launch Vehicle. *(Source: Wendell Minnick.)*

After the PLA procured a similar system from Israel, the Harpy UAV, NCSIST initiated R&D into an indigenous anti-radiation UAV. With an appearance similar to the Harpy, NCSIST integrated the Tien Chien-IIA anti-radiation missile seeker technology into existing UAV projects.[120] In 2011, the Chien Hsiang had its first successful test flight.[121] In 2017, NCSIST debuted the system and announced a successful engagement against a target ship and passed a design review that could lead toward an initial operating capability (IOC).[122] In 2019, NCSIST announced a six-year plan to produce 104 Chien Hsiang UAVs.[123]

Figure 8: Individual Chien Hsiang UAV. *(Source: Wendell Minnick.)*

According to NCSIST, the Chien Hsiang UAV will be assigned to the ROC Air Force to suppress land- and sea-based radar systems.[124] They are currently deployed on road-mobile launch vehicles. Each vehicle can carry 12 UAVs. Future variants could be deployed on naval ships.[125] The potential attack modes include "suicide attacks" and broad-area strikes with high-explosive shells. Once launched, Chien Hsiang UAVs will not be recovered.[126] If an enemy radiation source disappears after launch, they will loiter either until the target is found (e.g. the enemy radar is switched back on) or until they run out of fuel.[127]

Teng Yun (騰雲)

The Teng Yun is a medium-altitude long-endurance (MALE) UAV that has been compared to the American MQ-9 Reaper.[128] In August 2019, NCSIST announced the first operational Teng Yun aircraft would be completed by December 2019, with testing scheduled to begin in early 2020. MND plans to assess the Teng Yun's combat capabilities in 2021.[129] Designed for service in future ROCAF reconnaissance squadrons, Teng Yuns will reportedly be capable of ISR, electronic warfare, and land-attack missions.[130] MND plans to acquire 12 to 20 Teng Yun UAVs.[131]

Figure 9: Teng Yun UAV. *(Source: Wendell Minnick.)*

Considered a strategic asset, the Teng Yun is designed to conduct reconnaissance missions as far as the Chinese province of Jiangxi.[132] Prototype development began in 2009.[133] In 2015, NCSIST exhibited the prototype at a defense expo, and MND officials expressed interest in equipping the system with weapon systems such as machine guns, air-to-ground munitions, and air-to-air missiles.[134] In February 2017, NCSIST indicated that the Teng Yun could carry munitions, such as the AGM-114 Hellfire.[135] Officials have also suggested that the Teng Yun has been equipped with an electronic warfare system capable of surveillance and jamming.[136]

In August 2017, NCSIST exhibited launchers that could potentially allow the aircraft to carry Tien Chien I air-to-air missiles and Wan Chien air-to-ground munitions.[137] In 2019, NCSIST stated that the Teng Yun had enhanced its engine thrust, increased payload capacity, improved sensor resolution, upgraded its electronic warfare capabilities, and extended its loiter time. Also, the upgraded Teng Yun prototype introduced functions including automated take-off and landing, satellite navigation, and redundant systems to increase the reliability of its navigation.[138] It is envisioned that each ground control station will be able to control four connected Teng Yun UAVs and also link with to manned aircraft.[139] In 2017, NCSIST's Missile and Rocket Systems Research Division initiated R&D into a laser-guided, remote-controlled, 2.75-inch rocket for the Teng Yun

UAV.[140] NCSIST is reportedly developing variants with a reduced radar cross section, anti-jamming, and anti-icing designs, and upgraded navigation and data link control technologies.[141]

Future UAVs

Looking ahead, Taiwan's 2019 *National Defense Report* asserts MND will "acquire autonomous high-resolution military reconnaissance systems, generate a picture of militarily essential and terrain feature data, and expand intelligence support capacity."[142] UAVs in this category would contribute to a network of early-warning ISR systems, giving military commanders the ability to better anticipate enemy intentions and ensure that ROC armed forces could survive and recover from a first strike.

According to the report, if the PLA made an invasion attempt, MND envisions future UCAVs with tactical and surveillance applications to monitor incoming adversary targets and destroy them at the landing beaches."[143] MND is also developing the Chien Bing (尖兵) UAV to be used on naval vessels for anti-submarine warfare (ASW). Based on the Rui Yuan model, the system would be launched by catapult and recovered by arresting wires on the ship.[144] The Chien Bing is expected to be equipped with synthetic aperture radar (SAR).[145] In 2019, MND began a four-year program to fund NCSIST's R&D on small suicide combat drones, dubbed Chi Chun (奇隼).[146]

Future Opportunities for Cooperation Between the U.S. and Taiwan

UAVs equipped with interoperable systems could give Taiwan an expanded role in the United States' free and open Indo-Pacific strategy. This section will address future information sharing and other defense and security-related exchanges between the U.S. and Taiwan, with an eye to seizing opportunities to bolster Taiwan's ability to deter CCP use of force.

Deterrence by Detection

American defense strategists at the Center for Strategic and Budgetary Assessments (CSBA) have developed a concept called "deterrence by detection," which is applicable to the defense of Taiwan. This operational concept envisions deterring Chinese aggression by using a network of non-stealthy, long-endurance UAVs to monitor key geographic areas like the Taiwan Strait.[147] The concept of "deterrence by detection" is premised on the logic that adversaries (in this case CCP and PLA decision-makers) are less likely to take risks and engage in opportunistic acts of aggression "if they know they are being watched constantly and that their actions can be published widely."[148]

Taiwan and the United States currently appear to rely on a relatively small number of exquisite ISR capabilities to monitor Chinese activities across the Taiwan Strait. These capabilities are highly specialized and sensitive. Given their nature, they are unlikely to produce evidence of CCP aggression that could be published widely without fear of revealing secrets to the adversary. Examples of ISR systems in this category include reconnaissance satellites, signals intelligence (listening posts and cyber intrusions), and surveillance radars.[149] Other less-sensitive platforms, like fighters equipped with cameras, can take images for public-release, but this is an expensive way to collect ISR. Moreover, fighters can only provide periodic coverage of Chinese activities of concern. Flying them in this role increases the risk to their pilots, takes them away from more important missions, and degrades their wartime readiness levels.

From the U.S. perspective, Taiwanese UAVs capable of contributing to a common operational picture could reduce the burden placed on finite American aircraft. From Taiwan's perspective, its inclusion in an American-led regional security network would have considerable political and military benefits. If Taiwan is able to rapidly deploy MALE UAVs and network them with compatible American systems and large numbers of its own indigenous UAVs, it could transform the Taiwan Strait battle space and contribute to broader strategic stability.

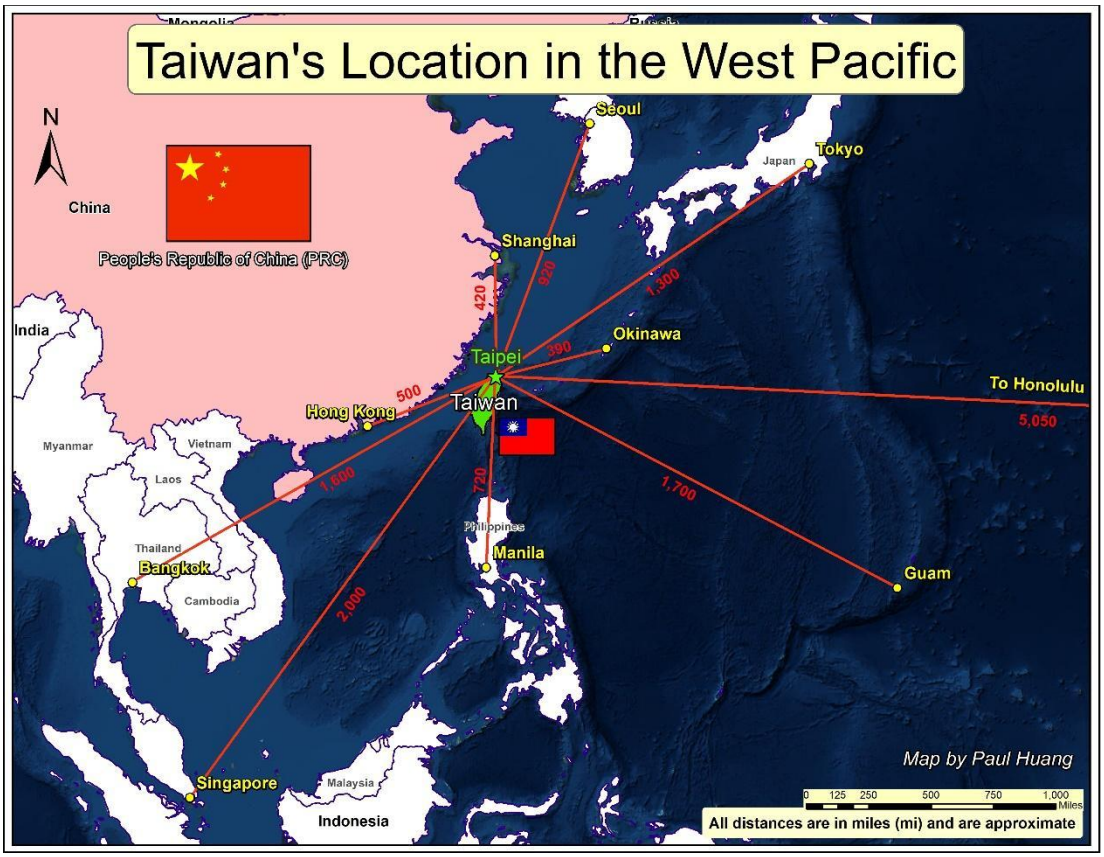

Figure 10: Distance from Taiwan to Key Locations in Region. *(Source: Project 2049 Institute.)*

Operational Missions

Taiwan's emerging UAV force could be employed across a broad range of operational missions in support of the Overall Defense Concept. In peacetime, they could carry out persistent, extended range surveillance of coastal areas to watch for indications and warning of hostile intent. When PLA bombers, fighters, drones, warships, or submarines conduct exercises or approach Taiwan, UAVs could be used to assess their capabilities and intentions. When needed, they could support ROCAF fighter aircraft making interceptions, serving in effect as their wingman. The ROC Air Force has also studied how UAVs could support humanitarian assistance and disaster relief (HA/DR) missions.[150]

During a crisis, Taiwanese UAVs could be used to counter a PLA maritime blockade and air and missile campaign. Over time, they could carry out ASW missions, identify and clear sea mines, and defend against limited air and missile strikes. They could execute electronic countermeasures to jam enemy communications and disrupt guidance systems. They could carry out deception operations, mimicking air activity in one area to confuse enemy commanders and distract them from friendly operations in another area.

In a worst-case PLA invasion scenario, Taiwan UAVs able to launch from trucks or non-traditional runways could conduct defense counterstrike operations against targets along the PRC coast to knock out the enemy's power grids, communications networks, and forward command posts. In addition, they could swarm vulnerable ships and helicopters as they prepare to make amphibious

landings and air assaults on Taiwan. Moreover, they could serve as forward air control assets, ensuring the safety of friendly forces and noncombatants in strike areas. They could also serve as a backup ISR and communication relay systems after Taiwan suffers heavy missile strikes, giving commanders the ability to see the battlespace and coordinate defense operations through the fog of war. UAVs could serve as scouts for coastal defense cruise missiles, rocket artillery, and tube artillery units, and provide armed reconnaissance in support of ground troops. Small UAVs could support units engaged in urban warfare against PLA special forces and Fifth Column agents.

The U.S. military could support ROC military efforts to increase their lethality and deter aggression — a potentially transformational defense effort — by deploying specialized liaison officers on long-term missions. Interoperable UAVs could allow U.S. and Taiwanese political and military leaders to seamlessly and continuously communicate with each other and share sensor data in near real-time. To this end, the U.S. Indo-Pacific Command and ROC armed forces should consider integrating UAVs into their future joint training drills and operational readiness exercises. UAVs could decrease the burden on the ROCAF's current and future inventory of F-16s and other advanced fighters in reacting to PLAAF flights operating within Taiwan's ADIZ.

In the coming five to ten years, UAVs are going to transform the security situation in the Taiwan Strait. Military analysts from the U.S. and Taiwan could conduct joint studies on possible future scenarios based on the proliferation of unmanned systems on both sides of the Strait. The U.S. and Taiwan can be expected to use their UAVs in support of joint HA/DR operations. As their defense and security ties deepen over time, they could consider jointly conducting ASW, counter-piracy, counter-terrorism, air and missile defense, and counter-amphibious landing operations.

Foreign Military Sales and Services

To augment its indigenous capabilities, Taiwan may seek to acquire proven UAV systems from the United States or other potential suppliers. Systems could include remotely piloted aircraft and associated engines, mobile ground control stations, satellite communications and other over the horizon tactical data links, synthetic aperture radar and other sensors, embedded GPS units, and spare parts.[151] A potential transfer through U.S. Foreign Military Sales (FMS) channels would further enhance Taiwan's ISR capabilities and increase latent interoperability between U.S. and Taiwan defense establishments. FMS programs to date have included both NATO and key non-NATO allies such as Japan, Australia, and India.

American UAV systems offer diverse payloads, significant electrical power, and relatively small mission and avionics sub-components. UAV systems potentially have a maximum altitude of 40,000 feet, endurance of more than 30 hours, speed of 210 knots, and more than a half dozen external hard points. Aircraft are able to conduct military and civilian missions, including coastal surveillance and HA/DR. Equipped with over the horizon communications and tactical data links, American UAV systems are an integral node in a reconnaissance-strike complex. A notional system, consisting of six aircraft and five ground control stations could allow Taiwan's armed forces to maintain 24/7 coverage of the waters surrounding the island. Advanced sensor systems enable long-range surveillance, target acquisition, tracking, range finding, and laser guided munitions. Remotely piloted vehicles can be fitted with automatic identification system

transponders to provide positive identification of vessels. The aircraft would also be capable of using the Link-16 military tactical data link.

For the U.S., release of UAVs to Taiwan, should it formally request a sale through FMS channels, would enhance latent interoperability. Exchange of data and sharing of workload in carrying out peacetime surveillance missions is in the interests of the United States.

Export Control Regimes and U.S.-Taiwan Cooperation

Export controls are key to ensuring UAVs are kept from the hands of hostile actors and are not used for the proliferation of nuclear, biological, or chemical (NBC) weapons. There are four multilateral export control regimes.[152] The United States is a member of each. Taiwan is not permitted to join, but maintains a control list based on their guidelines.[153] Taiwan's export control guidelines are transparent and made publicly available, in English, by the Ministry of Economic Affairs' Bureau of Foreign Trade (BOFT).[154] The PRC is not a member of any of the control regimes, instead it maintains its own internal control lists, which are partially available and in Chinese only. Despite being a major global supplier of UAVs, the PRC's internal Export Control Law (ECL) remains only in draft form.[155]

Of the four multilateral control regimes, the Missile Technology Control Regime (MTCR) is most relevant to U.S.-Taiwan UAV cooperation. The MTCR (and its 35 voluntary member states) places exports broadly under two categories (Cat. I and Cat. II).[156] UAV exports fall into Cat. I, and are subject to "strong presumption of denial," meaning it is unlikely MTCR members will approve transfers of UAVs to any but the closest of the United States' formal treaty allies (such as the United Kingdom).[157] According to the MTCR guidelines, UAVs are Cat. 1 if they can carry a payload of 500 kilograms to a distance of 300 kilometers or more.[158] In addition, they are Cat. I if there is reason to believe that they will be used for the delivery of NBC weapons.[159]

The mission of the MTCR is important, and its policies should not be adjusted haphazardly. Yet, three circumstances today make reform imperative: (1) China's burgeoning capacity to export UAVs (guided by its own alternative, and incomplete, export control regime); (2) the national security and economic implications of the U.S. being boxed out of the global UAV market and supply chain; and (3) Taiwan's constantly evolving need to bolster military capabilities to defend its democracy from a hostile and increasingly powerful authoritarian neighbor. The across-the-board strong presumption of denial for UAV sales under MTCR is becoming obsolete. Its guidelines are three decades old.

The push for reform is underway. In 2018, the Trump administration eased U.S. internal restrictions on UAV exports.[160] However, the MTCR is an obstacle and reforming its categorical guidelines is still under debate. Proponents of reform, such as Assistant Secretary of State for International Security and Nonproliferation Dr. Christopher Ford, have been arguing for responsible change, reclassifying certain types of UAVs as Cat. II, making them easier to export.[161] MTCR members meet annually for a Plenary Meeting around October.

In assessing avenues for U.S.-Taiwan UAV cooperation in the context of export controls (manifested mainly by the MTCR), perhaps the most important factor to consider is: what is the

purpose of the MTCR? The purpose is simple: to limit the risk of NBC weapons proliferation, especially among hostile actors.[162] The MTCR is a coordination platform; it has no enforcement mechanism save what each individual member state is willing to do. Whether or not the MTCR succeeds in its purpose depends on each member's export control laws and willingness to cooperate and enforce them. In that sense, Taiwan is as much of an MTCR member as any other country, and a critical partner to the United States in the future of UAVs.

Responsibly reforming UAV controls and competing with China is a process; the details (Cat. I vs. Cat II, payloads, flight times, velocities, etc.) remain to be settled. As the United States undertakes this process, it will benefit from the support of like-minded friends. Taiwan, being fully capable of its own UAV production, is a partner that can open doors for U.S. security, humanitarian, and economic (supply chain) cooperation in the Indo-Pacific. The key then, is to engage early. Taiwan can be a partner in this process. U.S.-Taiwan UAV cooperation could be the responsible pacesetter for the entire U.S. alliance network.

Conclusions and Recommendations

If knowledge is power, then Taiwan is well positioned to influence the course of future strategic events in the Indo-Pacific region. The importance of Taiwan's location for collecting and sharing information about China and monitoring adversarial behavior is difficult to overstate. Taiwan's technological prowess and special relationship with the United States have given it access to some of the most advanced ISR and communications technology in the world. To maintain a favorable defensive edge well into the future, the U.S. and Taiwan will have to deepen their bilateral military and security relationship, expanding into new domains of cooperation as part of long-term competition with the PRC.

The following recommendations underscore the importance of exploiting advanced unmanned systems to deter opportunistic acts of aggression and to defeat a broad range of potential PLA uses of force in the event that deterrence should fail. Given the CCP's stated objectives, military buildup, and recent provocations, it seems increasingly imperative that the U.S. and Taiwan advance their partnership in line with both countries' shared strategic interests. Much more can and should be done to ensure the long-term peace and stability of the Taiwan Strait area.

We offer eight recommendations for the consideration of policymakers in Washington and Taipei:

(1) **Expedite a review of ISR systems currently available to support Taiwan's self-defense in accordance with the ODC and the Taiwan Relations Act.** Given the urgency of the threat, policymakers should address shortfalls that undermine Taiwan's ability to mount an effective and credible defense.

(2) **Integrate new systems into Taiwan's defense strategy.** Political and military leaders in Taiwan may consider how to best integrate emerging military and civilian UAV capabilities into the operational inventory to ensure they can field large numbers of tactical aircraft during a crisis. U.S. policymakers should support this effort through a tailored security assistance program.

(3) **Establish a secure common operational picture for ISR and "deterrence by detection."** The U.S. and Taiwan should negotiate the selective pooling of resources in a mutually beneficial manner. An integrated network of unmanned systems could enhance deterrence and reduce risks of miscalculation.

(4) **Test latent interoperability during joint exercises.** Interoperable UAVs could allow political and military leaders in the U.S. and Taiwan to communicate and exchange ISR in near real-time. To this end, the U.S. Indo-Pacific Command and ROC Armed Forces should integrate UAVs into future joint training and operational readiness exercises.

(5) **Plan together.** In the coming five to ten years, UAVs will transform the security situation in the Taiwan Strait. Military analysts from the U.S. and Taiwan should conduct joint studies on possible future scenarios based on the proliferation of unmanned systems on both sides of the Strait.

(6) Operate together. The U.S. and Taiwan should leverage UAVs in support of humanitarian assistance and disaster relief (HA/DR) operations. As defense and security ties deepen over time, both sides should consider how to execute *ad hoc* coalitions, including anti-submarine warfare missions, air and missile defense, and coastal defense operations.

(7) Engage early. The United States' export control laws are evolving. But it is early in the process. The Missile Technology Control Regime is undermined by current developments in the international community. Taiwan has the unique prerequisites (both in terms of internal export controls and UAV manufacturing capabilities) to be a U.S. partner in navigating this process today.

(8) Establish a bilateral working group on UAV supply chain security. It is imperative that the U.S. and Taiwan are able to ensure that their unmanned systems are not infiltrated by adversary military or intelligence operators. To this end, they could establish a bilateral working group on UAV supply chains that is tasked with studying potential threats and making recommendations for mitigating them.

Appendix I: Target Drones

Flamingo II, Spark, and Tien Cheng Target Drones

In 2004, NCSIST Information and Communications Research Division initiated a joint technology development program of target drone Flamingo (火鶴) with Grand Wing (廣營) Servo-tech Co., Ltd. With imported power systems, NCSIST provided the existing UAV technology. Servo-tech was responsible for developing the remote-control system. The prototype Flamingo I successfully passed the test flight after a half-year of development. The Flamingo II was first exhibited in October 2004.[163]

The Flamingo II is designed to simulate aircraft, missile and artillery attacks through infrared homing, radar guiding, and optical guiding.[164] It can carry infrared heat emitters and radar signal boosters.[165]

The Hung Hu "Spark" (虹弧) target drone was developed by NCSIST in 2014 and first exhibited in 2015. It is designed to simulate threats from fighter jets, UAVs, and cruise missiles. It can be used to test surface-to-air or air-to-air weapon systems. NCSIST also has an upgrade planned for Spark including speed enhancement, low-altitude flight, additional payloads like smoke emitters, passive radar augmentation, infrared augmentation and smoke, and l ground and ship launch capabilities.[166]

The Tien Cheng (天成) is another new target drone system developed by the NCSIST Information and Communications Research Division.[167] Designed for simulating targets like fighter jets and cruise missiles, the Tien Cheng can engage in electronic warfare, as well as carry payloads like tow targets and decoy devices.[168]

Specifications of Taiwan's Target Drones			
	Flamingo II[169]	*Spark*[170]	*Tien Cheng*[171]
Length	2.8 m	3.59 m	
Wingspan	2.5 m	1.98 m	
Height	0.6 m	0.61 m	
Empty weight	75 kg		

Maximum take-off weight	90 kg	110 kg	
Payload	25 kg		Large
Max speed	200 km/h	611 km/h	High subsonic
Range	50 km	100 km	
Endurance	1.5 hr	40 minutes	
Altitude	3657.6 m	6,100 m	

Features of Taiwan's Target Drones	
Model	*Features*
Flamingo II[172]	• 30 hp piston 2 cycle engine • Take-off: conventional, catapult • Recovery: conventional, parachute
Spark[173]	• 80 lbs thrust turbine engine • Fuel capacity: 40 liters • The manual and pre-defined way-points flight path • Take-off: pneumatic launcher • Recovery: parachute
Tien Cheng[174]	• Pre-programmed autonomous flight • Constant high-G turnability • Real-time remote control • Target towing • Take-off: rocket assisted take-off (RATO) • Recovery: parachute

Appendix II: Publicly Acknowledged Accidents

Accidents of the Cardinal II System[175]	
Date	*Location*
September 19, 2017	Zuoying, Kaohsiung City
September 29, 2017	Itu Aba/Taiping Island
November 20, 2017	Zuoying, Kaohsiung City

Accidents of the Ruiyuan System[176]		
Date	*Location*	*Cause*
March 7, 2012	Taitung County	Signal disconnection with the ground control station
March 12, 2016	Taitung County	Irregular engine speed
October 27, 2016	Chiayi County	Low-altitude
October 3, 2017	Pingtung County	Failure of thermostat
March 8, 2018	Pingtung County	Failure of the navigation system
May 30, 2018	Taitung County	Low-altitude
January 10, 2019	Taitung County	Failure of gear disc
March 28, 2019	Pingtung County	Failure of the flight control computer

Appendix III: Tables on Taiwan's Combat UAVs

Specifications of Taiwan's Combat UAV Systems			
	Teng Yun[177]	*Chien Hsiang*[178]	*Fire Cardinal*[179]
Length	8 m		1.2 m
Wingspan	18 m		2 m
Height			0.6 m
Weight	~ 4,536 kg (10,000 lbs)		6 kg
Endurance	>24 hr	100 hr	
Range	4,000 km	1,000 km	
Max speed		185 km/h	

Features of Taiwan's Combat UAV Systems	
Model	*Features*
Teng Yun[180]	• TPE331 Turboprop Engine • MX-20 Electro-Optical/Infra-Red (EO/IR) High-Definition (HD) Camera • Triple backup power system
Chien Hsiang[181]	• 30 hp Rotary engine • Glass fiber & aircraft camouflage • Control devices enhancing maneuverability at the final phase of flight • No high-explosive warhead • Smaller than PLA anti-radiation UAV
Fire Cardinal[182]	• Twin-propeller • Non-radiative emission payloads • Real-time imagery for target recognition, tracking, and lockdown • Electro-optical and infrared sensor

	• Artificial intelligence target acquisition • Take-off: hand

Taiwan's UAV Program Budgets			
Date	*Program*	*Budget (NT$ / approx. US$)*	*Quantity*
2006-2011	Rui Yuan[183]	NT$ 3,558,054,000 / US$ 118,601,800	32
2015-2016	Cardinal[184]	NT$ 46,730,000 / US$ 1,557,667	45
2018-2021	Teng Yun[185]	NT$ 3,450,000,000 / US$ 115,000,000	12-20
Unknown	Chien Hsiang[186]	Less than NT$ 15,000,000,000 / US$ 500,000,000	104
2019-2022	Chi Chun[187]	NT$ 493,640,000 / US$ 16,454,667	Unknown

Appendix IV: PLA Activities Around Taiwan, January-June 2020

PLA Navy		
Date	*Vessels*	*Route*
3/18[188]	Type 052D destroyer *Xining* (西宁, 117), Type 054A frigate *Weifang* (潍坊, 550), Type 054A frigate *Anyang* (安阳, 599), Type 903A replenishment ship *Lake Kekexili* (可可西里湖, 968)	West Pacific, Miyako Strait, East China Sea
4/10-13[189]	Type 001 aircraft carrier *Liaoning* (辽宁, 16), Type 052D destroyer *Xining* (西宁, 117), Type 052D destroyer *Guiyang* (贵阳, 119), Type 054A frigate *Zaozhuang* (枣庄, 542), Type 054A frigate *Hengyang* (衡阳, 568), Type 901 fast combat support ship *Lake Hulun* (呼伦湖, 965)	Miyako Strait, West Pacific, Bashi Channel, South China Sea
4/22-30[190]	Type 001 aircraft carrier *Liaoning* (辽宁, 16), Type 052D destroyer *Xining* (西宁, 117), Type 052D destroyer *Guiyang* (贵阳, 119), Type 054A frigate *Zaozhuang* (枣庄, 542), Type 054A frigate *Rizhao* (日照, 598), Type 901 fast combat support ship *Lake Hulun* (呼伦湖, 965)	South China Sea, Bashi Channel, West Pacific, Miyako Strait

PLA Air Force and PLA Navy Air Force			
Date	*Aircraft*	*Route*	*Note*
1/23[191]	KJ-500, H-6, etc.	Bashi Channel, West Pacific	
2/9[192]	J-11, KJ-500, H-6, etc.	Bashi Channel, West Pacific, Miyako Strait	
2/10[193]	H-6, etc.	Bashi Channel, West Pacific, Taiwan Strait	Second time in 24 hours; shortly crossing the Taiwan Strait's median line
2/28[194]	H-6	Taiwan Strait, Bashi Channel, West Pacific	
3/16[195]	KJ-500, J-11, etc.	Taiwan Strait (Southwest)	First time approaching Taiwan's ADIZ at night
4/10[196]	H-6, KJ-500, J-11, etc.	Taiwan Strait, Bashi Channel, West Pacific	
5/8[197]	Y-8	Taiwan Strait (Southwest)	
6/9[198]	Su-30	Taiwan Strait (Southwest)	
6/12[199]	Y-8	Taiwan Strait (Southwest)	
6/16[200]	J-10	Taiwan Strait (Southwest)	
6/17[201]	J-10, Y-8	Taiwan Strait (Southwest)	
6/18[202]	J-10, J-11	Taiwan Strait (Southwest)	
6/19[203]	J-10	Taiwan Strait (Southwest)	

6/21[204]	J-10	Taiwan Strait (Southwest)	
6/22[205]	J-10, H-6	Taiwan Strait (Southwest)	
6/26[206]	Undisclosed PLA aircraft	Taiwan Strait (Southwest)	

Appendix V: Other Unmanned Weapons Systems

XTR-101/102 Short Range Defense System

In 2013, NCSIST debuted the single-barrel XTR-101 and twin-barrel XTR-102 short-range defense system (SRDS).[207] The system has shore and vehicle-based variants for ground forces and vessel-based variants for the Navy. Since 2014, NCSIST has test-fired the system on Wuciou of Kinmen County and Pingtung County.[208] XTR-101 and102 SRDS allow the operators to control the T-75 20mm autocannons remotely behind cover.[209] Following the Chiang Nu (強弩) development project from 2016 to 2018, the shore and vessel-based variant passed operational tests in 2018. The system is currently used on Wuciou and the Navy's Kuang Hua (光華) VI-class missile boats. XTR-101/102 SRDS, however, do not meet the Navy's requirements regarding its effectiveness and adaptability.[210]

The Army has appropriated NT$ 725,240,000 (approx. US$ 24,174,667) for 2019 to 2021 to procure six sets of XTR-102 SRDS, including 12 turrets, six electro-optical sensors, and six C2 systems.[211] The Army will deploy these systems on Dongyin of Matsu (Lienchiang County) and plans to deploy more on Kinmen, Matsu, Penghu County, and the defense area near the Tamsui River estuary. The Navy also purchased three sets of XTR-101/102 SRDS with a budget of NT$ 225,733,000 (approx. US$ 7,524,433) and plans to deploy the shore-based variants to the Marine Corps on Wuciou from 2019 to 2020.[212]

Gang San/Tan An Coastal Defense Rocket System

The Kang San (鋼鐵) or Tan An (灘岸) coastal defense rocket system (CDRS) was developed by NCSIST and first exhibited in 2015. Resembling Taiwan's Thunderbolt-2000 Multiple Launch Rocket System (MLRS), Kang San CDRS can be installed on fixed launch sites or mobile vehicles.[213] The Kang San CDRS is equipped with 12x7 multiple rocket launchers capable of concentrated fire, as well as electro-optical cameras for all-weather operations. Additional capabilities include target acquisition, target lock-on, and ballistic/gun order calculation.[214] In 2017, MND proposed that the Coast Guard Administration may deploy Kang San CDRS and XTR-101/102 SRDS on Itu Aba (Taiping Island) in the South China Sea.[215] In 2020, Kang San CDRS was modified as the Chen Hai (鎮海) Rocket System, which will be equipped on the Coast Guard Administration's patrol boats.[216]

San-Juen Short-Range Defense Weapon System

NCSIST exhibited the San-Juen Short-Range Defense Weapon System (複合式火箭系統) in 2018, which integrates XTR-101/102 SRDS, Gang San CDRS, radar, and electro-optical systems. Operators can have multiple rocket selection and options between fixed launcher sites or mobile vehicle launchers to initiate concentrated attacks against landing crafts or amphibious vehicles.[217] The system has not yet been deployed.

Specifications of the XTR-101/102 SRDS and Gang San CDRS		
	XTR-101/102 SRDS[218]	*Gang San* CDRS[219]
Ammunition	T-75 20mm guns	Kestrel (紅隼) anti-armor rocket[220] - Length: 46.5 cm - Weight: 2.4 kg - Effective range: 1,200 m - Kill radius: 35 ~ 40 m
Weight		1,500 kg
Train limit	360°	330°
Elevation limit	-15° ~ 85°	-10° ~ 60°
Angular speed	60° / sec	60° / sec

Yung Wu Target Unmanned Target Vessel System

Debuted in 2017, the Yung Wu (勇武) Unmanned Target Vessel System is an unmanned surface vehicle (USV) developed by NCSIST.[221] Navigated through unmanned, remote, or manned control systems, the Yung Wu USV is equipped with a radar frequency simulator and jammer, heater, flame thrower, and radar signal reflector.[222] Yung Wu USVs possess electronic countermeasures capabilities including jamming, relay, and reconnaissance. They can also be used in live-fire exercises.[223] On the basis of Yung Wu USV development, there may be further development of combat or reconnaissance USVs.[224]

Hui Lung Unmanned Underwater Vehicle

According to *Up Media*, NCSIST was assigned the Hui Lung (慧龍) Project from MND to develop prototypes of unmanned underwater vehicles (UUVs). Directed by the Shen Lung (神龍) Project Group — which is responsible for Taiwan's Indigenous Diesel Submarine program — the five-year Hui Lung Project will begin in 2020 with a budget of NT$ 3,660,000,000 (approx. US$ 122,000,000). The Phase 1 prototype UUVs, approximately 20 to 30 meters long, will resemble the Boeing Orca UUV, and will focus on surveillance, demining, and electronic warfare capabilities. Pending the success of the Hui Lung Project, there may be further developments of combat UUVs.[225]

List of Acronyms

A&M	Agricultural and Mechanical
ADIZ	Air Defense Identification Zone
AEW&C	Airborne Early-Warning and Control
AI	Artificial Intelligence
ASW	Anti-Submarine Warfare
BDA	Battle Damage Assessment
BOFT	Bureau of Foreign Trade
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CCP	Chinese Communist Party
CCTV	China Central Television
CDCM	Coastal Defense Cruise Missile
CDRS	Coastal Defense Rocket System
CMC	Central Military Commission
COVID-19	Coronavirus Disease 2019
CSBA	Center for Strategic and Budgetary Assessments
DIA	Defense Intelligence Agency
ECL	Export Control Law

EO/IR	Electro-Optical/Infra-Red
ETC	Eastern Theater Command
FMS	Foreign Military Sales
GPS	Global Positioning System
HA/DR	Humanitarian Assistance and Disaster Relief
HALE	High-Altitude Long-Endurance
HD	High-Definition
I&W	Indications and Warning
IOC	Initial Operating Capability
ISR	Intelligence, Surveillance, and Reconnaissance
KPMG	Klynveld Peat Marwick Goerdeler
MALE	Medium-Altitude Long-Endurance
MASIA	Master of Arts in Asian Studies
MLRS	Multiple Launch Rocket System
MND	Ministry of National Defense
MTCR	Missile Technology Control Regime
MTRG	Maritime Tactical Reconnaissance Group
NATO	North Atlantic Treaty Organization

NBC	Nuclear, Biological, or Chemical
NCSIST	National Chung-Shan Institute of Science & Technology
OBCOM	Observation and Communications
ODC	Overall Defense Concept
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
PLASSF	People's Liberation Army Strategic Support Force
PRC	People's Republic of China
RATO	Rocket Assisted Take-Off
ROC	Republic of China
ROCAF	Republic of China Air Force
SAM	Surface-To-Air Missile
SAR	Synthetic Aperture Radar
SRDS	Short Range Defense System
TATDE	Taipei Aerospace & Defense Technology Exhibition
TRG	Tactical Reconnaissance Group

U.S.	United States
UAV	Unmanned Aerial Vehicle
UCAV	Unmanned Combat Aerial Vehicle
UCLA	University of California, Los Angeles
USAF	United States Air Force
USV	Unmanned Surface Vehicle
UUV	Unmanned Underwater Vehicle

Endnotes

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[54] "The Anti-State Splitism Law (反分裂国家法)," *PRC National People's Representative General Assembly*, March 14, 2005, at http://www.npc.gov.cn/wxzl/gongbao/2005-05/08/content_5341734.htm.

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[56] Cao Zhengrong, Sun Longhai, and Yang Yin (eds.), *Informatized Army Operations* (信息化陆军作战), (Beijing: National Defense University Press, 2015), p. 112.

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[63] For background, see Ma Ruohu (马若虎), "Deeply Implementing Comprehensive State Security, Strongly Building a Legal Organization System for State Security (深入贯彻落实总体国家安全观 大力健全国家安全法律制度体系)," *Xinhua News*, December 4, 2019, at http://www.xinhuanet.com/2019-12/04/c_1125304062.htm; Zhang Hongzhou (张宏洲), "Counter Spy Law of the People's Republic of China (中华人民共和国反间谍法)," *Ministry of National Defense*, December 7, 2017, at http://www.mod.gov.cn/regulatory/2017-12/07/content_4799261.htm; "State Security Law of the People's Republic of China (中华人民共和国国家安全法)," *Ministry of National Defense*, April 7, 2017, at http://www.81.cn/2017gjaqjyr/2017-04/07/content_7553456.htm; and "Internet Security Law of the People's Republic of China (中华人民共和国网络安全法)," *Office of the CCP*

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[65] *Republic of China National Defense Report 2019*, (Taipei, Taiwan: Ministry of National Defense, October 2015), p. 56.

[66] Among various sources, see *Report to Congress on Implementation of the Taiwan Relations Act* (Washington D.C.: Department of Defense, 1999), at https://web-archive-2017.ait.org.tw/en/20001219-pentagon-report-on-implementation-of-taiwan-relations-act.html; and *Quadrennial Defense Review* (Taipei, Taiwan: Ministry of National Defense, 2013), at https://www.ustaiwandefense.com/tdnswp/wp-content/uploads/2020/02/2013-Taiwan-Quadrennial-Defense-Review-QDR.pdf.

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