

戰略與評估

第十五卷

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中國非聲學偵潛技術現況與未來

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摘 要

各國海軍長期以來主要依賴水下聲學技術進行潛艦偵測，其工作原理係運用潛艦航行時產生的噪音，透過信號蒐集、分析處理與特徵提取等過程，判斷潛艦精確位置並支援反潛作戰開展。然而，隨著潛艦降噪技術與艦體設計的優化，其產生的噪音水平已接近於海洋背景噪音，使得聲學偵潛面臨嚴苛挑戰。在聲學效能受限的背景下，非聲學偵潛被視為另一種突破途徑。非聲學偵潛係指不涉及水下聲學運用的另一種偵潛技術，透過潛艦航行時對自然環境擾動產生的物理訊跡進行偵測，例如地磁擾動、電磁效應與生物體激光現象，其可作為傳統聲學偵潛補充手段。近年來，中國積極進行非聲學偵潛技術研究與開發，在電磁感測、水動力分析與遙測影像處理等領域取得初步進展。中國未來若能在非聲學偵潛技術獲得突破，將可改善其長期以來反潛戰力不足困境，透過結合情資融合與人工智慧等賦能技術，將可建立更完善綿密的潛艦偵測網絡。

關鍵詞：反潛作戰、聲學偵潛、非聲學偵潛、解放軍海軍

Discussion on the Current Development and Prospects of China's Non-Acoustic Anti- Submarine Detection Technology

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Abstract

For a long time, navies have relied on underwater acoustic technology for submarine detection by capturing and analyzing noise generated by submarines. However, advances in noise reduction and hull design have brought submarine noise levels close to ocean background noise, making acoustic detection increasingly challenging. Against the backdrop of diminishing acoustic effectiveness, non-acoustic anti-submarine detection has increasingly been regarded as an alternative avenue for technological advancement. Non-acoustic detection provides an alternative by identifying physical traces left by submarines interacting with the environment, such as geomagnetic anomalies, electromagnetic effects, and biological luminescence phenomena. This serves as a complement to traditional acoustic methods. China has made initial progress in electromagnetic sensing, hydrodynamic analysis, and remote sensing image processing. If China can achieve

breakthroughs in this field, it could enhance its anti-submarine warfare capabilities. By integrating information fusion and AI, China aims to develop a more advanced submarine detection network. the SCS during 2021-2024 as well, and the Freedom of Navigation Operations (FONOPs) and the Malabar Exercises are the foci. Lastly, in conclusion, I argue that debates and uncertainties about whether the Quad will evolve into a “mini-NATO” are likely to persist, with India being a critical factor. Nonetheless, the strategic communication function inherent in the dialogue mechanism itself would have a positive role to play.

Keywords: *anti-submarine, acoustic submarine detection, non-acoustic submarine detection, People's Liberation Army Navy*

壹、前言

潛艦係海軍重要水下打擊力量，由於其機動快速並可藉水文進行匿蹤，潛艦無疑係一個典型時敏目標（time-sensitive target），因此如何快速偵知潛艦行蹤就成為反潛作戰的巨大挑戰。若無法有效掌握敵方潛艦踪跡，反潛作戰後續工作包括辨識、追蹤與獵殺等流程亦無法開展。在這種情況下，各國海軍皆投入相當資源進行偵潛技術與裝備研發。長期以來，反潛作戰領域關注的係先進聲納開發與水下聲學及信號處理技術的提升，聲學偵潛主宰了潛艦偵測的發展。然而，隨著潛艦靜音性能不斷完善，水下聲學偵潛技術逐漸面臨瓶頸。美國海軍早在冷戰時期即已投入非聲學偵潛技術研究，由於非聲學訊跡不易量測且存續時間極短，物理限制加上工程瓶頸無法克服，非聲學偵潛在無法取得實質進展情況下遂甚少被人提及。近年來，由於潛艦噪音水平降低，加上現代電子學與感測器技術日新月異，被人遺忘的非聲學偵潛技術再度受到重視，相關研究亦如火如荼進行，未來其可能成為聲學偵潛外的另一種潛艦偵測方式。

近期媒體報導揭露，中國在非聲學偵潛技術開發獲得若干進展，若能將這些實驗室成果轉化為偵潛技術或反潛裝備，不僅有助改善其長期反潛能力不足困境，同時亦為其反潛作戰遂行引入革命性創新手段。本文旨在對中國當前非聲學偵潛技術發展進行探討，除前言與結語外，將分三個部分對此涉及各項議題進行深入分析。首先，將對潛艦航行時各種非聲學訊跡及其在反潛作戰運用進行說明，這是評估非聲學偵潛技術的重要指標，藉此讀者可瞭解非聲學訊跡的物理限制與運用前景。接著，將對中國當前非聲學偵潛技術發展進行探討，聚焦與此領域研究機構與科研項目，這對瞭解其在非聲學偵潛技術能量有所幫助。最後，將對非聲學偵潛技術發展面對的挑戰進行分析，這是各國海軍面臨的共通性技術挑戰，在此部分將對中國解決非聲學偵潛技術困境可能作法進行說明。透過前文相關分析，讀者除可對中國當前非聲學偵潛技術發展有所認識外，亦可對非聲學偵潛涉及的專業領域能有全盤性瞭解。

貳、潛艦航行的非聲學訊跡及其在偵潛作業運用

潛艦水下航行時對自然環境擾動產生了各種不同物理訊跡，除作為聲學偵潛指標的俾葉運轉噪音外，尚有其他各種非聲學型式物理訊跡。這些非聲學訊跡包括電磁效應（electromagnetic effects）、生物體激光效

應（biological luminescence）、水動力位移效應（hydrodynamic displacement effects）與特殊操作環境下非聲學效應。在下文中，將綜整希爾（Richard Hill）等三位學者對此議題相關研究，對非聲學有感現象如何產生及其物理特性進行說明。¹

一、潛艦航行的非聲學訊跡

（一）電磁效應：

潛艦水中航行時產生的電磁效應包括地磁擾動、賈法尼電流（galvanic current）與磁流動力（magnetohydrodynamics, MHD）等現象。這些非聲學物理訊跡產生原因分述如下：

1. 地磁擾動：

潛艦水下運動時因切割地球磁場產生感應電流，此電流會產生一個瞬間磁場，兩者疊加之後使得潛艦所在區域出現地磁擾動。²

2. 賈法尼電流（電化學電流）：³

潛艦艦身與俾葉由不同材質製造，由於具有不同金屬電位，當其在海水運動時由於傳導作用，潛艦在水中就如同一個電池，因此在艦身與俾葉間產生感應電流並形成磁場。⁴

¹ Donald Daniel, *Anti-Submarine Warfare and Superpower Strategic Stability* (Urbana and Chicago: University of Illinois Press, 1986), pp.36-58; Richard Hill, *Anti-Submarine Warfare* (Annapolis, Maryland: Naval Institute Press, 1991), pp.42-43; 史坦菲利克 (Tom Stefanick) 原著，磨作昭等譯，《戰略反潛作戰與海軍戰略》(Strategic Antisubmarine Warfare and Naval Strategy) (台北：海軍學術月刊社，民國 80 年 6 月)，頁 129 至 144。

² James A. Watkins, Magnetic Anomaly Detection Buoy for Detecting Submarine, United States Patent, Patent Number: 6,031,377, February 29, 2000, <https://patentimages.storage.googleapis.com/89/ff/c5/cb72c563ba363f/US6031377.pdf>; Paul M. Moser, *Magnetic Signatures of Submarine I* (Warminster, Pennsylvania: Naval Air Warfare Center Aircraft Division Warminster, June 1994), p. 1, <https://apps.dtic.mil/sti/tr/pdf/AD1012958.pdf>.

³ 胡卓瀚等，《艦艇磁訊跡生成與艦艇磁性抑制技術》，第三十六屆中國造船暨輪機工程研討會、產學論壇暨國科會成果發表會，國立高雄科技大學造船及海洋工程系，2024 年 5 月 18 至 19 日，頁 4。

⁴ Naval Sea System Command, Training Manual Applied Engineering Principles Manual

3.磁流動力現象：

當具導電性的海水在地球磁場移動時，將會產生感應電流並形成一個由海水速度場決定的電磁場，此種現象即磁流動力現象，此效應在潛艦航行艤流中形成，稱為「磁流動力艤跡」。不同於地磁擾動與賈法尼電流，磁流動力效應源自潛艦運動對海水形成的擾動，其強度與潛艦航速、海水導電率、流體運動方向以及地球磁場的交互作用緊密相關。⁵

（二）生物體激光效應：

海洋中有許多生物體會發光，包括細菌、真菌、藻類與海洋動物等，由於此類發光體在潛艦周邊活動時，會受到潛艦移動形成擾流而產生閃光，雙鞭毛蟲（dinoflagellate）係數量最多且分布最廣物種，因此引發美國海軍高度重視，並開始研究其作為非聲學偵潛指標的可能性。雙鞭毛蟲受擾動發光時間僅能維持約半秒鐘，惟其可形成一條長度為潛艦艦身數倍光亮艤跡，此種非聲學訊跡可被太空衛星或低光度成像與照明（low-light-level imaging and illumination, LLLI）系統捕捉。⁶

（三）水動力位移效應：

潛艦航行時形成的水動力位移效應包括五種不同現象，它們相互關聯，各有特色。這五種現象包括近場波浪（位於移動潛艦上方，又稱伯努力丘；Bernoulli Hump）、遠場波浪（卡爾文波；Kelvin Wake）、擾動艤流（turbulent wakes）、內部波浪（internal waves）以及磁流動力現象等等。⁷前文已說明磁流動力現象，下文中將對其餘四項效應形成與特性進行扼要分析。

（Washington, D.C.: Naval Sea System Command, Navy Department, May 2003）, p. 5-24, https://www.navsea.navy.mil/Portals/103/Documents/NNPTC/Electrical%20Eng/applied_ce_v1.pdf?utm_source=chatgpt.com.

⁵ Bo Huang, Zhongyan Liu, Yujing Xu, Mengchun Pan, Jiafei Hu, and Qi Zhang, “Mechanism and Evolution of the Wake Magnetic Field Generated by Underwater Vehicles,” *Ocean Engineering*, Vol. 303, July 1, 2024, <https://www.sciencedirect.com/science/article/abs/pii/S002980182401117X>.

⁶ John A. Strand, Clarence G. Pautzke, and Gordon L. Mitchell, “The Antisubmarine Warfare (ASW) Potential of Dioluminescence Imaging,” *Technical Report 80-1*, ONR/NRL TAC52, January 1980, pp. 3-11, <https://apps.dtic.mil/sti/tr/pdf/ADA084124.pdf>.

⁷ 磨作昭等譯，前引書，頁 129-144；張軍、張效慈、趙峰與洪方文，〈源於水動力學的潛艇尾迹非聲學偵測技術研究之進展〉，《船舶力學》，第 7 卷第 2 期，2003 年 4 月，頁 122-126。

1.伯努力丘：

潛艦水下運動時會造成艦體上方水面隆起，此擾動稱為「伯努力丘」，其波幅大小與潛艦航速平方成正比而與潛深平方成反比，通常水面擾動範圍僅及數個船身。

2.卡爾文波：

如水面艦船般，潛艦水中運動時亦會產生 V 形艫波，其包絡在潛艦運動中心線兩側 19.5 度角範圍內。卡爾文波與伯努力丘性質極相似，其波幅大小與潛艦航速成正比而與潛深成反比，參見表 1-1 不難發現，當潛艦潛深達 300 公尺深度時，幾乎已無水面波浪產生，這些極微波浪將消失於巨大風生波浪中無法進行量測（表 1-1 為美國海軍俄亥俄級戰略飛彈潛艦在不同航速與潛深的近場與遠場波浪振幅）。

表 1-1、美國海軍俄亥俄級戰略飛彈潛艦近場與遠場擾動波幅高度

潛艦潛深 (公尺)	潛 艦 速 度 (節)	伯努力丘波 高 (公分)	卡爾文波波高 (公分) (與潛艦艫部距離)		
			100 公尺	500 公尺	10,000 公尺
30	5	1.1	0	0	0
	12	6.5	0.13	0.10	0.02
	20	19.0	12.0	8.3	2.0
100	5	0.10	0	0	0
	12	0.59	0.001	0.001	0.0001
	20	1.60	1.9	1.3	0.32
300	5	0.01	0	0	0
	12	0.07	0	0	0
	20	0.18	0.02	0.01	0.003

資料來源：史坦菲利克著，磨作昭等譯，《戰略反潛作戰與海軍戰略》（台北：海軍學術月刊社，1991 年 6 月），頁 137；張軍、張效慈、趙峰與洪方文，〈源於水動力學的潛艇尾迹非聲學偵測技術研究之進展〉，《船舶力學》，第 7 卷第 2 期，2003 年 4 月，頁 122。

3.擾動艇流：

潛艦水下運動時會使周圍海水向中心線匯聚，特別是從艦體頂部和底部向後方收縮，這種流動模式遂在潛艦艇部形成擾動艇跡。影響潛艦艇流長度與持續時間的主要因素包括潛艦尺寸、潛艦航速與潛航深度。這三者的數值越大，擾動艇流長度就越長，由於能量耗散變長，持續時間也越長，擾動艇流可偵測性因此大幅增加。

4.內部波浪：

海水由於溫度與鹽度的垂直差異形成密度層化（density stratification），當潛艦穿過這些密度層界面時，會擾動層狀水體從而激發內波。⁸內波通常無法直接目視，由於其可調變海面上短波長漣漪，影響其波長與陡度，從而改變水面對雷達波的散射特性，此效應使合成孔徑雷達（Synthetic Aperture Radar, SAR）等遙測技術可以感知水下潛艦存在。美國海軍研究發現，在潛艦後方路徑約 400 倍船體直徑處，內部波浪艇流可能出現塌陷導致海水電導率出現劇烈變動，此現象為非聲學偵潛提供一條嶄新技術途徑。⁹

（四）溫度斷差（thermal scarring）：

溫度斷差來自在航潛艦冷卻水排放，無論傳統動力還是核動力潛艦，皆必須吸入大量海水對推進系統主機與輔機進行冷卻排熱，由於冷卻水較周圍海水溫度高，密度則較周圍海水低，因此形成對流並上升至洋面，導致部分洋面出現水溫較高情況，這種現象稱為「溫度斷差」，這種效應在核動力潛艦較為顯著。冷卻水溫度雖高惟量體相較周圍海水相對有限，溫度斷差可能很快消失。¹⁰此外，洋面與大氣間的溫差常會造

⁸ 王展與朱玉可，〈非線性海洋內波的理論、模型與計算〉，《力學學報》，第 51 卷第 6 期，2019 年 11 月，頁 1589-1604。

⁹ T. Sarpkaya, and T. Massidda, “Conductivity Measurements in the Wake of Submerged Bodies in Density-Stratified Media,” <https://nap.nationalacademies.org/read/5870/chapter/20>.

¹⁰ 根據熱傳公式計算，若潛艦以 5 節速度航行時，後方海水溫度僅上升約 0.2°C，海水溫度會快速衰減。當冷卻水上升最終將與相同溫度水層相遇，此際在洋面就無法形成溫度斷差而被儀器量測。此外，潛艦高速航行時，冷卻水無法斂聚，因此無足夠數量冷卻水達於洋面形成溫度斷差現象。Sanjaya Kumar Swain, K. Trinath, and Tatavarti, “Non-Acoustic Detection of Moving Submerged Bodies in Ocean,” International

成錯誤警報（false alarm），從而降低溫度斷差作為非聲學偵潛指標的價值。

（五）重力梯度（gravity gradient）：

重力梯度是地球重力場在空間中的變化率，受地形特徵與物質分布影響，可能引發局部重力場改變形成重力梯度效應。潛艦水下航行時，本身具有巨大質量，加上運動過程排開海水，導致局部海水密度變化，從而在艦殼垂直方向產生可量度重力梯度，此非聲學訊跡可作為偵測潛艦的一個參考指標。¹¹

（六）化學及輻射效應：

潛艦水下航行時，由於將不同型式污染物遺留在海水中，形成可被感知的化學及輻射效應。這些污染物包括船體及犧牲陽極剝落油漆、鐵鏽及微小鋅粒、俾葉軸封洩漏滑油以及艦上人員排泄物等等。值得注意的，核子潛艦除前揭污染物外，冷卻水中尚可能存在放射性同位素（radioisotope）。¹²這些污染物會在海水中存留一段時間，惟在風浪與洋流作用下這些訊跡將與海洋中污染物相混，或因特殊水文環境導致污染物仍停留在原排放處，因此兩者作為偵潛指標意義不大。

（七）特殊作業環境的非聲學效應：

除前揭提及潛艦各種非聲學訊跡外，潛艦在某些特殊操作狀態下，尚會產生可感知其他有感現象，相關訊跡來自以下各種場景：

- 1.光學反射：發生在潛艦浮航或呼吸管航行時。
- 2.雷達反射：發生在潛艦浮航或呼吸管航行時。
- 3.電磁發射：發生在潛艦發射雷達或無線電信號時。

Journal of Innovative Research & Development, Vol.1, Issue 10(Special Issue), December 2012, p. 363.

¹¹ 劉騰蛟、王丹與劉金國，〈潛艇非聲學偵測技術綜述〉，《水下無人系統學報》，第 31 卷第 4 期，2023 年 8 月，頁 524。

¹² “Royal Navy Submarines and Non-Acoustic Sensor Technology,” *Navy Lookout*, February 12, 2021, <https://www.navylookout.com/royal-navy-submarines-and-non-acoustic-sensor-technology/>.

4.廢氣排放：發生在潛艦發射巡航（戰略）飛彈時。

此外，柴電潛艦啟動主機使用呼吸管航行時，其排放的一氧化碳可在大氣滯留約 3 小時，訊跡可被感測器量測作為偵潛作業潛在指標。¹³

二、非聲學訊跡在偵潛作業的運用

當前聲學技術仍是偵潛作業主要手段，主動聲納與被動聲納是各國海軍遂行反潛作戰利器。然而，隨著先進潛艦降噪技術提升，聲學偵潛的有效性受到巨大挑戰。在這種情況下，非聲學偵潛遂成為聲學偵潛的一種補充手段，亦為偵潛技術發展提供一個嶄新選項。在下文中，將以前文各項非聲學訊跡作為指標，探討其存續時間與偵測方式，相關說明如表 1-2 所示。

表 1-2、非聲學訊跡的不同型式、現象描述與偵測方式

訊跡型式	現象描述	偵測方式
地磁擾動	潛艦金屬艦體造成地球磁場微小變化，影響僅出現於潛艦周遭區域	磁異偵測器（magnetic anomaly detector, MAD）、光泵磁力計、 ¹⁴ 磁通門感測器 ¹⁵
賈法尼電流	潛艦航行時，海水流經艦身與俾葉產生微弱電流，可於數哩內感知此現象	電場感測器、弱磁測量感測器

¹³ 同註 9。

¹⁴ 光泵磁力儀（optically pumped magnetometer, OPM）係利用光泵作用和光磁共振進行磁場測量的一種高精度與靈敏度磁力儀。美國海軍 P-8A「海神」（Poseidon）海上巡邏機配備 AN/ASQ-233A 磁異偵測器，係一款使用氦-4（Helium-4）進行磁場異常偵測的光泵磁力儀。相關說明參見鞏奕軒、姜凱、高敬語、朱萬華與陳凱，〈海底光泵磁力儀研究〉，《物探與化探》，第 48 卷第 6 期，2024 年 12 月，頁 1501；“AN/ASQ-233A Digital Magnetic Anomaly Detecting Set,” Polatomic, http://www.polatomic.com/images/DMAD_Data_Sheet_09-2009.pdf.

¹⁵ 磁通門磁力儀（fluxgate magnetometer）：係利用鐵芯磁感率（magnetic permeability）隨外部磁場強度變化現象來測量磁場的高精度磁力儀。優賽科技，〈磁通門傳感器的應用原理〉，2022 年 11 月 7 日，<https://www.eusci.com/2100.html>。

磁流動力現象	潛艦航行時，由於其運動與海水離子的交互作用，導致周圍水體電磁場變化，特別是在艤跡附近，可維持數小時或更久	磁異偵測器、電場感測器、弱磁測量感測器
生物體激光效應	潛艦運動擾動海水引發生物發光，主要存於艤跡區域	深海光學測量計、低亮度影像增強器 ¹⁶
伯努力丘	潛艦運動時，流體動力學作用使艦體上方水面隆起	合成孔徑雷達
卡爾文波	潛艦水下高速航行時，水面會產生特徵性波浪模式，可維持數分鐘或更久	合成孔徑雷達
擾動艤流	出現在潛艦船體後方，艤跡長達可達數哩並持續數分鐘甚至更長時間	光學衛星、合成孔徑雷達
內部波浪	潛艦在不同水層間移動時，由於擾動密度不均水層形成內波，艤跡區域可能出現明顯陷縮現象	合成孔徑雷達、水文聲學偵測器
溫度斷差	潛艦排放廢氣或冷卻水，導致局部溫度出現變化，此效應可維持數分鐘至數小時	紅外線衛星、紅外線熱成像儀
重力梯度	潛艦質量分布導致周圍動力場發生改變，在艦體垂直方向產生可量度重力異常	重力梯度儀、衛星重力偵測

¹⁶ 2018 年起，美國國防部高等研究計畫局(Defense Advanced Research Projects Agency)開始推動「持續性水生生物感測器」(Persistent Aquatic Living Sensors, PALS)計畫，其係透過生物與生俱來對自然擾動的感知能力，對戰略水域的敵方潛艦進行監視。Tim McMillan, “DARPA Will Use Marine Life to Spy on Enemy Subs,” *DEBRIEF*, March 16, 2021, <https://thedebrief.org/darpa-will-use-marine-life-to-spy-on-enemy-subs/>.

化學及輻射效應	潛艦釋放化學物質或微量輻射造成周圍環境變異，其出現於艇跡中，可保持數分鐘至數小時	化學感測器、輻射計量器、水質分析儀
光學反射	潛艦浮航時，其船體與帆罩在低光環境下可能反射可見光	光學衛星、可見光攝影機、光學偵察無人機
雷達反射	潛艦浮航或部分裝備露出水面時，將會產生雷達回波	X/Ku 波段雷達、合成孔徑雷達
電磁發射	潛艦開啟通訊設備時，可能產生短暫性電磁訊號	頻譜分析儀、電子支援措施
廢氣排放	潛艦呼吸管航行時，柴油主機會排放微量廢氣，此效應短暫但可以檢測	廢氣偵測器、紅外線熱成像儀

資料來源：翟文中，《台灣生存與海權發展：我國海軍如何因應跨世紀中共海軍擴張》（台北市：麥田出版股份有限公司，1999 年 7 月），頁 212-213；劉騰蛟、王丹與劉金國，〈潛艇非聲學偵測技術綜述〉，《水下無人系統學報》，第 31 卷第 4 期，2023 年 8 月，頁 521-526；李閻閻、賈世鯤、趙海侗、蘭世泉、孫通帥與楊紹瓊，〈基於 UUV 的目標非聲學偵測技術發展及趨勢分析〉，《水下無人系統學報》，第 31 卷第 4 期，2023 年 8 月，頁 510-520。

參、中國非聲學偵潛技術的發展現況

長期以來，水下戰力係解放軍海軍整體戰力最羸弱部分，在其新造潛艦噪音水平大幅改善後，強化反潛戰力就成為解放軍海軍建軍最後一哩路。提升反潛戰力關鍵性要素，就是能迅速而準確偵測出敵方潛艦位置。囿於聲學偵潛技術發展已接近極限，中國近年亦積極投入非聲學偵潛技術開發，期能透過兩者聯合運用增加成功偵獲敵方潛艦機率。

嚴格而論，中國從事非聲學偵潛理論研究與技術開發由來已久，早在「八五」初期，中國船舶科學研究中心（702所）即已進行潛艦水動力艤跡研究，並在潛體近場艤流場的理論建立與數值研究取得相當進展。¹⁷此外，中國艦船研究設計中心（701所）亦著手進行非聲學偵潛裝備開發，經過多年努力，其研製的MS3A型磁通門感測器，在分辨率與靈敏度上均已達到先進水平。¹⁸未來，中國在軍民融合政策驅動下，國企、高校與科研機構勢必加大對非聲學偵潛相關研究，期能在此領域取得科技優勢或佔據制高點。在下文中，將對中國當前在非聲學偵潛技術上獲得成果進行說明，並對參與研究機構進行歸納與分析，藉此對中國在非聲學偵潛發展能較為宏觀看法。由於資料來自公開資訊，或出現遺漏不全或不夠權威情形，需後續研究予以補遺或強化。

一、科研成果

（一）電流磁場偵測

中國西北工業大學透過對潛艦卡爾文波的雷達影像分析，確認潛艦航行時將會產生微弱磁場信號。這項研究表明，潛艦在特定深度與速度航行時，其艤流感應磁場強度可以現有機載磁異偵測器捕捉獲得，因此可用來偵測潛艦並能對其進行精確定位。¹⁹

¹⁷ 張軍、張效慈、趙峰與洪方文，〈源於水動力學的潛艇尾迹非聲學偵測技術研究之進展〉，《船舶力學》，第7卷第2期，2003年4月，頁127。

¹⁸ 李閻閣、賈世鯤、趙海侗、蘭世泉、孫通帥與楊紹瓊，〈基於UUV的目標非聲學偵測技術發展及趨勢分析〉，《水下無人系統學報》，第31卷第4期，2023年8月，頁515。

¹⁹ 李建緯，〈核潛艦「尾流磁場」被盯上了！美軍隱形技術恐被中破解 面臨安全威脅〉，《Newtalk新聞》，2025年2月12日，<https://newtalk.tw/news/view/2025-02-12/956446>。

（二）空蝕感應電流偵測

中國福州大學先進製造學院與中國科學院福建物質結構研究所人員，利用流體力學、電磁學理論和有限建模方法進行模式模擬，探討「空蝕感應電流」的非聲學偵潛理論。此研究立論於潛艦高速航行或俾葉轉速過高時，會在俾葉周圍形成空蝕現象（cavitation）。在空蝕氣泡形成、脫落與破裂過程中，局部水流渦流分布發生變化，從而改變潛艦周圍感應電流分布，導致局部電場和磁場出現顯著變化。研究指出，在高靈敏度磁異偵測器協助下，此現象可作為非聲學偵潛一個參考指標。²⁰

（三）水動力學艤跡偵測

中國船舶科學研究中心利用其建立的分層水槽試驗系統，進行分層流體中運動潛艦內波增阻試驗研究，該中心亦協同其他單位進行潛艦內波生成機理及其在洋面表現特徵相關探索。由於中國船舶科學研究中心長期從事艦艇流場理論及數值研究，累積技術與經驗為潛艦內波艤跡的理論及數值研究奠定了堅實基礎。此外，中國多所高校亦加入潛艦內波研究，包括上海大學、天津大學、中國科技大學與青島海洋大學等，這些高校參與擴大了中國非聲學研究領域，更為中國海軍發展非聲學偵潛技術提供支撐。另外復旦大學、北京大學與中國科學院電子研究所則對合成孔徑雷達圖像處理進行研究，這是將水動力艤跡實際作為潛艦偵測最重要應用。²¹

（四）非聲學感測器研發²²

1. 磁異偵測器：

中國船舶重工集團公司第 701 研究所長期從事磁異偵測器開發，其研製的最新型號 MS3A 型磁通門偵測器，分辨率 0.2nT，靈敏度 50V/nT，

²⁰ 彭娥、鄒聖楠、李詩鑄與劉琳英，〈自然空化下潛艇感應電磁信號的演化〉，《中國艦船研究》（湖北武漢），第 18 卷第 4 期，2023 年 8 月，頁 140-150；楊幼蘭，〈核潛艦再匿蹤也沒用，陸曝罩門 美優勢危險了〉，《中時新聞網》，2023 年 8 月 14 日，<https://www.chinatimes.com/realtimenews/20230814001373-260417?chdtv>。

²¹ 同註 17，頁 127。

²² 李閣閣、賈世鯤、趙海侗、蘭世泉、孫通帥與楊紹瓊，〈基於 UUV 的目標非聲學偵測技術發展及趨勢分析〉，《水下無人系統學報》，第 31 卷第 4 期，2023 年 8 月，頁 513-517。

已達世界先進水平。²³

2.雷射偵測器：

2015 年，中國科學院上海光學精密機械研究所成功研製機載海陸測繪雙頻雷射雷達，該型雷達有效偵測深度 50 公尺，偵測精度 0.22 公尺，此雷射偵測器若能進一步改良，具運用於偵測水下潛艦巨大潛力。

3.重力梯度儀：²⁴

中國北京航天控制儀器研究所已開發出 SAG 系列航空 / 海洋重力儀，其可運用在水下運動體與障礙物偵測，用以輔助潛艦水下導航與進行非聲學偵潛。由於中國在此領域發展受限於技術理論不足與材料工藝限制，因此在高精度重力儀研製上距國際先進水平仍有一段距離。未來，中國能否研發出實際運用於非聲學偵潛的高精度重力梯度儀，仍有相當多技術瓶頸需要克服。

二、參與機構

中國高校、國企與科研機構參與國防研究例子不勝枚舉，近來在「深化軍民融合」政策指導下，這種案例將會倍於往昔。由於中國對機敏性國防資訊嚴格管制，加上民間機構從事國防科研經常遭到刻意掩藏，因此公開管道取得的資料存在相當侷限性。表 1-3 列舉部分參與中國非聲學偵潛技術開發機構，其係較重要且資訊來源可信度較高者，惟這祇是中國參與相關研究機構的一部分。更完整周密參與清單，有待後續研究者持續進行補充完善。

²³ 分辨率指感測器能區分的最小磁場變化量，靈敏度則是感測器輸出信號對輸入磁場變化的響應程度。50V/nT 表示磁場變化 1nT 時，輸出電壓則出現 50V 變動。

²⁴ 鄭偉、付騰達、李釗偉、祝會忠與徐愛功，〈潛器水下重力匹配導航研究進展〉，2022 年 9 月 11 日，<https://www.163.com/dy/article/HGVU4FI60511DV4H.html>。

表 1-3、中國參與非聲學偵潛技術開發相關機構研判表

高	哈爾濱工程大學水聲工程學院	該學院設有水聲技術全國重點實驗室，其下則組織了「海洋磁感測器和探測實驗室」。 ²⁵ 該實驗室負責人沈瑩博士，長期從事目標弱磁偵測研究工作。 ²⁶
	南京大學聲學研究所	中國最早建立的聲學教學與科研基地，設有近代聲學教育部重點實驗室，在光聲檢測、電聲技術、音頻數位測量儀器等領域取得重大成果。 ²⁷
校	西北工業大學聲學工程研究所	該所主體學科「水聲工程」於 2002 年與 2007 年，分別被批准為國防科工委重點建設學科與國家重點學科，長期從事水聲信號及非聲學偵測與傳輸研究。 ²⁸
國	中船重工艦船研究設計中心	中國從事艦船設計的最重要科研機構，設有聲隱身技術國防重點實驗室，主要研究項目包括水下浮體定深、弱磁檢測裝備與高抗流水下機器人等。 ²⁹
	中船重工中國船舶科學研究中心	該中心擁有各型試驗水槽，主要從事艦船及水中兵器、海洋工程等領域的水動力學、結構力學和聲隱身技術基礎與應用研究，該中心是中國最早投入潛艦水動力位移效應研究的科研機構。 ³⁰

²⁵ 〈水聲技術全國重點實驗室〉，《哈爾濱工程大學》，<https://uast.hrbeu.edu.cn/kxyj/kytd/1.htm>。

²⁶ 〈團隊受邀在“2021 IEEE/OES 中國海洋聲學國際會議”上交流學術成果並做產品展示〉，《海洋磁感測器和探測實驗室》，2021 年 7 月 17 日，http://www.maglab-heu.com/news/2021_07/2021-07-17.html。

²⁷ 〈南京大學聲學研究所—近代聲學教育部重點實驗室〉，2015 年 8 月 6 日，<https://acoustics.nju.edu.cn/jggk/jgjj/index.html>。

²⁸ 〈西北工業大學聲學工程研究所〉，<https://hanghai.nwpu.edu.cn/info/1609/6541.htm>。

²⁹ 浙商證券股份有限公司，〈艦船水聲防務龍頭，內生外延雙輪驅動—中國海防深度報告〉，2021 年 2 月 7 日，https://pdf.dfcfw.com/pdf/H3_AP202202081545678276_1.pdf?1644326407000.pdf=&utm_source=chatgpt.com；〈中國艦船研究設計中心有了新供應商：中國電子產品可靠性與環境試驗研究所（工業和信息化部電子第五研究所）（中國賽寶實驗室）〉，《航空產業網》，2025 年 2 月 11 日，<https://www.chinaerospace.com/article/show/e2f6a13149c82349faa0570afce754fa>。

³⁰ 〈中船重工—7 打頭的各研究所介紹〉，《龍船社區》，2007 年 5 月 17 日，

	中船重工杭州應用聲學研究所（715所）	中國最早從事水聲電子工程研究和超聲與非聲學偵測設備研製的科研單位。該所設有海洋聲學國家重點實驗室、水聲計量一級站和水聲產品性能檢測中心，並擁有世界一流中低頻消聲試驗水槽等科研設施。 ³¹
科 研 機 構	中國科學院聲學研究所	該所係結合聲學與信號處理技術研究的綜合性科研機構，主要研究為水聲物理與水聲偵測技術以及環境聲學與噪音控制技術等聲學領域項目。此外，該院研究人員亦從事非聲學偵測相關技術研究。 ³²
	中國科學院海洋研究所	該所設有實驗海洋生物學重點實驗室及海洋環流與波動重點實驗室，前者從事海洋生物生理與活動研究，後者則進行遙感偵測與大數據挖掘等項目。相關研究有助瞭解生物體激光效應機理，可拓展非聲學偵測研究範圍與內涵。 ³³
	中國科學院精密測量科學與技術創新研究院	該院工作一是開發精密偵測技術，另一則是研製精密儀器。該院精密重力測量技術研究部從事海空重力數據分析與重力儀研製；大地測量研究部進行海洋大地測量與水下重力匹配輔助導航研究，這些研究均可支援非聲偵潛作業進行。 ³⁴

資料來源：作者整理自網路公開資訊。

除前表列舉各個單位外，若將機構本身任務與研究重點作為出發點，結合非聲學偵潛技術依托各項物理訊跡特徵，研判下列單位有可能從事非聲學偵測理論與技術的研究，這些單位包括海軍研究院、海軍工程大學、北京大學地球與空間科學學院、東南大學水聲信號處理教育部重點實驗室、武漢大學測繪遙感信息工程國家重點實驗室、中國船舶重

<https://club.imarine.cn/comm/5578.html>。

³¹ 〈盤點我國船舶海工領域的科研院所〉，《網易》，2020年10月2日，<https://www.163.com/dy/article/FNVKF0TN0511DV4H.html>。

³² 例如：該所院士專家汪承灝曾從事空蝕發光（Sonoluminescence）研究，此效應具運用於非聲偵潛的潛力，研究員王文則著有探討化學感測器的專書，據此研判該所應進行非聲學偵測相關項目研究。參見〈中國科學院聲學研究所〉，<https://ioa.cas.cn/>。

³³ 〈中國科學院海洋研究所〉，<https://qdio.cas.cn/>。

³⁴ 〈中國科學院精密測量科學與技術創新研究院〉，<https://apm.cas.cn/ykjs/>。

工集團西安精密機械研究所（第 705 所）與中國科學院上海技術物理研究院等等。雖然，缺乏公開資訊確認這些機構涉入非聲學偵潛技術研發的深淺程度，惟從其業務職掌與作業需求兩個面向考量，前揭單位參與非聲學偵潛技術研究無庸置疑。就當前言，高校、國企與科研機構已儲備發展非聲學偵潛技術能量，祇要給予適當政策引導與充裕資金投入，中國在非聲學偵潛領域具有突破潛力，但仍需克服技術與應用挑戰。

肆、中國非聲學偵潛技術發展的挑戰與機會

主被動聲納係聲學偵潛最重要偵測裝備，其操作會受到海水溫度、鹽度與深度影響，海洋背景噪音與水中生物活動亦會造成其效能降低。加之人為各項抑制噪音舉措，例如安裝消音瓦與採用泵噴推進（pump-jet），這將形成聲學偵潛運用上不利影響。如聲學偵潛般，非聲學偵潛亦存在侷限性，這不單是中國海軍亦是全球各國海軍需面對嚴苛挑戰。在下文中，首先將對非聲學偵潛技術運用的限制進行說明，接著將分析中國海軍可能採取行動選項，藉此讀者對中國非聲學偵潛技術未來發展能有更宏觀認識。

一、挑戰

（一）非聲學訊跡雖多卻不易辨識

潛艦水下航行時，對自然環境擾動形成各種非聲學訊跡，例如地磁變動、伯努力丘與溫度斷差等現象，由於其數值本來就不高，加上存續時間短與背景環境干擾，導致感測器無法對這些微弱訊跡進行精確辨識。³⁵即以地磁擾動為例，海底金屬沉船、火山活動與太陽黑子引發的磁風暴等，將使潛艦運動產生的磁場淹沒在當地磁場巨大變化之中變得無法辨識。³⁶其他非聲學訊跡如伯努力丘與卡爾文波，當潛艦在淺水區域低速航行尚可有效量測，惟在潛深超過 100 公尺且高速航行時，兩者在洋面形成波高幾乎趨近於零（參見表 1-1）。此種微小的潛艦水動力位移效應，不僅難於量測同時將很快地消失在巨大風生波浪之中。不幸地，幾乎所有非聲學訊

³⁵ 一艘中型潛艦在其上方 400 公尺處形成的感應磁場強度約為 0.4nT，這個數值僅為當地背景磁場強度的十萬分之一，訊跡微弱不易辨識。陶榮華、王丹與遲鉞，〈國外航空磁探潛裝備應用分析及發展趨勢〉，《水下無人系統學報》，第 29 卷第 4 期，2021 年 8 月，頁 370。

³⁶ 〈我國反潛研發需要加強〉，2016 年 8 月 1 日，<https://blog.sciencenet.cn/blog-1354893-995751.html>。

跡均存在相同問題，時至今日這種物理限制未有完善解決方案。

（二）提高偵測精度造成誤警率高

這個問題和前揭困境可說是如出一轍，皆源自非聲學物理訊跡過於微弱，導致偵測系統無法有效感知。一般而言，為能對存在的微弱訊跡進行偵測，就必須研製精度更高儀器。然而，當高精度儀器能捕獲更多微弱訊跡同時，意味著其會受到來自環境噪音更多干擾，這使儀器錯誤地將環境噪音當成潛艦信號處理，遂產生令人困擾的錯誤警報問題。就信號偵測與處理言，如何在裝備靈敏度（*sensitivity*）與信號誤警率（*false alarm rate*）間尋求平衡是偵測系統設計重要考量。對裝備操作人員言，信號誤警率高會增加漏報或忽視真正信號機率。這項問題雖然存在，卻不致成為中國發展非聲學偵潛技術瓶頸。此外研究發現，祇需將多個感測器結合即可降低單一感測器高誤警率情況。換言之，系統任一閾值警報（*single threshold alarm*）不再具決定性，整合多個統計閾值方法可降低誤警信號發生。³⁷在這種情況下，中國海軍需處理更複雜的感測器信號融合（*signal fusion*）問題。

（三）非聲學偵潛技術多數不成熟

時至今日，多數非聲學偵潛技術發展並不成熟，許多領域迄今仍然處於理論探索階段，無法將研究成果技術轉化或研製工程樣機進行測試，更遑論能將裝備定型生產並交付部隊使用。除技術仍處於發展階段，相較傳統聲學偵潛，非聲學偵潛技術尚存在效能不足問題。即以非聲學偵測裝備運用最成功的磁異偵測器為例，³⁸最大偵測距離僅達 1,200 公尺，³⁹遠不及低頻主動聲納動輒數十到上百公里搜索距離，因此無法執

³⁷ Gabor POR, “Advanced Acoustic Detection System Monitoring Nuclear Power Plant Components,” 19th World Conference on Non-Destructive Testing 2016, pp. 1-2, <https://www.ndt.net/article/wcndt2016/papers/tu4e3.pdf>.

³⁸ 鞏奕軒、姜凱、高敬語、朱萬華與陳凱，〈海底光泵磁力儀研究〉，頁 1498。

³⁹ 加拿大航空電子公司（Canadian Aviation Electronics, CAE）研製的 AN/ASQ-508 磁異偵測器為美、英與日本等多國海軍採用，係同類產品性能指標最佳者，對傳統潛艦與核動力潛艦的偵測距離分別為 800 公尺與 1,200 公尺。陶榮華、王丹與遲鍼，〈國外航空磁探潛裝備應用分析及發展趨勢〉，頁 370；“Advanced Integrated Magnetic Anomaly Detection System (AIMS),” *Canadian Aviation Electronics Inc.*, https://www.cae.com/media/documents/Defence_Security/DM045_AIMS_EN_Septembre2017.pdf.

行區域搜索（area search）任務，祇能協助反潛兵力在終端階段進行精確定位。⁴⁰事實上，非聲學偵潛技術無法單獨執行反潛任務，其必須配合其他手段進行交叉確認或信號融合，因此其運用上受到相當程度制約。當前公開資訊揭露的中國非聲學偵潛技術發展，顯示其多數研究仍為衛星影像研判與模式模擬分析，這些科研項目並未顯示其在此領域發展已獲得實質性突破。由於非聲學偵潛技術的開發存在巨大挑戰，中國透過此技術達成「彎道超車」的目標並不容易。

二、機會

（一）投入嶄新技術與裝備開發

由於非聲學物理訊跡微弱且偵測不易，這導致技術的開發與運用受到相當限制。這個問題不難克服，隨著電子科技與人工智能等新興技術成熟，研發具高辨識度精密儀器或開發嶄新測量技術均較過往容易，中國擁有豐沛專業人才與強大製造能力，這為其開發嶄新非聲學偵潛技術與裝備提供奧援。2024 年 10 月，中國科學院微觀磁共振重點實驗室研發的「協同量子精密測量」技術，可提升磁場測量靈敏度，很大程度可運用於非聲學偵潛領域。⁴¹此外，中國科學院國家空間科學中心太陽活動和空間天氣重點實驗室領軍的研究團隊成功研製出量子磁量儀，⁴²這兩項突破對極弱磁場研究提供前所未有測量精度與靈敏度，可用於記錄潛艦穿越地球磁場形成的地磁擾動，為中國非聲學偵潛運用提供技術支撐。當前中國擁有龐大國家實驗室體系，挾其強大工業製造能力，兩者若能緊密結合，有助其在非聲學偵潛技術領域開發嶄新技術與裝備，從而強化其海軍的整體反潛作戰能力。

⁴⁰ 翟文中，〈非聲學偵潛簡介〉，《海軍學術月刊》，第 31 卷第 2 期，1997 年 2 月，頁 76。

⁴¹ 〈我國科研人員提出協同量子精密測量新技術〉，科學網新聞，2024 年 10 月 2 日，<https://news.sciencenet.cn/htmlnews/2024/10/530991.shtm>。

⁴² 這套名為 CPT 原子磁場精密測量系統的量子磁力儀，由 CPT 原子/量子磁力儀、AMR 磁阻磁力儀、NST 星敏感器與無磁伸展臂等組成，中國科學院國家空間科學中心太陽活動和空間天氣重點實驗室、複雜航天系統與電子信息技術重點實驗室以及中科院瀋陽自動化研究所共同開發研製。〈我國自主研發的量子磁力儀載荷實現全球磁場測量〉，中國科學院，2022 年 11 月 14 日，https://www.cas.cn/syky/202211/t20221114_4854706.shtml。

（二）發展多模感測器融合技術

非聲學信跡過於微弱經常淹沒於自然環境中或受到背景雜訊干擾，導致裝備的偵測率普遍不高。就實際操作言，沒有任何非聲學偵潛裝備偵測率高於主被動聲納，加上其無法獨立操作的致命缺點，這使得非聲學偵潛技術發展受限，無法如聲學偵潛般運用於海軍反潛作戰。對中國非聲學偵潛發展言，這個問題不難解決，祇要將非聲學偵測系統所有感測器有效整合，透過信號資料融合將可大幅提升系統偵測率。例如：四種不同型式非聲學偵測裝備偵測率分別為 45%、35%、30%與 20%，個別感測器偵測率雖然都不高，倘若將四者聯合運用其偵測率則可提升至 80%左右。⁴³換言之，祇要新增感測器偵測率不是零，系統整體偵測率將較原任何感測器偵測率高，這個原則被廣泛運用於軍事領域，尤以情監偵系統建構與規劃為然。在這種情況下，中國毋須投入大量資源提升非聲學感測器分辨率與靈敏感，祇需將各式非聲學感測器整合或是與聲學感測器共組系統，將可大幅提升偵測系統整體偵測率。

（三）引進與運用賦能科技支援

當前人工智慧與大數據分析等科技具有優異「賦能效應」，運用這些技術將可提高系統原有能力，使用者能更有效率解決問題與執行任務。例如，中國可運用人工智慧對多源感測器獲得數據進行分析，或透過深度學習對水文異常現象進行快速檢測，從而提高非聲學偵測效率與準確性。此外，大數據分析則可整合來自不同感測器非聲學訊跡，建立高精度潛艦識別模型，例如當某水域出現磁異常現象時，系統可立即通報並建議加派反潛兵力執行進一步搜索與確認。此外，中國海軍尚可將非聲學感測器部署於無人水下載具（unmanned underwater vehicle, UUV），相較多數非聲學感測器係以空基或太空基方式部署，⁴⁴此種方式可降低海空介面存在雜訊干擾，提高非聲學感測器對水下目標分辨能力。再者，無人水下載具較航空器擁有更長作業時間，且可接近水下目標進行近接偵測，有助改善並增加對敵潛艦偵測機率。⁴⁵中國當前已成

⁴³ Siobhan Athena Capley, "How to Calculate the Joint Probability of Two Events," *Study.com*, <https://study.com/skill/learn/how-to-calculate-the-joint-probability-of-two-events-explanation.html>.

⁴⁴ Emerging Disruptive Technology Assessment Symposium, "Remote Undersea Surveillance," *Australian Government Department of Defence*, <https://www.dst.defence.gov.au/sites/default/files/events/documents/Insights%20Paper%20-%20Remote%20Undersea%20Surveillance%20F1.pdf>.

⁴⁵ *Ibid.*

功研製「潛龍系列」、海鯨-2000、SIA-4500 與 HSU001 等型無人水下載具，未來可作為非聲學感測器的載台，擴大其可部署空間範圍。

伍、結語

長期以來，反潛作戰一直是中國海軍的「短板」，亦是中美海軍戰力差距最大領域，為加速向「全面建成世界一流海軍」目標邁進，中國勢將強化非聲學偵潛技術研發的力度與廣度，期能在潛艦作戰與反潛作戰領域同美國競爭。近期媒體報導指出，中國西北工業大學與中國科學院福建物質結構研究所在非聲學偵潛技術取得進展，這種發展將使美軍潛艦在中國周遭活動面臨巨大風險。雖然，媒體對中國在非聲學偵潛領域研發成果過於誇大，因為相關理論研究絕非中國科研機構獨有，美國海軍對此議題早已投入廣泛研究。即令如此，中國近年在非聲學偵潛技術大規模投入，其後續發展與研究成果值得吾人持續追蹤。總體而論，中國當前高校、國企與科研機構所屬實驗室，在非聲學領域開展範圍廣泛研究，科目包括電磁學、紅外線、重力梯度與水動力效應等等，這些研究多數仍停留在實驗室階段，並未進行技術成果轉化或研製樣機進行測試，中國非聲學偵潛技術落實乃至成熟絕非一蹴可及。

人工智慧等新興科技出現，為中國開發與建立非聲學偵潛能量提供「賦能」效應。這意味中國在非聲學偵潛技術領域即令未取得突破性進展，祇要其能夠善用大數據、人工智慧與模式模擬等賦能工具，將非聲學偵潛技術與發展成熟聲學偵潛技術整合，透過多源信號融合與模式模擬支援協助，即可更精準研判敵方潛艦動向、優化反潛作戰戰術與有效整合各感測器特有功能。藉此中國海軍將能提升對敵潛艦偵測的有效性與準確性，能高效且在兵力節約情況下執行反潛作戰任務。尤其重要的，非聲學偵潛技術可彌補傳統聲學偵潛技術不足，兩者整合將使中國水下監偵能力獲得強化，除可加快對水下目標的偵測、辨識與追蹤外，亦可提升水下戰略預警能力。雖然，非聲學偵潛不致改變反潛作戰規則，卻可作為聲學偵潛輔助手段，成為補足中國海軍反潛戰力最後拼圖。屆時，結合既有反進入／區域拒止能力，在中國周邊活動的水下載台將承受倍於往昔風險。

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解放軍核力量現代化：

現況、趨勢與戰略意涵

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摘 要

中國人民解放軍的核武力量正經歷自 1964 年以來最深刻的轉型。其核心特徵體現在核武庫存以前所未有的速度擴張，預計 2030 年將突破千枚，朝向與美、俄形成三足鼎立的態勢。同時，一個現代化、高生存性的「核三位一體」打擊體系已然成形：陸基力量透過大量新建發射井強化生存能力；海基力量藉由 094 型核潛艦與巨浪-3 飛彈具備可靠的二次打擊能力；空基力量則以轟-6N 與空射彈道飛彈補齊缺口。此番轉型不僅是數量的擴張，更反映了核戰略思想的演變，從傳統的「保證報復」向更具實戰意涵的「預警反擊」邁進，實質上挑戰了其「不首先使用」的公開承諾。此趨勢不僅衝擊美中戰略穩定，更透過「穩定-不穩定悖論」升高了台海等區域衝突的核升級風險，並對美國的延伸嚇阻及全球核不擴散體系構成嚴峻挑戰。

關鍵詞：解放軍、核三位一體、核戰略、嚇阻、預警反擊

PLA Nuclear Force Modernization : Current Status, Trends and Strategic Implications

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Abstract

The nuclear forces of the People's Liberation Army (PLA) are undergoing their most profound transformation since 1964. Its core feature is the unprecedented expansion of its nuclear arsenal, which is projected to exceed one thousand warheads by 2030, moving towards a tripolar nuclear landscape on par with the United States and Russia. Concurrently, a modernized and highly survivable nuclear triad strike system has taken shape: land-based forces have enhanced their survivability through the construction of numerous new missile silos; sea-based forces have achieved a credible second-strike capability with Type 094 nuclear submarines and JL-3 missiles; and the air-based leg is completing its capabilities with the H-6N bomber and air-launched ballistic missiles.

This transformation reflects not only a quantitative expansion but also an evolution in nuclear strategy, shifting from a traditional “Assured Retaliation” posture towards a more operationally significant “Launch-on-Warning” strategy. This substantively challenges its public commitment to a “No First Use” policy. This trend not only impacts US-China strategic stability but also elevates the risk of nuclear escalation in regional conflicts, such as in the Taiwan Strait, through the “stability-instability paradox”. Furthermore, it poses a severe challenge to U.S. extended deterrence and the global nuclear non-proliferation regime.

Keywords: the People's Liberation Army, Nuclear Triad, Nuclear Strategic, Deterrence, Launch-on-Warning

壹、前言

本文剖析中國人民解放軍核武力量當前正經歷的一場自 1964 年首次核試爆以來最為深刻且全面的轉型。其核心特徵體現在三個相互關聯的層面：首先，核武庫存正以前所未有的速度擴張，其規模已遠遠超越傳統上為人所知的「最低限度嚇阻」水準，並正朝向與美國、俄羅斯在部署數量上三足鼎立的門檻邁進。其次，一個現代化、具備更高生存能力與更快反應速度的「核三位一體」(Nuclear Triad) 打擊體系已基本成形，陸基力量的規模與生存性大幅提升，海基力量已具備可靠的二次打擊能力，空基力量則在補齊最後的不足。最後，從近年大幅擴張的核武部署的趨勢來看，中國的核戰略思想與戰略態勢似乎正從傳統、被動的「確保報復」，向更具實戰嚇阻意涵的「預警反擊」演進，這一轉變與其長期堅持的「不首先使用」核武器承諾相衝突。

本文的分析將主要藉助「嚇阻理論」(Deterrence Theory) 與「戰略穩定」(Strategic Stability) 的相關概念，作為評估解放軍核武轉型意涵的核心框架。嚇阻理論強調，國家透過威脅使用武力（特別是核武）來阻止對手的特定行動；而戰略穩定則關注核武國家之間（尤其是美中）能否在危機中避免非自願的衝突升級，以及是否缺乏在平時發動先制攻擊的動機。¹本文主張，解放軍的核武擴張與戰略姿態的演進，正從根本上挑戰傳統基於「核武不對稱」的穩定狀態，迫使外界必須重新評估嚇阻的可信度、危機管理的難度，以及潛在的「穩定—不穩定悖論」(Stability-Instability Paradox) 如何在印太地區（特別是台海）體現。

解放軍核武此番轉型不僅是軍事技術與武器數量的迭代升級，更是中國國家戰略雄心、安全觀念以及國際地位認知變遷的直接體現。它勢必衝擊美、中之間的戰略穩定關係，將雙方推向一個更具不確定性的核武競爭時代。同時，解放軍核武的升級也加劇了印太地區的安全困境，並對美國的「延伸嚇阻」承諾構成了實質性挑戰。長遠來看，中國核力量的不透明擴張，對全球核不擴散體系與未來軍備控制框架的構建，均構成了根本性的挑戰。

¹ 參見：B. A. Most and Harvey Starr, "International Relations Theory, Foreign Policy Substitutability, and 'Nice' Laws," *World Politics* Vol. 36, No. 3, April 1984, pp. 383-406. 另見 Thomas C. Schelling, *The Strategy of Conflict* (Cambridge, MA: Harvard University Press, 1960)。

貳、戰略轉型的背景與驅動因素

一、全球安全格局的變遷：進入「第三核時代」

當前的國際安全格局正經歷一場結構性轉變，從後冷戰時代相對穩定的單極格局，逐漸演變為一個大國競爭加劇、地緣政治衝突頻發、既有軍備控制體系瀕臨瓦解的新階段。部分戰略分析家將此定義為「第三核時代」。²此時代的核心特徵是，美國首次必須同時應對兩個在核武能力上與其相當的戰略競爭對手（peer competitor）——俄羅斯與中國。因此，傳統上基於美蘇（俄）雙邊框架的戰略穩定模型、嚇阻邏輯與軍控談判機制，已難以完全適用於當前更為複雜的多極核武環境。³

在此宏觀背景下，中國的核武力量擴張並非單一的事件，而是影響這一全球戰略動態中最為顯著且最具影響力的變量之一。中國的崛起及其核武庫的快速現代化，正從根本上改變全球核力量的平衡，迫使其他主要核武國家重新評估其嚇阻態勢與戰略規劃。⁴

二、核心驅動因素分析：安全憂慮與戰略雄心的交織

中國此輪核武擴張並非由單一因素驅動，而是一個由外部安全壓力與內部戰略雄心相互交織、螺旋上升的複雜過程。

（一）外部驅動：安全困境與威脅感知

長期以來，中國的戰略規劃者對美國擁有的壓倒性軍事技術優勢深感憂慮，認為這些優勢可能使其有限的核報復能力失效，從而陷入戰略被動。具體而言，中國的威脅感知主要來自兩個方面：

1. 飛彈防禦系統的挑戰：美國及其盟友在全球範圍內部署的多層次飛彈防禦系統，在中國看來，其潛在目標是削弱甚至抵銷中國規模相對較小

² Matthew Kroenig, “Strategic Stability in the Third Nuclear Age,” *Atlantic Council*, October 7, 2024, <https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/strategic-stability-in-the-third-nuclear-age/>.

³ *Ibid.*

⁴ “Nuclear Risks Grow as New Arms Race Looms—New SIPRI Yearbook Out Now,” *SIPRI*, June 15, 2025, <https://www.sipri.org/media/press-release/2025/nuclear-risks-grow-new-arms-race-looms-new-sipri-yearbook-out-now>.

的核報復攻擊，從而給予美國單方面進行核訛詐或實施打擊的優勢。⁵

2. 常規精確打擊能力的威脅：美國大力發展的「常規快速全球打擊」（Conventional Prompt Global Strike, CPGS）等高超音速、遠程精確打擊武器，理論上具備在衝突初期對中國的核指揮控制中心、飛彈發射井、戰略潛艦基地等關鍵目標進行先發制人式非核打擊的能力。這種「斬首」威脅，直接挑戰了中國核力量的生存能力，迫使其必須尋求更可靠、更多樣化、反應更快的核力量部署方式。⁶

這種脆弱感是中國近年來大規模擴建加固飛彈發射井、大力發展洲際彈道飛彈機動載台和建立常態化戰略核潛艦巡弋的直接動因。其首要目標是確保在經受第一輪打擊後，仍有足夠的核力量能夠存活下來並實施有效報復。⁷

（二）內部驅動：戰略企圖與地位追求

與此同時，中國的核擴張也受到其日益增長的國家雄心和對大國地位的追求所驅動：⁸

1. 大國地位的象徵：北京領導層普遍認為，一個國家的國際地位與其戰略力量，特別是核力量的規模和質量直接相關。一個與其全球第二大經濟體和重要政治影響力相稱的強大核武庫，被視為其大國地位不可或缺的標誌和支撐。
2. 拒止外部干預的工具：更為核心的考量是，一個強大且可信的核武庫被視為在涉及中國核心利益（尤其是台灣問題）的潛在衝突中，拒止第三方（主要是美國）進行軍事介入的關鍵工具。北京的戰略盤算是，通過顯著提升美國干預的潛在代價——即可能將衝突升級至核對抗，

⁵ Tong Zhao, “Political Drivers of China’s Changing Nuclear Policy: Implications for U.S.-China Nuclear Relations and International Security,” *Carnegie*, July 17, 2024, <https://carnegieendowment.org/research/2024/07/china-nuclear-buildup-political-drivers-united-states-relationship-international-security?lang=en>.

⁶ Amy F. Woolf, “Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues,” *the Congressional Research Service*, July 16, 2021, <https://sgp.fas.org/crs/nuke/R41464.pdf>.

⁷ Li Bin, “Chinese Perspectives on Strategic Stability Engagement with the United States,” *Brookings*, July 21, 2025, <https://www.brookings.edu/articles/chinese-perspectives-on-strategic-stability-engagement-with-the-united-states/>.

⁸ Tong Zhao, *op. cit.*.

從而迫使華盛頓在決策時更加謹慎，為中國在常規軍事層面實現其目標創造更有利的戰略環境。

這種戰略企圖驅動了中國的核力量發展超越了單純「確保生存」的範疇，轉而追求更大的規模、更高的技術水準和更多樣化的打擊選項，旨在產生更強的政治與心理嚇阻效應，從而實現「不戰而屈人之兵」的最高戰略目的。⁹

（三）技術賦能：經濟與科技的支撐

數十年持續的經濟高速增長，為中國的國防現代化提供了雄厚的物質基礎，使其能夠承擔高昂的核武研發、部署與維持費用。¹⁰與此同時，中國在材料科學、空氣動力學、精密導引、通信技術等軍事相關科技領域的長足進步，使得解放軍有能力自主研發和部署更先進的固體燃料飛彈、核潛艦、空射彈道飛彈乃至下一代匿蹤戰略轟炸機，從而將戰略構想轉化為實質的軍事能力。¹¹

綜上所述，中國的核戰略正經歷一場根本性的轉變。它不再僅僅是一種為應對最壞情況而準備的「被動反應型」嚇阻姿態，即確保自身在遭受核攻擊後能實施報復。相反，它正演變為一種「更為主動型」的嚇阻姿態，意圖利用一個強大、可靠且令人生畏的核武庫，來主動塑造戰略環境，保障其在傳統軍事領域的行動自由，並扼止潛在對手的干預。

參、核彈頭庫存與裂變材料生產能力評估

一、核彈頭數量評估：從「精幹有效」到大規模擴張

中國核彈頭的數量在過去數年間經歷了爆炸性增長，徹底顛覆了其

⁹ John Lee & Lavina Lee, “Implications of Chinese Nuclear Weapons Modernization for the United States and Regional Allies,” *Hudson Institute*, July 30, 2025, <https://www.hudson.org/defense-strategy/implications-chinese-nuclear-weapons-modernization-united-states-regional-allies-john-lee>.

¹⁰ Daniel Ortwerth, “Update on the US-China Military Balance of Power,” *Confluence*, May 12, 2025, <https://www.confluenceinvestment.com/weekly-geopolitical-report-may-12-2025/>.

¹¹ Matthew P. Funairole and Brian Hart, “China’s Military in 10 Charts,” *CSIS*, September 2, 2025, <https://www.csis.org/analysis/chinas-military-10-charts>.

長期以來奉行的「精幹有效」的最低限度核武庫形象。¹²根據美國國防部（US Department of Defense, DoD）發布的 2024 年《中國軍力報告》，截至 2024 年中期，中國擁有的可操作核彈頭數量已超過 600 枚。¹³這一數字與 2019 年時外界普遍估計的約 200 枚相比，在短短五年內呈現了三倍的增長。¹⁴斯德哥爾摩國際和平研究所（SIPRI）在其《2025 年鑑》中也給出了相似的評估，確認中國截至 2025 年 1 月擁有至少 600 枚核彈頭，並指出其核武庫正以每年約 100 枚新彈頭的速度增長，是全球所有核武國家中擴張速度最快的。¹⁵倘若這一增長趨勢預計將持續，中國的核彈頭總數將在 2030 年超過 1,000 枚，並可能在 2035 年達到 1,500 枚的驚人水準。倘若這一預測成為事實，中國將在部署的核彈頭數量上，達到與美國和俄羅斯三足鼎立的核均勢格局，從而根本性地改寫全球核力量的戰略版圖。

表 2-1、中國核武數量統計與預估

年份	美國國防部（DoD）估計	斯德哥爾摩國際和平研究所（SIPRI）估計
2019	約 200+	-
2023	500+	500
2024	600+	-
2025	-	600+
2027（預測）	700+	-
2030（預測）	1,000+	-
2035（預測）	1,500	1,500

資料來源：作者統整自公開情資。

¹² 林柏州，〈美國國防部「2022 年中共軍力報告」的火箭軍戰力評估〉，《國防安全研究院即時評析》，2022 年 12 月 8 日，<https://indsr.org.tw/focus?uid=11&pid=532&typeid=22>。

¹³ David Sacks, “Six Takeaways From the Pentagon’s Report on China’s Military,” *Council on Foreign Relations*, December 20, 2024, <https://www.cfr.org/blog/six-takeaways-pentagons-report-chinas-military>.

¹⁴ Joseph Rodgers and Heather Williams, “Parading China’s Nuclear Arsenal Out of the Shadows,” *CSIS*, September 4, 2025, <https://www.csis.org/analysis/parading-chinas-nuclear-arsenal-out-shadows>.

¹⁵ *Supra* note 4.

二、戰備狀態的演變：從「彈頭與載具分離」到「預警反擊」

除了庫存數量的大幅擴張，另一個值得關注的焦點是中國核力量戰備狀態可能開始變化。過去為了體現其「不首先使用」的防禦性核政策，中國長期奉行較低的戰備等級，即在和平時期將核彈頭與其運載工具（飛彈）分開儲存，不處於隨時待命的發射狀態。這種「彈、具分離」的姿態，雖然降低了意外發射的風險，但也意味著其反應時間較長。¹⁶

然而，美國國防部的報告明確指出，隨著中國核力量的現代化，特別是其生存能力的增強和預警系統的完善，這種傳統姿態可能正在發生根本性改變。¹⁷ 該報告評估，解放軍正致力於在 2030 年前實現一種被稱為「預警反擊」(Launch-on-Warning, LOW) 的作戰態勢。這意味著，中國的核力量將具備在通過衛星和地面雷達等預警系統探測到敵方洲際彈道飛彈來襲後，在這些敵飛彈擊中中國領土前，下令發射核武器進行報復性反擊的能力。¹⁸

然而，要實現「預警反擊」，不僅需要高度整合且可靠的早期預警、指揮與控制系統，也必然要求部分核武器（至少是發射井內的飛彈）處於更高的戰備狀態，即彈頭與飛彈結合，隨時準備在接到命令後數分鐘內發射。這一轉變倘若實現，代表著中國核力量從一支純粹的「二次打擊」力量，向一支具備快速反應能力的嚇阻力量演進。¹⁹

值得注意的是，除了「預警反擊」(LOW)，核戰略光譜中亦存在「遭攻擊下發射」(Launch-under-Attack, LUA) 的姿態。LOW 依賴早期預警系統（如衛星、雷達）偵測到敵方洲際彈道飛彈發射即發動反擊；而 LUA 則是在確認敵方飛彈確實朝本國領土而來，並在飛彈落地前發射

¹⁶ Mark A. Stokes, "China's Nuclear Warhead Storage and Handling System," *Project 2049*, March 12, 2010, https://project2049.net/wp-content/uploads/2018/05/chinas_nuclear_warhead_storage_and_handling_system.pdf.

¹⁷ US DoD, "Military and Security Developments Involving the People's Republic of China 2024," *Annual Report to Congress*, December 2024, <https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF>.

¹⁸ *Ibid.*

¹⁹ Gregory Kulacki, "Xi Jinping's Thoughts on China's Nuclear Weapons," *the Equation*, April 1, 2024, <https://blog.ucs.org/gregory-kulacki/xi-jinpings-thoughts-on-chinas-nuclear-weapons/>.

核武力進行報復。²⁰ 解放軍若轉向「預警反擊」姿態，其對戰略穩定的衝擊，遠大於「遭攻擊下發射」。LOW 對預警系統的準確性要求更高，大幅壓縮了決策時間（從數小時縮短至數分鐘），顯著增加了因「錯誤警報」而意外觸發核戰的風險。

此外，在評估中國「不首先使用」政策的演變時，亦須考量其主要對手（美國）的政策作為平衡。美國從未承諾「不首先使用」核武器。根據美國最新的《2022 年核態勢評估報告》（Nuclear Posture Review），華盛頓保留在「極端情況下」使用核武器以保衛自身及其盟友重大利益的權利，這被廣泛解釋為可能包含應對重大的非核戰略攻擊。²¹因此，中國的戰略轉型，也可被視為是對其所感知到的（來自美國的）先制打擊威脅所做的回應，即便這使其自身的「不首先使用」承諾可信度下降。

三、「裂變材料」生產的瓶頸與突破

（一）核心設施：CFR-600 快中子增殖反應爐

核彈頭數量的擴張，其物質基礎在於充足的武器級「裂變材料」（Fissile Materials，主要是鈾-235 和高濃縮鈾）供應。長期以來，「裂變材料」的產能被視為限制中國核武庫規模擴張的主要瓶頸。然而，近年來中國在「核燃料循環」領域（Nuclear Fuel Cycle）的兩大突破，正從根本上解決這一問題。位於福建省霞浦縣的兩座 CFR-600 型「鈉冷快中子增殖反應爐」（Sodium-cooled Fast Breeder Reactor）的建設與投產，是中國核工業乃至核武計畫的里程碑。第一座反應爐已於 2023 年成功啟動並實現低功率運行。與傳統的壓水堆核電站主要消耗核燃料不同，快中子增殖反應爐在發電的同時，能夠將反應堆中的鈾-238 轉化為鈾-

²⁰ Center for Strategic and International Studies (CSIS), "Launch on Warning and Launch under Attack," *Missile Defense Project*, last modified June 15, 2021, <https://missilethreat.csis.org/launch-on-warning-and-launch-under-attack/>; Natalie Montoya and R. Scott Kemp, "Launch Under Attack: A Sword of Damocles," *War on the Rocks*, March 17, 2023, <https://warontherocks.com/2023/03/launch-under-attack-a-sword-of-damocles/>.

²¹ Arms Control Association, "The 2022 U.S. Nuclear Posture Review," *Fact Sheets*, November 2022, <https://www.armscontrol.org/factsheets/2022-US-Nuclear-Posture-Review>.

239，其產生的裂變材料比消耗的還多，因此被稱為「增殖」反應爐。²²

更為關鍵的是，從快中子增殖反應爐的「已使用核燃料」(Spent Nuclear Fuel)中提取的鈾，其同位素純度非常高，是製造核武器的理想材料。²³儘管中國政府一再聲明 CFR-600 項目純粹用於民用發電和科研，但其自 2017 年起便停止了向國際原子能總署(International Atomic Energy Agency, IAEA)自願申報其國內鈾庫存的慣例，此舉引發了國際社會對其將這些反應爐用於軍事目的的廣泛擔憂。²⁴北京當局於 2016 年最後一次申報的民用鈾庫存約為 40.9 公斤。²⁵根據一些獨立機構的分析，若兩座 CFR-600 反應爐進入穩定運行狀態，其每年產出的武器級鈾總量可能超過 330 公斤。²⁶按照每枚核彈頭需要約 3.5 公斤鈾的核心計算，這意味著僅這兩座反應爐的年產能就足以支持製造近百枚新的核彈頭。這也說明了為何美國國防部預測中國核彈頭數量將在 2030 年後突破千枚。

(二)「核再處理」設施建設

要將反應爐產生的「已使用核燃料」轉化為可用於武器的鈾，必須經過一道稱為「核再處理」(Nuclear Reprocessing)的複雜化學分離工序。衛星圖像及公開的商業招標文件顯示，中國正在甘肅省金塔縣的核技術產業園區內，加速建設一個規模龐大的核燃料再處理基地。²⁷該基地規劃了多個大型後處理廠。其中，第一座年處理能力為 200 噸「已使用核燃料」的示範工廠預計將在 2025 年投入運營，而第二座和第三座同等規模的工廠也已動工建設。²⁸與此同時，為實現核燃料閉合循環而配套

²² Yuki Kobayashi, "China's Fast Breeder Reactor Operating? Possibility of Accelerating Nuclear Arms Race," *Sasakawa Peace Foundation*, November 30, 2023, <https://www.spf.org/spf-china-observer/en/eisei/eisei-detail006.html>.

²³ *Ibid.*

²⁴ Sulgiye Park, "Is Russia Helping China Expand Its Nuclear Weapons Program?" *the Equation*, September 19, 2024, <https://blog.ucs.org/sulgiye-park/is-russia-helping-china-expand-its-nuclear-weapons-program/>.

²⁵ International Panel on Fissile Materials, "China," May 22, 2025, <https://fissilematerials.org/countries/china.html>.

²⁶ Yuki Kobayashi, *op. cit.*

²⁷ World Nuclear Association, "China's Nuclear Fuel Cycle," April 25, 2024, <https://world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-fuel-cycle>.

²⁸ Hui Zhang, "China Starts Construction of A Third Demonstration Reprocessing Plant," *IPFM Blog*, December 24, 2024,

的「混合氧化物」(Mixed Oxide Fuel, MOX) 燃料生產線也在同步建設中。²⁹ 這一系列基礎設施的建設表明，中國不僅在解決裂變材料的「生產」問題，也在建立規模化的「提取」和「再利用」能力。通過建立自主可控的快中子增殖反應爐和大型後處理設施，中國正在構建一個完整的、可持續的核燃料循環體系。這不僅是為了滿足當前核武庫擴張的需求，更是為了發展一種長期的、不受外部供應鏈中斷或國際制裁的戰略核力量。這意味著中國的核擴張並非一次性的短期衝刺，而是一個經過深思熟慮、有著強大工業基礎支撐的長期、系統性國家戰略工程。

肆、核三位一體打擊載具的現代化進程

中國正在全力打造一個由陸基、海基和空基平台組成的現代化核三位一體打擊體系。其發展路徑清晰地呈現出「以陸基為核心，以海基求延伸，以空基補短板」的戰略佈局，在各個領域均加速追趕美、俄的水準。特別是在 2025 年 9 月 3 日舉行的紀念抗戰勝利 80 週年閱兵式上，解放軍首次集中展示了其陸、海、空三位一體的戰略核力量，公開了多款此前從未亮相或僅有少量資訊的新型核打擊載具，向外界傳達了其核武庫在質與量上均取得大幅進展的戰略訊號。³⁰

一、陸基核力量：核心能力的再強化

解放軍火箭軍 (People's Liberation Army Rocket Force, PLARF) 掌管的陸基彈道飛彈，一直是中國核嚇阻力量的關鍵組成。近年來的發展重點在於通過增加數量、提升生存能力和打擊精度，來強化這一核心支柱。例如，國際社會通過商業衛星圖像，在中國北部地區發現了三個規模龐大的洲際彈道飛彈發射井場，分別位於甘肅玉門、新疆哈密和內蒙古杭錦旗，總計建造了約 320 個現代化發射井。³¹美國國防部的報告確

https://fissilematerials.org/blog/2024/12/china_starts_construction_2.html.

²⁹ *Ibid.*

³⁰ Hans Kristensen & Eliana Johns & Matt Korda & Mackenzie Knight-Boyle, "Nuclear Weapons At China's 2025 Victory Day Parade," *Federation of American Scientists*, September 4, 2025, <https://fas.org/publication/nuclear-weapons-at-chinas-2025-victory-day-parade/>.

³¹ Hans M. Kristensen, Matt Korda, Eliana Johns, Mackenzie Knight-Boyle, "Chinese Nuclear Weapons, 2025," *the Bulletin of the Atomic Scientists*, March 12, 2025, <https://thebulletin.org/premium/2025-03/chinese-nuclear-weapons-2025/>.

認，這些發射井場已於 2022 年基本完工，並且解放軍火箭軍已開始向其中一部分發射井裝填飛彈。³²

除了這批新建的發射井，中國還在中部和東南部地區對原有的液態燃料飛彈陣地進行了現代化改造，並新建了約 50 個加固發射井。這一系列建設使得中國擁有的洲際彈道飛彈發射裝置總數（包括發射井和機動發射車）已超過 550 個，在數量上首次超越了美國現役的 400 個陸基發射井。³³ 在部署的型號方面，北部地區新建的發射井預計主要用於部署更具生存能力的固體燃料飛彈，如東風-31A 以及更先進、能夠攜帶多枚分導式彈頭的東風-41。而中部地區的發射井則用於部署威力巨大、可攜帶數百萬噸級當量彈頭的東風-5C 液體燃料飛彈。³⁴

這種大規模建造發射井的策略，其戰略意圖是多層次的。除了直接部署飛彈外，形成一種與冷戰時期美蘇對抗所採取的「殼體遊戲」(shell game) 一樣的手法，即透過大量的空置發射井與實彈發射井混雜部署，這將極大增加對手在衝突中進行打擊的難度和成本。因為對手將難以分辨哪些是實彈井、哪些是誘餌井，從而被迫消耗大量的偵察和打擊資源，進而提高了中國核心核力量的生存機率。³⁵ 這反映了一種已經遠超「最低限度嚇阻」範疇、經過深思熟慮的複雜生存戰略。

除了固定發射井，解放軍火箭軍還裝備了大量的公路機動發射平台，主要用於發射東風-31 和東風-41 洲際飛彈。這些機動發射車可以在廣闊的地域內進行隱蔽機動，難以被敵方衛星實時追蹤，從而極大地提高了飛彈在敵方第一波打擊下的生存能力。這種「固定發射井」與「機動發射平台」相結合的部署方式，形成了一個兼具快速反應能力和高生存能力的陸基核力量體系。³⁶

³² *Supra* note 17.

³³ *Ibid.*

³⁴ 前田祐司，〈『中華人民共和国に関する軍事・安全保障動向』——米国防総省報告書に見る中国の核・ミサイル戦力の変化〉，《NIDS コメンタリー 第 367 号》，2025 年 3 月 6 日，<https://www.nids.mod.go.jp/publication/commentary/commentary367.html>。

³⁵ Thomas Newdick “Is China Reviving America’s Cold War-Era ‘Shell Game’ ICBM Deployment Strategy?” *The War Zone*, July 1, 2021 <https://www.twz.com/41381/is-china-reviving-americas-cold-war-era-survivable-icbm-concept>.

³⁶ 同註 34。

中國擁有世界上規模最大、型號最齊全的陸基中程和中遠程彈道飛彈部隊。其中，射程約 4,000 公里的東風-26 和具備更遠射程的東風-27 是其戰區級嚇阻力量的核心。³⁷ 這些飛彈被明確定義為核、常兼備武器，既可以發射常規彈頭執行反艦或對地精確打擊任務，也可以換裝核彈頭執行戰區級的核嚇阻與核打擊任務。特別是東風-26，因其高精度和靈活性，被廣泛認為是中國在西太平洋地區實施有限核嚇阻的關鍵武器，可能搭載低當量戰術核彈頭，為中國提供比戰略核武器更靈活、更可控的核運用選項。³⁸

此外，「九三閱兵式」上出現三款引人注目的陸基洲際彈道飛彈。首先是經過重新設計的東風-5C 液態燃料洲際飛彈，其被官方媒體描述為能夠打擊全球任何目標。³⁹ 其次是全新的東風-61 公路機動洲際飛彈，這款新型號公開亮相令外界頗感意外，因其發射車與已在役的東風-41 極為相似，倘若東風-61 確實投入量產與服役，代表解放軍火箭軍正進一步多樣化其機動洲際飛彈的型號與部署方式。最後，閱兵還展示東風-31 的一款新型號——東風-31BJ，這是一款可用於發射井部署的改良型固態燃料飛彈，進一步證實中國大規模擴建發射井的戰略意圖。⁴⁰

二、海基核力量：可靠的二次打擊能力

由於對陸基核力量生存能力的長期擔憂，凸顯了發展高隱蔽性、高生存能力的海基核力量的重要性。近年來，中國海軍（PLAN）在這一領域亦取得了一定的突破。中國海軍目前已裝備至少 6 艘 094 型（晉級）戰略核潛艦。美國國防部的報告指出，這些潛艦已經開始執行常態化的「海上嚇阻巡邏」任務，這意味著中國已首次具備了「持續性海上核嚇阻存在」的能力。這標誌著解放軍終於擁有了一支真正意義上的海基核嚇阻力量，能夠在陸基力量遭受打擊後，從水下發起毀滅性的核報

³⁷ *Supra* note 14.

³⁸ Missile Defense Project, “DF-26,” *Missile Threat*, Center for Strategic and International Studies, January 8, 2018, last modified April 23, 2024, <https://missilethreat.csis.org/missile/dong-feng-26-df-26/>.

³⁹ Heather Williams and Joseph Rodgers, “Parading China’s Nuclear Arsenal Out of the Shadows,” CSIS, September 8, 2025, <https://nuclearnetwork.csis.org/parading-chinas-nuclear-arsenal-out-of-the-shadows/>.

⁴⁰ Hans Kristensen & Eliana Johns & Matt Korda & Mackenzie Knight-Boyle, *op. cit.*.

復。⁴¹

094 型核潛艦的戰鬥力核心，在於其預計搭載的巨浪-3 (JL-3) 潛射彈道飛彈。「九三閱兵式」上，巨浪-3 首次公開亮相，該型飛彈的射程被評估為超過 5,400 海里 (約 10,000 公里)，這是一個關鍵的技術突破。⁴² 這一射程意味著，中國的戰略核潛艦無需再冒險穿越第一島鏈、深入美日反潛兵力嚴密布防的西太平洋，僅需在相對安全的中國近海，如南海或渤海等受到嚴密防護的海域進行巡邏，其發射的飛彈就能夠直接覆蓋美國本土大部分地區。這極大地降低了解放軍潛艦在戰時被敵方探測和摧毀的風險。此次閱兵式的公開展示，標誌著這款關鍵的海基二次打擊武器可能已經成熟並投入部署，隨著解放軍的 094 型潛艦逐步換裝新型的巨浪-3 飛彈，將大幅增強了其海基核力量的生存性與嚇阻可信度。

此外，中國正在研發下一代的 096 型戰略核潛艦，預計將在靜音性能、推進系統和電子設備方面較 094 型有明顯的提升，並可能搭載具備多彈頭分導打擊能力的潛射飛彈。一旦 096 型服役，中國的海基核力量對美國及其友盟的威脅將達到一個新的高峰。⁴³

三、空基核力量：補齊最後一塊拼圖

相較於陸基和海基，空基核力量曾是中國核三位一體中最薄弱的一環。然而，近年來中國空軍 (PLAAF) 在這一領域也取得了長足進步。中國空軍現已列裝了轟-6K 的改進型號——轟-6N。與早期型號相比，轟-6N 最顯著的特點是具備了空中加油能力，使其作戰半徑大幅延伸，具備了洲際打擊的潛力。更為重要的是，轟-6N 的機腹經過特殊設計，能夠半埋式掛載一枚大型「空射彈道飛彈」(Air-Launched Ballistic Missile, ALBM)。⁴⁴ 此次「九三閱兵式」便首次展示了一款名為「驚雷

⁴¹ *Supra* note 17.

⁴² Brandon J. Weichert, “Why China’s New JL-3 Submarine-Launched Nuclear Missile Should Scare America,” *the National Interest*, August 27, 2025, <https://nationalinterest.org/blog/buzz/why-chinas-new-jl-3-submarine-launched-nuclear-missile-should-scare-america-bw-082725>.

⁴³ Brandon J. Weichert, “China’s Type 096 Submarine is a Nuclear Nightmare for America,” *the National Interest*, March 15, 2025, <https://nationalinterest.org/blog/buzz/chinas-type-096-submarine-is-a-nuclear-nightmare-for-america>.

⁴⁴ Parth Satam, “China’s H-6N Bomber Spotted with Air-Launched Ballistic Missile in Clearest Image Yet,” *the Aviationist*, April 6, 2025,

-1」(JL-1)的空射彈道飛彈⁴⁵。這款武器由具備空中加油能力的轟-6N 轟炸機掛載，其出現被視為解放軍補齊「核三位一體」最後一塊拼圖的關鍵標誌，意味著中國首次擁有了可信的空基核打擊能力。⁴⁶

此外，為了建立一支真正具備全球打擊能力的現代化空基核力量，中國正在全力研發一款採用飛翼佈局、類似於美國 B-2 或 B-21 的遠程匿蹤戰略轟炸機，其暫定代號為轟-20 (H-20)。一旦轟-20 研製成功並服役，其匿蹤突防能力和洲際航程，理論上能夠穿透競爭對手的防空體系，對全球任何目標實施核打擊或常規打擊。屆時，中國將建成一個能力均衡、真正意義上的現代化核三位一體體系。⁴⁷

總體而言，中國此次「九三閱兵」所展示的五款新型核打擊載具，清晰地勾勒出解放軍核力量的發展藍圖：一個由多樣化、高生存能力的陸基飛彈（涵蓋液態與固體燃料、機動與固定發射）、可靠的海基二次打擊平台，以及新生的空基打擊力量所構成的、強大且全面的核嚇阻體系。這一系列能力的公開，旨在向外界傳遞一個明確的訊息：中國的核武庫不再僅僅是一個規模有限的防禦性力量，而是一個能夠對潛在競爭對手（特別是美國）本土構成實質性威脅，企圖扼止美國在可能的區域衝突中進行軍事干預的戰略工具。⁴⁸

<https://theaviationist.com/2025/04/06/h-6n-albm-clearest-image/>.

⁴⁵ Henrik Stålhane Hiim, "The Last Atomic Waltz: China's Nuclear Expansion and the Persisting Relevance of the Theory of the Nuclear Revolution," *Contemporary Security Policy*, Vol. 45, Issue 2, January 8, 2024, <https://www.tandfonline.com/doi/full/10.1080/13523260.2023.2291258>.

⁴⁶ Joseph Trevithick, "China's JL-1 Air Launched Ballistic Missile's Official Debut Is A Big Deal," the War Zone, September 4, 2025, <https://www.twz.com/air/chinas-jl-1-air-launched-ballistic-missiles-official-debut-is-a-big-deal>.

⁴⁷ Harry Kazianis, "China's New H-20 Stealth Bomber Is Being Built for Just 1 Purpose," *National Security Journal*, September 1, 2025, <https://nationalecurityjournal.org/chinas-new-h-20-stealth-bomber-is-being-built-for-just-1-purpose/>.

⁴⁸ Kainan Gao and Margaret M. Pearson, "Military Parades and Memory Wars: China and Russia Commemorate History to Reimagine International Order," *Brookings*, August 27, 2025, <https://www.brookings.edu/articles/military-parades-and-memory-wars-china-and-russia-commemorate-history-to-reimagine-international-order/>.

表 2-2、解放軍「核三位一體」能力現況

類別	載具 型號	部署 方式	預估射程 (公里)	燃料 類型	彈頭 能力	服役 狀態
陸基	東風-5C (DF-5C)	發射井	>13,000	液體	單一 (高當量) 或 MIRV	服役中
	東風-31A/AG (DF-31A/AG)	發射井 / 公路 機動	>11,000	固體	單一	服役中
	東風-41 (DF-41)	發射井 /公路 機動	>12,000	固體	MIRV (多彈頭)	服役中
	東風-26 (DF-26)	公路 機動	~4,000	固體	核常兼備	服役中
海基	巨浪-2 (JL-2)	094 型核 潛艦	>7,200	固體	單一	服役中 (逐步被 JL-3 取代)
	巨浪-3 (JL-3)	094 型核 潛艦	>10,000	固體	單一 (可能具備 MIRV 潛力)	服役中
空基	轟-6N (H-6N) +ALBM	空中 發射	>6,000 (轟 炸機航程+ 飛彈射程)	固體 (ALBM)	核常兼備	服役中
	轟-20 (H-20)	空中 發射	洲際	-	預計 核常 兼備	研發中

資料來源：作者統整自公開情資。

伍、核武器使用原則的模糊與演變

中國的核武器使用原則，正呈現出一種「官方表述的穩定性」與「實際能力和戰略姿態的重大轉變」之間日益擴大的鴻溝。這種看似矛盾的現象，反映了其核戰略在適應新安全環境過程中的複雜調整。

自 1964 年成功進行首次核試驗以來，中國政府便向全世界公開宣布，其奉行「在任何時候、任何情況下不首先使用核武器」的政策。⁴⁹ 同時，中國還無條件承諾不對無核武器國家和無核武器區使用或威脅使用核武器。⁵⁰ 這一「不首先使用」(No First Use, NFU) 的承諾，在其歷年發布的國防白皮書中都得到了反覆重申，是中國官方核戰略的基石，也是其在國際舞台上區別於其他主要核大國的一個顯著原則。⁵¹ 例如，美國從沒宣布過「不首先使用核武」的立場，甚至 2018 年的 Nuclear Posture Review 亦曾提出針對恐怖攻擊等狀況不排除進行核報復等。⁵²

然而，儘管在官方文件中，中國的核戰略依然被描述為「自衛防禦核戰略」，其核力量規模被定義為維持在「國家安全需要的最低水平」，但其核武庫在量和質上的飛躍式發展，已使這一官方描述與現實能力產生了巨大差距。⁵³ 中國的核戰略極可能在實質上，已經從傳統的「最低限度嚇阻」(Minimum Deterrence) 演變為一種更為強硬的「保證報復」(Assured Retaliation) 戰略。⁵⁴ 這兩種戰略的核心區別在於：「最低限

⁴⁹ Henrik Stålhane Hiim, "The Last Atomic Waltz: China's Nuclear Expansion and the Persisting Relevance of the Theory of the Nuclear Revolution," *Contemporary Security Policy*, Vol. 45, Issue 2, 2024, pp. 239-264.

⁵⁰ 〈中國關於互不首先使用核武器倡議的工作檔〉，《中國外交部軍控司》，2024 年 7 月 22 日，
https://www.mfa.gov.cn/web/wjwb_673085/zzjg_673183/jks_674633/fywj_674643/202407/t20240722_11457979.shtml。

⁵¹ 〈新時代的中國國家安全_白皮書〉，《中國政府網》，2025 年 5 月 12 日，
https://www.gov.cn/zhengce/202505/content_7023405.htm。

⁵² Office of Secretary of Defense, "Countering Nuclear Terrorism," *Nuclear Posture Review 2018*, February 2018, <https://media.defense.gov/2018/feb/02/2001872877/-1/-1/1/executive-summary.pdf>.

⁵³ China Power Team, "How is China Modernizing its Nuclear Forces?" *CSIS China Power*, Updated March 19, 2024, <https://chinapower.csis.org/china-nuclear-weapons/>.

⁵⁴ Hongjung Shin and Seong-ho Sheen, "The Evolution of China's Assured Retaliation: An Analysis Focusing on the Development of China's Strategic Nuclear Submarines," *The Korean Journal of International Studies*, Vol. 23, Issue 1, April 2025, pp. 61-98,

度嚇阻」強調擁有少量能夠打擊對手城市的核武器即可構成有效嚇阻；而「保證報復」則追求一種更為可靠和強大的能力，即確保在經受敵方的第一波打擊之後，仍擁有足夠數量、具備高生存能力、且能成功穿透對方飛彈防禦系統的核力量，對敵方的高價值目標（包括軍事和經濟中心）造成其無法承受的打擊。中國當前大力發展的加固發射井、機動飛彈和戰略核潛艦，其根本目標正是為了構建這種可靠的「保證報復」能力。⁵⁵

為了更直觀地理解這一演變，我們可以將中國核戰略的發展軌跡置於一個光譜上進行觀察。光譜的最左端是純粹防禦性的「最低限度嚇阻」，其特點是規模小、戰備等級低、奉行「彈、具分離」原則，嚇阻目標僅限於阻止對手發動核攻擊。隨著能力的提升，中國進入了「保證報復」階段，其特點是中等規模的核武庫、強調平台的生存能力（如機動發射和潛艦巡弋），目標是確保在任何情況下都能對敵方造成不可承受的損失。當前的發展趨勢顯示，中國正朝著光譜上更靠右的位置移動，即「預警反擊」姿態，這要求更大規模的核武庫、高度的戰備狀態和先進的預警系統，能夠在探測到攻擊後、在核彈落地前發動反擊。而光譜的最右側則是最為激進極端的「有限核戰」策略，這意味著擁有低當量、高精度的戰術級核武器（*Tactical Nuclear Weapons*），以更為主動的態勢，在常規衝突中執行有限的、戰術性的核打擊任務。⁵⁶ 目前，中國的實際能力和姿態正處於從「確保報復」向「預警反擊」過渡的關鍵階段。

為了給其核力量的擴張提供理論依據和合法性解釋，中國的戰略學術界提出了一些新的概念，這些概念在一定程度上重新定義了戰略穩定和核嚇阻的內涵。

一、「非對稱戰略穩定」：這一理論認為，在美中這種核力量嚴重不對等的關係中，戰略穩定並非取決於數量的對等，而是取決於弱勢方（中國）的二次打擊能力是否安全。⁵⁷ 該論點支持者認為，強勢方（美國）發展飛彈防禦系統和常規精確打擊能力的行為，正在單方面破

<https://www.kjis.org/journal/view.html?doi=10.14731/kjis.2025.04.23.1.61>.

⁵⁵ *Ibid.*

⁵⁶ 謝沛學，〈為何中國核測試傳聞值得擔心〉，《國防即時評析》，2020年4月22日，<https://indsr.org.tw/focus?typeid=30&uid=11&pid=38>。

⁵⁷ Li Bin, *op. cit.*

壞這種穩定，因為它威脅到了中國的二次打擊能力。因此，為了恢復和維持「穩定」，中國有必要擴大和升級其核武庫，以抵銷美國的技術優勢，確保「相互嚇阻」的繼續存在。⁵⁸

二、「戰略嚇阻體系」：這一概念將核武器置於一個更為廣泛的國家戰略嚇阻體系之中。該體系不僅包括核力量，還涵蓋了高超音速武器等高階常規打擊力量，以及太空、網絡和電磁領域的作戰能力。這種理論模糊了核武器與非核戰略武器之間的界限，認為來自太空、網絡空間或由高超音速武器發動的大規模常規攻擊，可能產生與核攻擊相當的「戰略效應」，因此也可能成為觸發中國核反擊的條件。這為中國在更廣泛的衝突場景中運用核嚇阻，甚至在理論上降低核武器的使用門檻，提供了可能性。⁵⁹

如前所述，中國正積極發展「預警反擊」(LOW) 的作戰能力。從操作層面來看，「預警反擊」與嚴格的「不首先使用」(NFU) 政策之間存在著深刻的內在矛盾。NFU 政策的邏輯前提是，一個國家必須首先確認自己遭受了核攻擊(即承受第一波打擊)，然後才能進行核報復。而 LOW 政策則要求在敵方飛彈尚在飛行途中、尚未造成實際損害時，就依據預警系統的數據做出發射反擊的決定。這不僅對早期預警系統的可靠性提出了極高的要求，也大幅地壓縮了國家最高決策層的判斷和時間，從數小時甚至數天縮短到幾分鐘。更為危險的是，它增加了因預警系統出現技術故障或人為誤判(例如將大規模常規飛彈攻擊誤判為核攻擊)而導致核戰爭意外爆發的風險。⁶⁰

雖然從字面意義上看，LOW 仍然是一種「反擊」，但它在時間和程序上極大地模糊了「首先使用」與「報復性使用」之間的界限。這種戰略態勢的採納，即使沒有在公開聲明中放棄 NFU，也已經在實質上侵蝕了 NFU 政策的核心精神和可信度。

中國可能正在有意地製造一種「戰略模糊性」：在公開的外交和宣

⁵⁸ David C. Logan, "Chinese Views of Strategic Stability: Implications for U.S.-China Relations," *International Security*, Vol. 49, Issue 2, October, 2024, pp. 56-96, <https://direct.mit.edu/isec/article-abstract/49/2/56/125213/Chinese-Views-of-Strategic-Stability-Implications?redirectedFrom=fulltext>.

⁵⁹ *Ibid.*

⁶⁰ William Burr, "The 'Launch on Warning' Nuclear Strategy and Its Insider Critics," *National Security Archive*, June 11, 2019, <https://nsarchive.gwu.edu/briefing-book/nuclear-vault/2019-06-11/launch-warning-nuclear-strategy-its-insider-critics>.

傳層面，繼續堅持 NFU 政策，以佔據國際道義高地，並安撫周邊國家；但在實際的軍事能力建設和作戰規劃上，則朝著反應更快、更具嚇阻效果的「預警反擊」姿態發展。這種言行不一的模糊性，本身就是一種複雜的嚇阻工具，它讓潛在對手無法準確判斷中國的反應模式和核武紅線，從而在危機處理中被迫採取更為謹慎的態度，可說是一種比公開宣布放棄 NFU 更為精巧和高明的戰略。

陸、結語：中國核武發展趨勢對國際安全的衝擊

中國核武力量的快速現代化與規模擴張，其戰略影響遠遠超出了軍事技術層面，正對全球及區域安全格局產生深遠的外溢效應。

一、對美中戰略穩定的衝擊：走向核武同儕競爭

過去數十年來，美中之間的戰略穩定關係，一定程度是建立在雙方核力量極度不對稱的基礎之上的。美國擁有絕對的核優勢，而中國則滿足於維持一個小規模但可信的二次打擊能力。⁶¹ 然而，隨著中國核武庫向千枚彈頭級別邁進，並在投射載具技術上不斷追趕，這種基於不對稱的穩定正在被動搖。美國將首次面臨需要同時嚇阻兩個核實力與其相當的戰略競爭對手——俄羅斯和中國的空前困境。這將迫使華盛頓重新評估其自身的核力量規模、部署態勢和作戰準則，可能引發自冷戰結束以來新一輪的核軍備競賽。更重要的是，三方核博弈的動態遠比過去的美蘇（俄）雙邊關係複雜，危機管理和升級控制的難度將呈指數級增長，誤判的風險也隨之顯著提高。⁶²

二、台灣海峽：核陰影下的常規衝突

中國增強核力量的一個核心戰略目標，就是大幅提高美國軍事介入台海潛在衝突的成本和風險，從而達到拒止美國干預的目的。一個更強大、更具生存能力的核武庫，為中國在常規衝突層面採取更為果斷甚至冒險的行動，提供了「戰略後盾」。這引出了一個核嚇阻研究領域的典型場景，即「穩定-不穩定悖論」（Stability-Instability Paradox）：當兩個

⁶¹ Li Bin, *op. cit.*

⁶² Tong Zhao, “What’s Driving China’s Nuclear Buildup?” *Carnegie*, August 5, 2021 <https://carnegieendowment.org/posts/2021/08/whats-driving-chinas-nuclear-buildup?lang=en>.

核大國在戰略核層面達成某種相互確保摧毀的「穩定」狀態時，反而可能增加在次一級的常規衝突層面爆發戰爭的風險，因為某一方可能認為，由於核戰爭的威脅，對方不敢將常規衝突升級。⁶³ 在台海情境下，中國可能自恃其增強的核嚇阻能力能夠阻止美國的全面介入，從而更敢於發動一場有限的常規戰爭以實現其政治目標。⁶⁴

由美國著名研究機構－蘭德公司（RAND）⁶⁵ 和戰略與國際研究中心（CSIS）⁶⁶ 進行的多輪兵棋推演一致表明，台海衝突具有極高的升級風險。在激烈的常規戰鬥中，任何一方若面臨戰敗的可能，都可能面臨使用核武器以扭轉戰局或避免災難性失敗的巨大壓力。這使得核升級的風險並非遙不可及的理論，而是一個在衝突場景中真實存在且極難控制的現實危險。

三、南亞次大陸的連鎖反應

歷史上，儘管中印之間存在長期的邊界爭端和戰略競爭，但印度對中國的核優勢長期持一種相對容忍和務實的態度。⁶⁷ 然而，中國核武庫近年來的快速且不透明的擴張，正在從根本上改變印度的戰略考量。⁶⁸ 新德里的戰略界普遍認為，儘管印度無需也無力在核彈頭數量上與中國展開對等的軍備競賽，但為了維持對中嚇阻的可信度，必須在核武器的

⁶³ Glenn Herald Snyder, "The Balance of Power and the Balance of Terror," in Dean G. Pruitt and Richard C. Snyder ed., *Theory and Research on the Causes of War* (Englewood Cliffs, NJ: Prentice-Hall, 1965), pp. 114-126.

⁶⁴ Matthew Kroenig, *op. cit.*

⁶⁵ Dahlia Anne Goldfeld, Nathan Beauchamp-Mustafaga and Shawn Cochran eds., "Denial Without Disaster—Keeping a U.S.-China Conflict over Taiwan Under the Nuclear Threshold," *RAND*, November 15, 2024, https://www.rand.org/pubs/research_reports/RRA2312-1.html.

⁶⁶ Benjamin Jensen, Bonny Lin, and Carolina G. Ramos, "Shadow Risk: What Crisis Simulations Reveal about the Dangers of Deferring U.S. Responses to China's Gray Zone Campaign against Taiwan," *CSIS*, February 16, 2022, <https://www.csis.org/analysis/shadow-risk-what-crisis-simulations-reveal-about-dangers-deferring-us-responses-chinas>.

⁶⁷ Masahiro Kurita, "China-India Relationship and Nuclear Deterrence," *NIDS Journal of Defense and Security*, December 2018, https://www.nids.mod.go.jp/english/publication/kiyo/pdf/2018/bulletin_e2018_4.pdf.

⁶⁸ Rajeswari Pillai Rajagopalan, "Assessing India's Perceptions of China's Nuclear Expansion," *United States Institute of Peace*, January 2025, https://www.usip.org/sites/default/files/2025-01/sr535_assessing-indias-perceptions-chinas-nuclear-expansion.pdf.

「質與量」上做出有力回應。這可能觸發印度採取一系列的核武升級措施，包括：⁶⁹

- （一）發展射程更遠的彈道飛彈，以覆蓋中國全境的縱深目標。
- （二）印度首艘搭載核飛彈的戰略核潛艦「阿里哈特號」（INS Arighaat S3）已於 2024 年下水服役。倘若中國的核武器庫持續升級，恐將加速印度海基核力量的建設，部署更多先進的戰略核潛艦，以提高其二次打擊能力的生存性。⁷⁰
- （三）完善多彈頭分導重返大氣層載具（Multiple Independently-targetable Reentry Vehicle, MIRV）技術，以增強其飛彈的突防能力。
- （四）在內部重新審視其「不首先使用」核武器的政策，以應對更為複雜的嚇阻環境。

印度的這些反應，倘若逐步實現，將不可避免地加劇南亞次大陸的核競賽動態。由於印度同時需要嚇阻巴基斯坦，其針對中國的核能力提升將會被巴基斯坦視為直接威脅，從而刺激伊斯蘭馬巴德尋求進一步發展其自身的核武庫，形成一個從全球（美中）到區域（中印）再到次區域（印巴）的多層次、連鎖性的安全困境。

四、美國盟友（日、韓）：對「延伸嚇阻」的挑戰

中國日益增強的、能夠直接對美國本土構成可信核威脅的能力，正嚴重挑戰美國對其亞太地區盟友（如日本、韓國）提供的「延伸嚇阻」（Extended Deterrence）承諾的可信度。這些盟友的安全保障建立在這樣一個信念之上：即在它們遭受攻擊時，美國將會動用包括核武器在內的一切力量來保衛它們。

然而，隨著中國核能力的增強，這些盟友國內的質疑聲浪將會越來越大：當東京或首爾面臨攻擊時，華盛頓是否真的願意冒著舊金山或芝加哥遭受核報復的巨大風險，來履行其條約義務？這種對美國安全承諾的疑慮，即所謂的「常一核衝突脫鉤」的風險，可能會促使這些國家尋

⁶⁹ *Ibid.*

⁷⁰ Richard Thomas, 'India's New SSBN Augments Nuclear Deterrence Against China,' *Naval Technology*, August 30, 2024, <https://www.naval-technology.com/news/globaldata-indias-new-ssbn-augments-nuclear-deterrence-against-china/>.

求更為獨立的防禦能力。在極端情況下，如果它們認為美國的核保護傘不再可靠，甚至可能引發其國內關於發展自主核武器的辯論，這將對地區穩定和全球核不擴散體系構成最為嚴峻的挑戰。⁷¹

尤其需要指出的是，朝鮮（北韓）核武計畫的快速發展，是加劇日、韓安全焦慮的另一關鍵變量。來自中國的核威脅，與來自朝鮮日益可信的核恫嚇相疊加，共同對美國的延伸嚇阻承諾構成了「雙重挑戰」。這種對美國安全承諾的疑慮，即「常一核衝突脫鉤」的風險，可能會促使這些國家尋求更為獨立的防禦能力。⁷²雖然中國的核擴張本身不等於直接導致核擴散，但它顯著增加了區域的「核擴散壓力」（proliferation pressure）。在極端情況下，如果日、韓等國最終認為美國的核保護傘不再可靠，其國內關於發展自主核武器的辯論可能將獲得更大聲勢，這將對地區穩定和全球核不擴散體系構成最為嚴峻的挑戰。

綜上所述，解放軍的核武現代化，特別是朝向「預警反擊」（LOW）姿態的轉變，對戰略穩定的破壞尤為顯著。LOW 姿態的脆弱性（對預警系統的依賴）和模糊性（敵方難以辨別常規或核打擊），使其在危機中極易引發誤判，導致衝突的非自願升級。面對此一嚴峻趨勢，本文提出以下政策性思考：

- （一）重啟並深化美中戰略穩定對話：美中兩國亟需建立一個常態化、高層級的「戰略穩定與風險管控對話」機制。對話的重點不應強求軍備控制，而應聚焦於降低誤判風險，例如就各自的核戰略（特別是 LOW 與 NFU 的矛盾）進行透明化交流，並探討危機溝通的 SOP。
- （二）建立區域性核風險溝通管道：鑑於中國的核力量亦對印度、日本等國產生連鎖反應，建立一個包含美、中、俄、印、日、韓、朝等相關方的多邊「區域核風險降低中心」（Regional Nuclear Risk Reduction Center）概念，雖具挑戰性，但值得長遠探索。

⁷¹ John Lee & Lavina Lee, *op. cit.*

⁷² Gettinger, Daniel M.; Nikitin, Mary Beth D, “North Korea’s Nuclear and Missile Program,” *Congress Research Service*, updated September 26, 2025, <https://www.congress.gov/crs-product/IF10472>.

- (三) 強化危機管理機制：在台海等潛在爆發點，美中兩軍必須確保現有的軍事熱線（如國防部通話）在危機中真正有效。此外，應探索建立針對「戰略性非核攻擊」（如針對對方預警衛星或指揮中心的網路攻擊）的專門溝通機制，以避免此類攻擊被誤判為核打擊的前奏，進而觸發 LOW 反應。⁷³

⁷³ James M. Acton, "Minimizing the Risk of Nuclear Miscalculation with China," Carnegie Endowment for International Peace, January 27, 2025, <https://carnegieendowment.org/2025/01/27/minimizing-risk-of-nuclear-miscalculation-with-china-pub-91419>.

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Taiwan's Evolving Defense Strategy: The Shift to Asymmetric Warfare since the 2011 Defense White Paper

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Abstract

Taiwan's defense strategies are critically important in the contemporary world because their failure has the potential to shift the balance of power and bring devastating consequences to the region. Their defense is also dependent on the United States, which has assisted Taiwan for more than several decades. With the unstable security environment in the region, it becomes crucial to thoroughly research the defense mechanisms Taiwan has in place in order to deter China effectively.

This research hypothesizes that the strategic shift toward asymmetric warfare capabilities was a rational adaptation urged by a convergence of internal factors and external threats. The paper dives deep into internal and external reasons behind this non-traditional shift, marked by the adoption of the 2011 Defense White Paper.

Internal struggles examined include economic decline, insufficient resources, lack of military-aged citizens, declining birth rates, and a low defense budget. The research thoroughly debates China's actions, demonstrating the increased number of activities in the Taiwan Strait by providing examples of Air Defense Identification Zone (ADIZ) incursions, military exercises, and cyberattacks. External pressure also stems from a

decline in United States guarantees with a continuous strategic ambiguity approach, which has proven to be ineffective in deterring China's development. The United States advocated for the self-reliance of Taiwan and pushed for it by maintaining strategic ambiguity. The paper also thoroughly examines the implementation of the new strategy, specifically analyzing the creation of the Overall Defense Concept (ODC) and the development of key asymmetric assets like the Hsiung Feng III missile and the Indigenous Defense Submarine (IDS) Program. Furthermore, the paper also pinpoints the challenges and limits of the strategy, addresses specific vulnerabilities (such as gaps in cyber defenses) and highlighting the necessity of leveraging external support to achieve the self-reliance.

Ultimately, by examining these internal and external pressures, the research aims to explain the reasons behind the adoption of asymmetric warfare. The development of asymmetric assets compels Beijing to respond with unprecedented intensity. The research findings can be used as an analytical tool for policymakers, scholars, and readers to navigate the complex relationships in the Asia-Pacific region.

Keywords: Asymmetric Warfare, Taiwan Defense, Strategic Ambiguity, Overall Defense Concept (ODC), People's Republic of China (PRC), Taiwan Strait, self-reliance.

台灣不斷演變的國防戰略： 自 2011 年國防白皮書發布以來 朝向不對稱戰爭的轉變

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摘 要

在當今世界，台灣的防衛戰略至關重要，因為其失敗可能改變權力平衡，並給該地區帶來毀滅性後果。台灣的防禦也依賴美國，美國已援助台灣數十年。鑑於該地區安全環境的不穩定，深入研究台灣現有的防禦機制，以有效遏制中國，顯得尤為重要。

本研究假設，向不對稱作戰能力的戰略轉變是內部因素和外部威脅共同作用下的一種理性妥協。本文深入探討這項非傳統轉變背後的內、外部原因，其標誌是 2011 年《國防白皮書》的發布。

內部挑戰包括經濟衰退、資源匱乏、適齡兵役人口不足、出生率下降、國防預算不足。該研究深入探討了中國的行動，透過防空識別區入侵、軍事演習和網路攻擊等實例，展現了其在台灣海峽日益頻繁的活動。外部壓力也源自於美國持續的戰略模糊政策，以及對台灣的保障力度下降，而這種政策已被證明無法有效遏止中國的發展。美國主張台灣自力更生，並透過維持戰略模糊政策來推動這一目標的實現。本文並深入分析新戰略的實施，重點關注「全面防禦概念」（ODC）的構建以及雄風三型飛彈和自主防禦潛艇（IDS）計劃等關鍵非對稱武器的研發。此外本文還指出該策略的挑戰和侷限性，探討具體的脆弱性（例如網路防禦方面的漏洞），並強調利用外部支援實現自力更生的必要性。

最後，透過分析這些內外壓力，本研究旨在解釋非對稱戰爭興起的原因。不對稱資產的發展迫使北京以前所未有的力道回應。研究成果可作為政策制定者、學者和讀者理解亞太地區複雜關係的分析工具。

關鍵詞：不對稱戰爭、台灣國防、戰略模糊性、整體防禦概念（ODC）、中華人民共和國（PRC）、台灣海峽、自力更生。

I. Introduction

Ever since the China-Taiwan conflict began in 1949, managing the security environment in the Asia-Pacific region has become a challenge. Currently, the major source of tension is Taiwan's aspirations for sovereignty. Their objective is met with political, economic and military obstacles from the People's Republic of China (PRC), which will be thoroughly discussed in the second chapter. Since only a few states recognize Taiwan, they wish to expand the established claim by shifting existing flawed policies and setting objectives that will eventually result in international recognition. One of the most notable milestones for Taiwan is the adoption of the 2011 Defense White Paper, which marked progress in defensive strategy and introduced the new era of asymmetric warfare capabilities.

Over time, Taiwan's perception of the Chinese threat has evolved. The process is accentuated by numerous events such as China's incursions into Taiwan's Air Defense Identification Zones, swift Chinese responses to visits by U.S. officials to Taiwan, economic manipulations, coercive signals and China's Anti-Secession Law (2005). The latter has become a red light for Taiwan's path to independence as it authorizes the use of force if Taiwan formally declares itself as an independent country. Faced with ongoing pressures, the decision to adopt asymmetric warfare did not happen in one day. It was a lengthy process filled with costly decisions and deliberate actions. Both internal and external factors played a crucial role in the decision-making process. The shift to asymmetric warfare is a recalibration of its defense priorities and an acceptance that matching China's capabilities is neither necessary nor achievable. This choice was symbolic and displayed an alteration from the traditional to the contemporary strategic era. Amid the transformation, navigating the political environment in the Asia-Pacific has become extremely difficult. Taiwan has shown the will to engage proactively and take the necessary steps to strengthen its international standing, setting the stage for strategic decisions.

The 2011 White Paper was adopted to manage the external and internal hurdles. Declining birth rates, shrinking defense budgets, economic reliance

on China and its incursions accompanied by warning messages, and the ambiguous nature of U.S. support all became a tipping point, prompting Taiwan to make non-traditional decisions and prioritize self-reliance. On the other hand, President Ma Ying-jeou's administration (2008-2016) pursued closer economic ties with China in hopes of de-escalating the situation in the Taiwan Strait; however, Beijing's main objective, the unification, remains unchanged. Despite them being on stable ground at that time, China still used cyberattacks, diplomatic pressure, and military exercises to demonstrate its unmoved position. Asymmetric warfare was a calculated choice and could shift the scale in Taiwan's favor. Because of limited resources, they cannot make significant developments in this area without the backing of dominant friendly nations.

To add to this, the partnership with the United States has significantly affected Taiwan's domestic and foreign policies. Despite their historical partnership in the Taiwan Strait Crisis, uncertainty surrounds the U.S. commitments. It is worth noting that presidential changes and thus shifting foreign policies have affected Washington's stance and perception of Taiwan. For instance, Barack Obama's presidency marked the time for cautious engagement. They avoided openly supporting Taiwan because maintaining a solid relationship with the more powerful and more developed China was their top priority. China, after all, posed the greater threat, and the administration had no interest in stirring up trouble or inviting retaliation. At the same time, they kept their relationship steady with Taiwan. During the Trump administration (first term), it was evident that Taiwan was seen as a deterrent to China's rise. More than \$18 billion in arms sales were approved, underscoring the importance of deterring China's hegemony. Notably, Trump's first term is noteworthy exactly for this reason; it was one of the most active periods during US-Taiwan relations. As for President Joe Biden, he also mentioned that support would be provided in case of an attack from China. The assistance in arms was substantial during his presidency as well.

Additionally, it is crucial to mention Trump's second term, which is more cautious and leans towards strategic ambiguity. They encouraged Taiwan to increase defense spending, which sparked dissatisfaction. Trump is

critical of Taiwan's defense spending. Defense accounts for 3% of its gross domestic product (GDP). Trump mentioned that the number should be at least 10 percent. Elbridge Colby, now Under Secretary of Defense for Policy, stated his support to President Trump's perception and believes Taiwan should focus more on defense.¹

As Beijing continued developing A2/AD (Anti-Access, Area-Denial) capabilities and with the U.S. offering no clear assurances regarding its support for Taiwan in the event of an attack (Donald Trump made no direct commitments on this matter), self-reliance through an asymmetric warfare strategy became the only viable path to survival. This was a deliberate, calculated decision - the culmination of more than a decade of events surrounding the island.

Given the developments discussed above, it is worth examining why Taiwan adopted a different strategy, leading to the part of the study around which the paper is constructed. The most important question this research thoroughly answers is: Why did Taiwan opt for an asymmetric warfare strategy with the 2011 Defense White Paper? The question is multifaceted and allows for a broader understanding of the topic by providing information about Taiwan's strategic evolution. It is imperative to discuss every angle to reach objective conclusions. For this reason, the paper will address internal and external reasons behind this non-traditional shift.

Current events in the Taiwan Strait signal the escalation in conflict. The asymmetric warfare strategy has the potential to become a decisive factor for regional stability. Such a seemingly small decision, the deviation from regular policies, can have a tremendous impact, which is why it is beneficial to discuss this topic thoroughly. This paper aims to offer a wide-ranging view of the possibility of overcoming pressure and choosing the most valuable choice. The research findings can be used as an analytical tool for policymakers, scholars and readers to navigate the complex relationships in the Asia-Pacific

¹ T. J. Shattuck, "The Return to Strategic Ambiguity: Assessing Trump's Taiwan Stance," *Foreign Policy Research Institute*, May 7, 2025, <https://www.fpri.org/article/2025/05/the-return-to-strategic-ambiguity-assessing-trumps-taiwan-stance/>.

region.

II. The Evolution of Taiwan's Defense Strategy

A. Taiwan's Internal Hurdles before 2011

Taiwan's defense strategy evolution is multifaceted and consists of various broad perspectives. Historically, Taiwan has mostly been in a defensive mode. It has limited resources and cannot be considered an aggressor, as it cannot afford such an audacious attitude with the regional hegemon nearby. The island has always been focused on countering a possible invasion by China. They relied on tanks, fighter jets, naval ships and other traditional military hardware to have a sense of security. However, considering the restricted resources, it became impossible to maintain this model. With China's developments, it also became unmanageable to follow their progress and acquiring new and strategic defense mechanisms turned out to be the solution.

Demographic changes became one of the pressing issues for Taiwan. With the ageing population and one of the lowest birth rates, the concerns are alarming. Low birth rate is directly connected to the decline in military-aged citizens. When there is a shortage of manpower in the army, the internal situation is in decline and the actor is left vulnerable. After the move towards All-Volunteer Force (AVF), the volunteers are not inspired to serve due to the poor working conditions and low wages. The populace did not have faith in the military's ability to defend Taiwan. They were not keen on supporting another defense strategy because the previous ones effectively malfunctioned. The scandals about corruption in the military contributed to the lack of faith. The population saw the military service as an obligation, not a duty. This part became clear for the decision-makers and instead of attempting to match China's military might, they decided to establish a defensive stance. AVF remains one of the core initiatives aimed at modernization. With the correct path, it has the ability to become successful and influential in asymmetric defense.

It is notable here that Taiwan's internal problems are not limited to AVF,

low birth rate and insufficiency of middle-aged manpower. Dependence on the United States created certain challenges as well. The Taiwan Relations Act (TRA) (1979) assures the superpower's assistance in case of an attack from the PRC. Under George W. Bush's presidency, the assistance was delayed and even frozen because the administration had concerns about cross-strait relations and their stability. Overdependence always comes at a cost. Such actions by the US led to uncertainty and Taipei started to doubt its commitment to a strategic partnership. Programs, such as IDF (Indigenous Defense Fighter), were costly and relied on external support, mainly from the United States. IDF aimed to develop a domestically produced multirole combat aircraft. It was alarming to see that such development was impossible without external help. The lack of resources is yet another reason why Taiwan decided to become more self-reliant and not to put "all eggs in one basket".

Another crucial program was Sky Bow (Tien Kung) Surface-to-Air Missile System. The Tien-Kung is an advanced, sophisticated, mobile, air defense system (For detailed information visit the link mentioned below).² It is a conventional asset and can have certain advantages, though its use will be limited against a more developed tools of PLA. Considering limited resources and capabilities, Taiwan needed US radar technology (phased array radar systems) to succeed in this program. As the U.S. is Taiwan's unofficial ally, its assistance is appreciated across all key areas of Taiwan's defense and development efforts. Significant financial aid from the superpower resulted in numerous successful technology developments.

To sum up, Taiwan's dependence on the US exposes vulnerabilities such as low defense spending and ineffective tactics, limited domestic resources and lack of strategic autonomy. All three combined create the need for Taiwan to urgently address these issues and eradicate any vulnerabilities that may be used as leverage. Furthermore, tackling demographic, financial and strategic matters will be beneficial for the stronger strategic defense Taiwan requires.

Another important aspect that directly eliminates the possibility of

² Army Technology, "Tien-Kung III (Sky Bow III) Surface-to-Air Missile System," March 23, 2016, <https://www.army-technology.com/projects/tien-kung-iii-sky-bow-iii-surface-to-air-missile-system/>.

strong development is the overdependence on China's trade relations. This seems like an external factor; however, the impact PRC has on Taiwan's internal politics is immense. China is Taiwan's largest trading partner. This allows the use of dependence as leverage and the possibility of manipulating Taiwan's behavior on the international and regional scale. The New Southbound Policy (NSP) focused on reducing dependence and decentralizing resources. Taiwan decided to avoid having "all eggs in one basket". The policy achieved success after its adoption in 2016. With the data about exports to US reaching \$111.4 billion, the numbers with Association of Southeast Asian Nations (ASEAN) also increased 15.1 percent. Both numbers indicated a new peak.³ The increased numbers point to the reduction in exports to China. The exports to China and Hong Kong dropped significantly to 31.7 percent, which marked the lowest number in 23 years.⁴ The NSP achieved success in 7 short years; more success of this policy is still to be expected. Despite the decreased numbers resulting from the NSP, the dependence is high but possible to reduce. Furthermore, insufficient funds and a declining economy became a pressing issue because a strong economy is crucial for developing a solid military and defense. Not including it, the actor is perceived as vulnerable and subject to manipulation, scrutiny and pressure. One of the most important driving forces for young men in the military is the money they can earn to provide for their families. Since Taiwan's economy wasn't strong and durable, people had their concerns about the possibilities the military service could have for their family's well-being.

In conclusion, declining birth rates, decreased military-age manpower, overdependence on the United States' assistance, economic overdependence on China, insufficient funds to support key aspects of defense, and lack of trust in the population were the main internal issues that led to the adoption of an asymmetric warfare strategy. Evidently, with the external factors that will be discussed in the upcoming chapters, the internal situation also played

³ "Taiwan Reports 2nd Highest Foreign Trade in 2024," *Taiwan Today*, February 26, 2025, <https://www.taiwantoday.tw/Economics/Top-News/266277/Taiwan-reports-2nd-highest-foreign-trade-in-2024>.

⁴ *Ibid.*

a crucial role in the development process.

B. Understanding the 2011 Defense White Paper with the Focus on Asymmetric Warfare

In 1997, the U.S. Department of Defense's Quadrennial Defense Review (QDR) marked a significant acknowledgement of an asymmetric warfare as a tactic against powerful nations. The word "asymmetry" made its debut in this official document. The paper mentioned the opponents of U.S. started using asymmetric methods because the superpower has advanced conventional weapons that will render any of its competition ineffective.⁵ The year 2011 marked an important date for Taiwan as it was the first time the administration used the term asymmetric warfare and officially embraced the concept that had been circulating since 1997. The decision was made about the vitality of altering the path they followed since 1949. Released in July 2011, Taiwan's National Defense Report (the equivalent of its White Paper) marked an unprecedented event in both tone and content. The report is extensive and includes key aspects of Taiwan's concerns and approaches regarding China, the U.S. and other pressing issues. The security environment is thoroughly discussed. Since one of China's most important policies is its A2/AD concept. The paper regarding these reads:

'In view of the U.S. Army's active joint air and sea operation exercises recently, and its adjustment of force deployment in the Asia-Pacific, moving its forces forward for capability preservation, the PLA has thus been actively developing "anti-access/area-denial" capabilities in recent years to enhance the effectiveness of its intimidation strategy. As of 2010 the PLA Air Force and Navy possess joint fire support strike capabilities to penetrate the first island chain, forcing the U.S. and other states in the region to face the fact of the PRC's military expansion. Furthermore, although the quantity of new

⁵ U.S. Secretary of Defense, *Report of the Quadrennial Defense Review* (Washington, D.C.: U.S. Department of Defense, 1997), pp. 1-69, <https://history.defense.gov/Portals/70/Documents/quadrennial/QDR1997.pdf?ver=2014-06-25-110930-527>.

*equipment outfitted by the PLA in 2010 was relatively less than past years, it is the likely result of immense defense funding invested in the development and production of long-range delivery equipment for its armed forces and second artillery. In the future, as this equipment is developed and outfitted, it will help the PLA accumulate area-denial capabilities.”*⁶

In this part, Taiwan emphasized the real possibility of the concept's success, which will have serious consequences for the region. The shift in U.S. strategy in the Asia-Pacific is notable because its primary countermeasure is an area-denial approach, which will prevent it from assisting Taiwan in combat. The power competition between two superpowers is also mentioned in the white paper. The extensivity of the information provided signals the grasp Taiwan has of the ongoing events. The previous behavioral patterns by China and the US are also considered to form a strong, example-based hypothesis.

Another notable part accentuated in the report is the defense strategy: Taiwan is not focused on aggression or adopting an offensive posture; rather, it focuses on defense and prosperity through peace. Their objective is to prevent war, withstand attacks and launch effective countermeasures in case deterrence fails. This is a defensive realism orientation because realists also see the conflict as a last resort if the survival of an actor is threatened. The defense white paper is focused on strengthening joint operations, enhancing force mobility, and building a layered defense system; all of them united are designed to make Taiwan stronger to withstand an attack. The objective is to survive against China and the defensive strategy strengthens idea about Taiwan wanting peace and prosperity. It is repeatedly mentioned in the report that peace in the Taiwan Strait is crucial and Taipei will ensure that this hope will be strengthened by appropriate events and relevant actions. Their aim is to build defense force with wide-ranging capabilities, to provide defense to the nation and safeguard it.⁷

⁶ National Defense Report Editing Committee, Ministry of National Defense, *2011 ROC National Defense Report*, 1st ed. (Taipei: Ministry of National Defense, 2011), pp. 72-73.

⁷ *Ibid.*, pp. 72-73.

Moving on to the most crucial shift demonstrated by the Defense White Paper - the Asymmetric Warfare strategy. According to the US Department of Defense, the definition of asymmetric warfare is explained in the following way: “A weaker or technologically backward opponent uses unexpected means or innovative ways to launch attacks on the weak points of stronger enemies while avoiding the sharp front of the stronger enemy.” To demonstrate how unparalleled their capabilities are, Figure 3-1 below shows the comparison of PRC and ROC military strengths. This is yet another reason why the asymmetric strategy became the most effective and advantageous option for Taiwan. Given the disparity in numbers, adopting a more clever and sustainable strategy becomes a logical long-term strategy.

	ROC Armed Forces	Category	People's Liberation Army
Total Force	Over 270,000		Over 2,300,000
Ground Forces	180,000 (including central, joint logistics, military police and reserve forces)	Force	1,284,000
	Tanks and armored vehicles: Over 1,200	Combat Equipment	Tanks and armored vehicles: Over 7,000
	Helicopters: Over 200		Helicopters: Over 400
	Heavy artillery: Over 1,000		Heavy artillery: Over 8,000
Navy	39,000	Force	264,000
	Over 180	Battleships	Over 930
	Large battleships: Over 30	Principal Combatants	Large battleships: Over 70
	Amphibious ships: Over 10		Amphibious ships: Over 40
	Submarines: 4		Submarines: Over 60
	Over 10,000	Marines	Over 8,000
Air Forces	37,000	Force	394,000
	Over 480	Fighters	Over 3,400 (including navy aviation)
	Bombers: 0		Bombers: Over 300
	Fighters: Over 380	Principal Combatants	Fighters: Over 1,880
	(F-16, M-2000, IDF and F-5E)		(J-7, J-8, J-10, Su-27, Su-30)
	Attack aircrafts: 0		Attack aircrafts: Over 300
	UAV: 0		UAV: Over 280
	Air defense missile systems: about 30		Air defense missile systems: about 1,000
Second Artillery	N/A	Force	148,000
	N/A	Strategic Missiles	Over 180
	N/A	Tactical Missiles	Over 1,400 (including cruise missiles)
	N/A	Nuclear Warheads	450-500

Figure 3-1

Source: ROC, *National Defense Report 2011*, p. 82, <https://www.ustaiwandefense.com/wp-content/uploads/2025/02/Taiwan-National-Defense-Report-2011.pdf>.

The war prevention objective is crucial because Taiwan can't withstand full scale military attack from China on its own. The Figure 3-1 is a clear demonstration of the power imbalance. The report mentions that Taiwan's military advantages provided by an opportune time, space and force will be employed to destroy enemy forces.⁸ With this, they aim to show that their strengths will be used accordingly and will give them a decisive advantage. ROC will be ready for war; however, they will try to prevent it altogether at first, because the losses outweigh the gains in their case. They will continue to boost defensive countermeasures. Furthermore, they are open to communication with the PRC and remove obstacles that undermine their successful relationship.

In addition to All-Voluntary Force, their goal is to have firmer defense mechanisms. The focus on development is apparent. By making changes to equipment, personnel management, certain laws, structure, the military has a goal to enhance the quality of its personnel and the rules of engagement, allowing them to form more capable armed forces able to withstand significant strikes.⁹ They will also develop better technology to issue warnings in case of any disturbance. This allows them to be more prepared and minimizes the risk of a surprise attack.

One of the most important parts in international relations nowadays is a collective alliance around pressing issues. Taiwan's decision to bolster its participation in the battle for regional stability is a prominent step forward. They are the first to bear the fruit of an attack if the stability is breached. Therefore, it is in their interests to protect and safeguard the stability of the Asia-Pacific region.

In conclusion, the 2011 Defense White Paper, also known as the National Defense Report, marked a historical shift for Taiwan. By acknowledging its lack of resources, China's growing development of A2/AD and frequent military exercises, dependency on the United States and shifting power

⁸ National Defense Report Editing Committee, Ministry of National Defense, *2011 ROC National Defense Report*, 1st ed. (Taipei: Ministry of National Defense, 2011), p. 102.

⁹ *Ibid.*, p. 103.

dynamics in the region prompted Taiwan to adopt a more self-reliant strategy focused on developing asymmetric warfare capabilities to counter China effectively. All of these factors collectively contributed to the shift. Take two out of the equation, and we might have ended up with a completely different scenario. Furthermore, if the aforementioned objectives such as war prevention, boosting regional stability, conflict avoidance and defensive measures signal to defensive realism. With this shift, Taiwan understands its capabilities and is focused on using its advantages, but also thinking of survival. Even though the shift to Asymmetric Warfare is not specifically mentioned in the paper, their objectives signal this important alteration in strategy. The main objective is to avoid war altogether; however, Taiwan also understands China's desire for unification is strong and will not deter with time. Therefore, the forefront of their strategy is a stable environment in the region, while also focusing on developing asymmetric capabilities in the face of an inevitable Chinese threat.

III. China's Role in Shaping Taiwan's Asymmetric Warfare Strategy

This chapter is focused on uncovering the importance of China's actions for Taiwan's strategic shift. PRC has strong objectives in the region, especially regarding unification and denying access to the United States. The consequences and effects of asymmetric warfare on China's policies will be discussed here, along with the actions that prompted the doctrinal shift. The objective is to demonstrate how successful the move has been so far, what areas were affected, and the countermeasures devised by the PRC. One of the hypotheses of this paper is to display, and strengthen with examples, that China played an important role in Taiwan's strategic shift by increasing defense spending and developing capabilities that directly undermined Taiwan's previous strategy.

Since the late 1990s, China's defense spending has considerably increased. Most experts believe the official national statistics are not entirely accurate and the numbers are far greater. The expansion rate was 16.2 percent

every year from 1999 to 2008.¹⁰ For Taiwan, this is alarming because its much smaller budget makes it impossible to match China's ability to defend or project power. A substantial boost in defense allocation was announced in March 2011, bringing China's defense budget to 601 billion RMB (US\$ 91.5 billion).¹¹ It starts to become obvious that Beijing's path to hegemony is only filled with two obstacles - U.S. and Taiwan independence issue. China cleverly uses resources to develop and become a hegemon in the Asia-Pacific region. Since their main objective is to bring the island under the control of the People's Republic of China, countermeasures are essential for Taipei to prevent this. Furthermore, the military exercises and launches China conducts around Taiwan also alarm them and prioritize survival. US government reports provide new information regarding China's missile threat to Taiwan. While China's Short-Range Ballistic Missiles (SRBMs) has remained at constant number (1200) growing numbers of Chinese cruise missiles indicates that Taiwan could face a threat of approximately 2,000 Chinese missiles.¹² A key countermeasure was developing asymmetric warfare tools such as mobile radar and hardened infrastructure to combat such attacks. Certainly, this was not the first time China launched this tactic. Even back in 1996, before the presidential elections, the PRC launched missile tests because they did not desire voters to support the candidate. The PRC Premier Zhu Rongji's display of aggression on TV by waving his fists to deter the support to DPP candidate because consequences would be alarming, indicated yet another tactic besides use of force that China tries to employ in the fight against Taiwan.¹³ This becomes a strong representation of how China wants Taiwan under its wing and united. They try to disturb any and every

¹⁰ "China Plans to Boost 2009 Military Spending by 14.9%," *The Chinese People's Liberation Army in 2025*, March 4, 2009, (Strategic Studies Institute, U.S. Army War College Press), <https://apps.dtic.mil/sti/pdfs/ADA621434.pdf>.

¹¹ Richard A. Bitzinger, "Modernizing China's Military, 1997–2012," *China Perspectives*, no. 2011/4 (2011).

¹² Richard D. Fisher Jr., "New Chinese Missile Threats to Taiwan," *Global Taiwan Institute*, July 26, 2017, <https://globaltaiwan.org/2017/07/new-chinese-missile-threats-to-taiwan/>.

¹³ Chong-Pin Lin, "More Carrot than Stick: Beijing's Emerging Taiwan Policy," *China Security*, Vol. 4, No. 1, 2008, p. 8, <https://www.files.ethz.ch/isn/48318/Vol%204%20Issue%201.pdf>.

development in Taipei, using threatening messages, military means, diplomatic pressure, etc. Another crucial example is the implementation of spyware in Taiwan's Ministry of National Defense computers. An official of Taiwan's Ministry of National Defense stated that in 2006, Taiwan detected PLA attacks that resulted in two months of construction. It took 178 days to overcome this problem because notifying Microsoft and receiving the resolution took some time. For the duration of the time, Taiwan's Ministry of National Defense was vulnerable against attacks.¹⁴ The cyberattacks were frequent against Taiwan's political institutions and agencies which made them contemplate the security and devised measures to fight it.

In recent years, China's incursions into Taiwan's Air Defense Identification Zone (ADIZ) and crossings of the median line have been more frequent than in the early 2000s. However, there are several notable instances. In 1999, PLA's fighter jets crossed Taiwan's median line of the waterway. The incursions continued until the re-election of President Tsai Ing-wen. The median is considered a buffer between PRC and ROC. China does not recognize it. It was defined again by Taiwan's Defense Ministry in 2019. This marked an important date because Taiwan has not defined its coordinates since 2004. In 2 years (2022-2024) PLAAF aircraft crossed the unofficial median line in the Taiwan Strait on an exceptionally high number of days (almost a year), indicating an escalation of military pressure.¹⁵ On August 2, 2022, Nancy Pelosi visited Taiwan. This became alarming for China because the visit marked the first time since 1997 that the US Speaker of the House visited Taiwan. China responded with one of the most frequent exercises around the island ever witnessed. They demonstrated their unwillingness to deepen US-Taiwan relations and that any further actions would not be tolerated. Figure 3-2 below shows the Taiwan Strait median line and Figure 3-3 shows how frequently it was crossed from 2019 to 2025. Showing this is crucial to understand the severity of the situation in the Taiwan Strait, to demonstrate the quickened unification processes initiated by China and the

¹⁴ Major General Huei-Jane Tschai, "Information Assurance Challenge and Readiness" (presentation, U.S.-Taiwan Defense Industry Conference, Annapolis, MD, September 11, 2007), p. 14.

¹⁵ J. Wilkes, "What Median Line?" *Domino Theory*, August 13, 2024, <https://dominotheory.com/what-median-line/>.

high risks for the Asia-Pacific region.

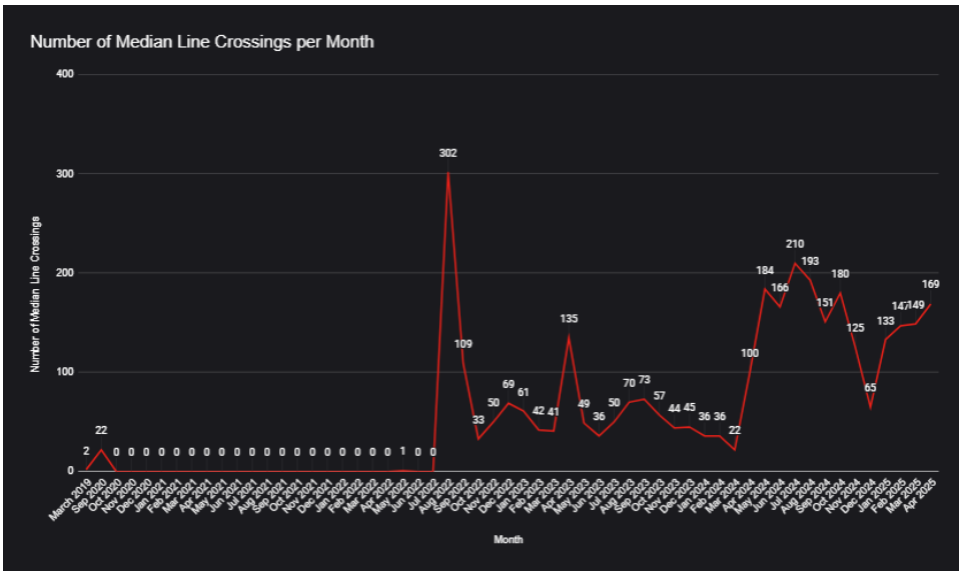


Figure 3-2

Source: “China and Taiwan ships stand off near sensitive buffer zone,” *Skynews*, April 9, 2023, <https://news.sky.com/story/china-and-taiwan-ships-stand-off-near-sensitive-buffer-zone-12853403>.

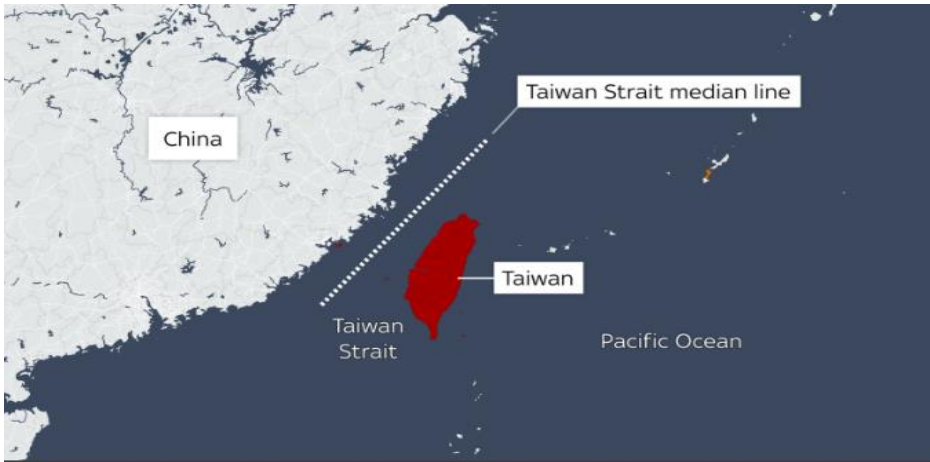


Figure 3-3

Source: PLATracker, “Median Line Crossings” category, <https://www.platracker.com/>.

Additionally, in 2004, China conducted record number of aerial drills. According to U.S. accounts, Beijing's military staged an unusually extensive and aggressive air drill. This involved dispatching over 30 aircraft sorties, organized into 10 distinct groups, to operate near the Taiwan Strait's median line. The sheer scale of this aerial display surpassed even the record set in 1998, causing extreme tension as Taiwanese authorities closely observed the unfolding situation.¹⁶ China makes such moves to deter the US-Taiwan relationship and speed up the unification process. It is evident that China's relentless pursuit of unification becomes more prominent each year and its exercises as well as intrusions become more frequent. The regular incursions in ADIZ can be seen in a spreadsheet provided by PLATracker.¹⁷ The document is informative and includes the time, dates, locations, aircraft types - all the needed data - about PLA's actions in the zone.

To understand the ongoing situation about this issue, let's observe the last reported activity in the ADIZ and median line performed by PLA. On May 31, 2025, Taiwan's Ministry of National Defense reported "5 sorties of PLA aircraft, 7 PLAN ships, 1 official ship" around Taiwan. 4 out of 5 sorties crossed the median line of the Taiwan Strait and entered Taiwan's northern and southwestern ADIZ.¹⁸ Taiwan's response was employing CAP aircraft, Navy ships and coastal missile systems to observe their activity and act accordingly. Figure 3-4 below shows the activity of PLA's military assets in the Taiwan Strait on May 31 - June 1. There are various similar reports published by Taiwan's Ministry of Defense. This, once again, suggests the unstable situation in the Taiwan Strait and without an action plan, the international community might have another war on its hands.

The consequences of the PRC's numerous calculated actions, incursions,

¹⁶ Nancy Chao, "China Conducted Huge Drills in Strait," *Taipei Times*, October 22, 2004, <http://www.taipeitimes.com/News/front/archives/2004/10/22/2003207884>.

¹⁷ This is the link for the spreadsheet mentioned above. <https://docs.google.com/spreadsheets/d/1qbfYF0VgDBJoFZN5elpZWNTiKZ4nvCUcs5a7oYwm52g/edit?gid=0#gid=0>.

¹⁸ Ministry of National Defense, R.O.C. (Taiwan). (2025, June 1). 臺海周邊海、空域活動 [Military activities around the Taiwan Strait] [Image]. Ministry of National Defense. https://www.mnd.gov.tw/Publish.aspx?u=NewUpload/202506/1140601_%e8%87%ba%e6%b5%b7%e5%91%a8%e9%82%8a%e6%b5%b7%e3%80%81%e7%a9%ba%e5%9f%9f%e6%b4%bb%e5%8b%95_050982.jpg&fid=52200.

and pressures were Taiwan's adoption of asymmetric warfare and a move toward defensive realism, which enabled the development of military might and stronger security capabilities. Current actions have pushed Taiwan to expand its drone systems, implement stronger defense reforms outlined in the 2025 Quadrennial Defense Review, boost international cooperation, and develop its domestic defense industry, among other measures.

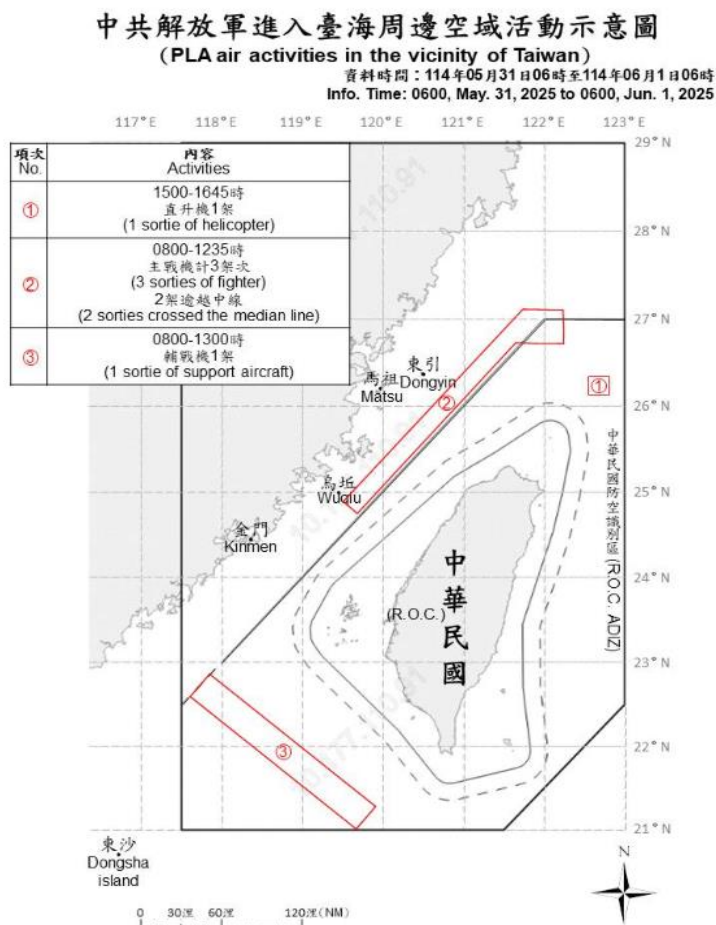


Figure 3-4

Source: Ministry of National Defense R.O.C. (Taiwan),
<https://www.mnd.gov.tw/en/news/plaact/84474>.

A. Effects of Asymmetric Warfare on China's Policies

Taiwan's defensive path paved the way for its adversary's new offensive course. PRC's diversified offensive course creates a dynamic best understood through the lens of the security dilemma. ROC states that they are focused on war prevention but at the same time continue developing mechanisms that will assist them in times of need in case of invasion. This is a normal behavior in today's political and security environment. Suppose the party is not involved in an arms race; they are in survival mode, which does not last long considering contemporary threats (not only military but also cyber and economic as well). Despite the accurate defensive stance and focusing on preventing a war that will have regional and international consequences, the countermeasures devised by China are also understandable. Their main objective since 1949 has been the unification and Taiwan's strategic development interferes with achieving this goal. China's Anti-Access/Area Denial strategy is bound to be the most effective tool in the invasion process. The idea behind the Anti-Access part is easy to understand. Its goal is to keep enemy forces from entering the region. In this case, China aims to make it difficult for the US to access the Taiwan Strait. The tools for the success of this include submarines, long-range missiles, air defense systems, etc. If Taiwan withstands the attacks and secures the island quickly, the U.S. might consider intervention. For successful anti-access, a swift victory is essential. If there is no swift victory, the chances of China's unsuccessful attempts to secure the territory and anti-access zones become higher; hence, the U.S. will ensure its adversary is finally defeated.

Area denial is focused on making it difficult for the enemy to operate in the region. Tools for this include cyberattacks, anti-ship and anti-aircraft systems, short and medium-range air defenses and others. Taiwan's asymmetric warfare is dangerous for A2/AD because it is meant to withstand the obstacles erected in that zone. It is worth mentioning that the shift in strategy had a counterproductive effect on China-Taiwan relations. PRC did not waste any time expanding its policies. For instance, there have been significant missile expansions to strengthen A2/AD capabilities. They include DF-21D, the DF-26 and the YJ-18. Beijing commands an arsenal of

conventionally-armed ballistic missiles, notably the highly precise DF-21 series. This includes the formidable DF-21D antiship ballistic missile (ASBM), colloquially known as the ‘carrier killer,’ specifically designed to target and neutralize large vessels, such as aircraft carriers, at sea. China grasps the necessity of advancing its capabilities because asymmetric warfare erodes its advantages and any weakness in the battle can be costly.

After Taiwan’s asymmetric warfare capability demonstration which included investing in IDF, UAV, ISR systems, introduction of ODC, shifting to AVF, US representative visit, developing naval capabilities, enhancing mobile coastal defense units, expanding missile systems, China responded with swifter measures such as military exercises around Taiwan’s ADIZ and median line, enhanced A2/AD capabilities, cyberattacks and disinformation operations, naval exercises, tests new technologies around the island. These actions were specifically designed to neutralize asymmetric threats. The main developments focus on the military, which must ensure that Taiwan’s asymmetric warfare capabilities do not gain the upper hand in a conflict or turn China’s own advantages against it. PRC’s actions directly signal the effectiveness of Taiwan’s strategy in persuading them to adopt its operational planning.

Paradoxically, asymmetric warfare, which was designed to foster a sense of security, further aggravated China and prompted the boost of the security dilemma in the region. States’ actions to boost their own security (Taiwan’s asymmetric warfare) are interpreted as threatening by others (China), leading to an increase in the latter’s military capabilities in response, which in turn makes the former insecure, prompting further development. This never-ending dance is a dangerous loop to find oneself in, especially given that the adversary is much more powerful with fully developed economic and military assets.

Additionally, China is not developing its capabilities to boost resources. They are doing so to counter Taiwan’s asymmetric warfare assets, their “porcupine quills” so to speak. Countermeasures such as advanced precision-strike assets, missiles such as DF-21D and YJ-18 are clear indicators that Taiwan’s asymmetric warfare tools influence Beijing’s strategic investments.

It forces the PLA to seek different tools that will prove to be effective against the island's quick asymmetric ones. Developing new properties and strategies takes resources, which PLA now has to spend to have swift victory as they so eagerly anticipate.

Another important factor in this equation is China's reputation and international image. Taiwan's strong resistance to military strikes can directly undermine China's legitimacy. Since asymmetric warfare is focused on making the invasion as costly as possible, in the event of a continued conflict, China has a disadvantage and will have casualties. One-child policy has created only sons in the military and since Chinese society is already sensitive to military losses, the policy creates more damage in this front. The social and political pressure will be immense in the case of a failure of a swift invasion. The ineffective strategy and loss of life because of it will result in public discontent. This will also affect China's public image, erode the trust in the regime's stability and expertise. An example of this is the Russian-Ukraine war. After Russia was unable to defeat Ukraine in several days, the international society started seriously doubting its capabilities. The expectation of rapid success was blocked by Ukraine's effective defensive tools, demonstrating how small adversary can counter advantageous technologies and reshape the perception of state's power.

Ultimately, asymmetric warfare leaves China with no choice but to abandon its broader objectives and focus on neutralizing Taiwan's warfare tools. Instead of addressing regional challenges, the PLA is focused on locating and engaging Taiwan's asymmetric assets using ISR, a process that is costly and time-consuming. Taiwan's policies clearly influence Beijing's behavior, as even a seemingly small diplomatic gesture, such as a U.S. official's visit to Taiwan, provoked numerous exercises around the Taiwan Strait. The development of asymmetric assets, whose main purpose is to render the opponent's powerful army ineffective, compels Beijing to respond with unprecedented intensity.

IV. The United States and its Role in Taiwan's Self Reliance

A. United States' Evolving Strategic Approach and its Impact on Taiwan

The United States made its presence known in the Asia-Pacific region in the 19th century. Over time, the influence has significantly grown and the countries have made deeper connections with the US. The assistance to Taiwan was critical because back in the 20th century, the island was more vulnerable. US involvement in the Asia-Pacific and its conflicts made it complicated for powers to dominate the region. After the Cold War, as the hegemon, they had the responsibility to address conflicts in various parts of the world and have effective strategies to ensure peaceful conflict resolution. Taiwan became crucial to the US in containing China and unofficially delaying unification.

With the establishment of US-Taiwan relations, strategic ambiguity was erected. The approach suggests acknowledging the 'One China' policy while also assisting Taiwan in its defense, sending substantial arms sales packages, and honoring the obligation under TRA. For many years, strategic ambiguity was perceived as an effective US strategy used in the region, allowing the navigation of complex political terrain with minimal confrontation. This strategic posture formed from the circumstances of its time.

In 1979, China did not possess the level of power it does today. Bearing in mind its economic, military and political developments, strategic ambiguity remained the predominant US strategy in the region for deterrence. Today, it is outdated and ineffective in deterring Chinese expansion. The goals of this approach are multifaceted. It prevents both sides from taking actions that could destabilize the region and end the peace. The indefinite responses from the US about their commitments to defend Taiwan give China doubts and without this certainty, they will not start an invasion. At the same time, strategic ambiguity deters Taiwan from becoming an internationally recognized independent state, as it could spark a conflict that the US has been tirelessly working to avoid. With this approach, US-China relations are also mitigated. They cooperate on global issues but avoid confrontations over

Taiwan. For the United States, the continuous pursuit of its objectives and interests in the region remains a critical component of its strategic posture. Despite continued arms sales to Taiwan, US administrations strongly encouraged Taipei to develop sturdy self-defense capabilities - a message suggesting that their assistance in case of a military conflict is not fully guaranteed. This approach shed light to the vulnerabilities within the broader US strategy.

While strategic ambiguity was initially effective, its limitations became apparent well before 2011. The events that ultimately prompted the release of the Defense White Paper highlighted that the United States' approach was no longer suitable and effective in the current environment. This logic becomes clearer when we consider that peace in the Taiwan Strait has always been a vague concept. The US objective of maintaining peace in the region is directly clashing with China's primary aspiration for decades - unification, which by nature is highly unlikely to be peaceful. PRC has not yet renounced the use of force, which is a clear indication that it remains as the last resort for achieving its decades-long goal. This unwillingness to abandon the use of force, combined with Taiwan's democratic autonomy, creates conditions that strategic ambiguity can no longer effectively address.

Because of the long history of the conflict, this topic has been debated many times. Many scholars have criticized strategic ambiguity and offered insightful ideas. With the immense assistance that the United States provided to Taiwan, the administrations also strongly emphasized the increase in self-defense. The full dependence on US support and commitment highlighted vulnerable aspects of Taiwan's defense. (Deng, 2018) in his work *US Taiwan Policy during the George W. Bush Administration* (2001-2009) observes that compared to previous presidents W. Bush supported Taiwan on a great scale. He also showed public support and sent arms sales package. The author states that US did not fundamentally change its course. Their main objective since 1950s has been deterring PRC aggression and avoiding ROC independence. The main goal is the stability of the region and US achieves it by managing the relationship between the two. (Deng, 2018)'s work is informative in proving that the pragmatic approach during the Bush administration was adjusted by the next administrations. He has a skeptical stance on US policy

toward Taiwan at that time. He is certain that the US did not long for Taiwan's independence because the change of status quo was not in their interests. Therefore, Taiwan was left as a bargaining chip. The strategic ambiguity has its limits, which were reached many years ago. If Taiwan is an instrument in the US-China conflict, this decreases reliance on external guarantees and strengthens the motivation for self-reliance.

On the other hand, (Grinter, 2010) has more optimistic stance on US policy. He deemed necessary for US to continue its policy aimed at maintaining peace in Taiwan Strait given the importance of US-China relations. However, "peace" is intrinsically an ambiguous term. Even back in 2010, Taiwan strait was not peaceful and the conflict remains unresolved today. The author makes a recommendation for the United States to continue highlighting the following: provocations toward China, such as declaration of independence, will not prompt US support.¹⁹ The motivation is explicit, suggesting that the US is focused on maintaining strong US-China relations. Although, in today's security environment, attempting a two-faced approach is no longer feasible, as choices will inevitably have to be made. As the finish line approaches, the options too become increasingly limited. With the surge in China's military and economic capabilities, the United States cannot afford to delay the direct involvement in the region. To avert another Cold War, drastic measures may be necessary to ensure that China's influence will remain balanced rather than hegemonic.

Between 2009 and 2011, Barack Obama's administration took steps that continued his predecessor's policies. The "One China" policy has remained relevant. Strategic ambiguity was maintained and the president took cautious actions regarding the assistance to Taiwan. The Taiwan Relations Act (TRA) was preserved and the US continued providing arms. Vice President Joseph Biden made similar points during a visit to Beijing in August 2011. He emphasized that US will not support Taiwan's independence and expressed

¹⁹ Lawrence E. Grinter, "Handling the Taiwan Issue: Bush Administration Policy toward Beijing and Taipei," *Asian Affairs: An American Review*, Vol. 29, Issue 1, 2002, pp. 3-15, DOI: 10.1080/00927670209598873.

hope for the stable and fruitful cross-strait relations.²⁰ However, the Obama administration articulated concerns about China's political and economic leverage on Taiwan. They wished the cross-strait reconciliation to be achieved in a stable context and included \$6 billion arms package for Taiwan in February 2010 with \$5.85 billion deal in September 2011.²¹ For a better demonstration of US assistance in this aspect, the Figure 3-5 below shows major US arms sales as notified to Congress from 2007 to 2011. While providing support, every president before 2011 emphasized Taiwan's self-reliance and strong defense capabilities. With Taiwan's limited resources, the US role is decisive in implementing the strategies and deterring China successfully.

²⁰ David G. Brown, "Progress Slow as Taiwan Campaign Begins," *Comparative Connections*, Vol. 13, Issue. 2, September, 2011, pp. 3-4

²¹ Michael McCally, *Physicians for Social Responsibility: The Maryland Chapter*, Maryland Series in Contemporary Asian Studies, No. 4, 1995, p. 28, <https://digitalcommons.law.umaryland.edu/cgi/viewcontent.cgi?article=1215&context=mscas>.

Taiwan's Evolving Defense Strategy:

The Shift to Asymmetric Warfare since the 2011 Defense White Paper

Date of notification	Major item or service as proposed (usually part of a program with related support)	Value of program (\$ million)
2007		
02/28	(218) AMRAAMs and (235) Maverick air-to-ground missiles for F-16 fighters	\$421
08/08	(60) AGM-84L Harpoon Block II anti-ship missiles	\$125
09/12	(144) SM-2 Block IIIA Standard air-defense missiles for Kidd-class destroyers	\$272
09/12	(12) P-3C maritime patrol/ASW aircraft	\$1,960
11/09	Patriot configuration 2 ground systems upgrade	\$939
2008		
10/3	(330) Patriot Advanced Capability (PAC)-3 missile defense missiles	\$3,100
10/3	(32) UGM-84L sub-launched Harpoon anti-ship missiles	\$200
10/3	spare parts for F-5E/F, C-130H, F-16A/B, IDF aircraft	\$334
10/3	(182) Javelin anti-armor missiles	\$47
10/3	upgrade of (4) E-2T aircraft (Hawkeye 2000 configuration)	\$250
10/3	(30) AH-64D Apache Longbow attack helicopters, (173) Stinger air-to-air missiles, (1,000) AGM-114L Longbow Hellfire missiles	\$2,532
2010		
01/29	(114) PAC-3 missile defense missiles	\$2,810
01/29	(60) UH-60M Black Hawk utility helicopters	\$3,100
01/29	(12) Harpoon Block II anti-ship telemetry (training) missiles	\$37
01/29	(60) MIDS (follow-on technical support for Po Sheng C4 systems)	\$340
01/29	(2) Osprey-class mine hunting ships (refurbished and upgraded)	\$105
2011		
09/21	Retrofit of 145 F-16A/B fighters, with 176 AESA radars, JDAMs, etc.	\$5,300
09/21	Continuation of training of F-16 pilots at Luke Air Force Base	\$500
09/21	Spare parts for F-16A/B, F-5E/F, C-130H, and IDF aircraft	\$52

Figure 3-5

Source: Shirley A. Kan, "Taiwan: Major U.S. Arms Sales Since 1990," Congressional Research Service, p. 62, <https://sgp.fas.org/crs/weapons/RL30957.pdf>.

Despite significant financial assistance, the state of affairs in the Taiwan Strait remained the same. US commitments were limited to arms sales and their objective remained strategic ambiguity aimed at stabilizing peaceful relations in the region. The US had maintained a neutral position. While it could not strain relations with China, it also needed to support Taiwan to maintain a stable regional environment and manage its relationship with Beijing. Strategic ambiguity became the most useful tool for safeguarding US interests in the region. There is a discussion over the extent of its success.

Today, the circumstances are still very similar. During Donald Trump's first term, his decisions were often viewed as unconventional or unpredictable. The president emphasized: "I don't know why we have to be bound by a 'one China' policy unless we make a deal with China having to do with other things, including trade."²² However, in 2017, the president agreed with Xi Jinping to honor "'one China'" policy. He also approved arms sales to Taiwan at a higher level and capacity than during the Obama Administration. While his 'America First' approach is greatly aligned with the interests of American people, as the global superpower, the United States, carries broader responsibilities that require to address international conflicts.

As for the next president, even though Joe Biden made a historic speech assuring Taiwan of US defense in the event of a potential military conflict with China. The White House quickly withdrew the suggestion and affirmed publicly that the US's strategic ambiguity has not changed. This acutely highlights the delicacy of US-China relations. Both countries possess significant nuclear, economic and military capabilities as well as political standing, and a single miscalculation could trigger a conflict with catastrophic implications for the world. US policy-makers are well aware of these risks. At the same time, Washington has a reputation to consider, as being overtly conciliatory toward China could raise questions about its level of influence and capabilities.

Additionally, there is debate over the potential adoption of strategic clarity and its possible influence on Taiwan's defense posture. Under this approach, the US would explicitly define its stance regarding potential Chinese military actions. Experts argue that this would remove ambiguity about US commitments from the equation and reduce the likelihood of miscalculated steps by Beijing or Taipei. Critics warn that this approach could potentially escalate tensions and make Taiwan more reliant on the United States. It limits flexibility and could risk escalating tensions in the region. Overall, strategic clarity remains an uncertain option for the future. Its

²² The Associated Press, "A History of Trump's Statements on the 'One China' Policy," *AP News*, February 10, 2017, <https://apnews.com/general-news-c646266824ac47dea49bd9820985af81>.

benefits and risks are still contested.

In conclusion, this chapter has shown that while the United States remains a crucial security partner for Taiwan, its strategic ambiguity has shaped the conditions that persuaded Taipei's shift toward increased self-reliance. As China amplified its military capabilities and regional tensions persisted, the limits of ambiguity became evident, prompting Taiwan to reassess its defense position.

Additionally, successive U.S. administrations have maintained the careful balance while urging Taiwan to consider and develop a stronger self-reliant posture. The United States has been deterring Beijing, discouraging Taiwanese independence and with these calculated steps, preserving the regional stability. The ongoing debate over strategic ambiguity versus clarity highlights these tensions and the potential problems. Ultimately, this chapter explained that the United States advocated for the self-reliance of Taiwan and pushed for it by maintaining strategic ambiguity, publicly stating the limits to U.S. support and providing conditional arms sales, which then should have been interpreted as an independent defense capability.

V. The Asymmetric Warfare Strategy in Practice

This chapter examines the tools developed through asymmetric warfare. The introduction of ODC marks an important step, which will be explored in more detail in the following chapter. Adopting this new strategy also presents challenges, as shifting from conventional tactics to a non-traditional approach requires significant resources, careful decision-making, and comes with inherent limitations. The chapter highlights how Taiwan has applied this strategy in practice, showing that despite internal resistance, notable progress has been achieved across several key areas.

A. Acquired Asymmetric Capabilities and Their Effectiveness

Taiwan embarked on a pivotal journey after the adoption of the 2011 Defense White Paper. Their objective became acquiring asymmetric capabilities that would allow strong self-defense and deter its powerful adversary. This shift was imperative in ensuring that the island could

effectively withstand a potential attack from China. The aim was to take effective steps and implement clever strategic actions to deter their adversaries. This subsection outlines the capabilities Taiwan obtained and provides an assessment of its effectiveness.

Prior to 2011, Taiwan primarily focused on traditional defense systems, such as tanks, jets, and ships, which had demonstrated effectiveness in past conflicts. The Defense White Paper caused a remarkable shift in defense doctrine, because before this document, Taiwan did not recognize the necessity or importance of asymmetric warfare or its potential. Although Taiwan did not develop any asymmetric technology in 2011, the doctrinal shift was enough to push it into a new era of defense, which continues to this day.

For such traditionally minded people, adjusting to such a drastic transformation takes time. In 2013-2015 the resistance within military about new warfare tactics grew stronger. To address strategic needs, Taiwan has domestically developed Hsiung Feng III missile which is an advanced and most recent part of the Hsiung Feng missile series. It is Taiwan's first supersonic missile which signifies the giant leap in the technology development.²³ This system has already been in use before 2013; however, they introduced mobile land-based variants, which added to the level of effectiveness and survivability. Its effectiveness stems from its ability to remain unnoticed. They are much harder for the enemy to spot and remain a reliable threat in an attack. The ability to strike enemy vessels with high impact and swiftly makes this asset a vital part of Taiwan's military arsenal. In 2014, the Tuo Chiang Prototype was introduced, designed to evade radar detection and combat big ships using asymmetric warfare tactics. The best advantage is its small size, which makes effective against large ships.

Furthermore, Taiwan began developing drones, unmanned aerial vehicles (UAVs) for ISR (Intelligence, Surveillance, and Reconnaissance) purposes. Without harming human pilots, they will be able to observe the

²³ Missile Defense Project, "Hsiung Feng III," *Missile Threat*, Center for Strategic and International Studies, July 13, 2017, last modified April 23, 2024, <https://missilethreat.csis.org/missile/hsiung-feng-iii/>.

enemy forces and obtain information that will be beneficial for establishing and deploying asymmetric warfare tactics. The technological progress in 2013-2015 was evident; however, skepticism within the military played a big role in the success of these strategies. (See subsection 4.3. for detailed information about challenges.)

Taiwan's wish to develop its own submarine did not come to fruition because the necessary technologies and systems were readily obtainable. Taiwan acquired two Dutch Swordfish-class submarines in 1987; however, no significant development followed. Later on, assistance packages from US President George W. Bush included submarines and other kinds of arms. There is debate over whether submarines are considered the tools of asymmetric warfare; however, they are widely regarded as one of the most important asymmetric assets, mainly because of Taiwan's geographical location. Although the Indigenous Defense Submarine (IDS) Program was initiated before the mid-2010s, considerable progress was made under President Tsai Ing-wen, culminating in the launch of Taiwan's first indigenous submarine in 2023. (See Figure 3-6 below).



Figure 3-6. IDS Haikun (SS-711)

資料來源：〈國造潛艦原型艦「海鯤號」下水 預計明年底交艦〉，《公視新聞網》，2023年9月28日，<https://news.pts.org.tw/article/659284>。

All the mentioned strategic asymmetric assets demonstrate Taiwan's willingness and commitment to implement a new defense strategy successfully. The collective deployment of these assets substantially strengthens Taiwan's self-defense posture and enhances the effectiveness of deterrence against threats, ensuring a reliable defense structure.

B. The Overall Defense Concept (ODC)

This part of the research examines not only what was acquired by Taiwan in the process of asymmetric warfare, but also its intended applications. It also specifies why asymmetric warfare was selected as the strategic approach, the chosen path. This part is vital because without it, the research would not illustrate how Taiwan plans to employ its capabilities.

From 2017 to 2018, one of the most pivotal concepts was introduced by Admiral Lee Hsi-ming. Overall Defense Concept (ODC) is a set of strategies based on asymmetric principles. The concept emphasizes the use of asymmetric capabilities in a defense strategy. It is a blueprint for a better understanding of their might and more effective tactics. The focus of the ODC is for Taiwan to be able to: “1) resist the existential threat, 2) effectively allocate limited defense resources, 3) build instant capabilities to address near-term crisis, and 4) maintain the ability to counter gray-zone coercion to maintain the public's morale”.²⁴ He also emphasizes on an interesting theory “winning the war” and highlights operational concepts against PLA.

The ODC defines “winning the war” as “fail the enemy's mission to occupy Taiwan” instead of totally destroying enemy forces. Under this definition, the ODC specifically established some operational concepts based on the threat from the PLA and Taiwan's unique environment. First is to abandon the traditional war of attrition and adopt concepts of asymmetric warfare. Second, we need to adopt the concept of “denial” instead of “control.” Third, we need to focus on mission kills and attack the enemy's

²⁴ Hsi-min Lee, “Taiwan's Overall Defense Concept: A Conversation with Admiral Lee Hsi-min,” speech transcript, *Hoover Institution*, September 27, 2021, https://www.hoover.org/sites/default/files/210927_adm_lee_hoover_remarks_draft4.pdf.

*center of gravity instead of focus on destroying their actual forces. Fourth, we need to shape the battlefield conditions to our advantage and engage the enemy when they are most vulnerable. Fifth, we need to utilize Taiwan's unique geographical environment and civilian resources. Sixth, we need to do our best to prevent the enemy from landing on our soil and establishing footholds. Seventh, the last line of defense is to conduct insurgency operations to make the enemy not able to effectively control our homeland.*²⁵

These concepts form an objective that makes an invasion costly and unsustainable for Beijing. Admiral Lee left the office in 2019 and Taiwan abandoned his work. ODC was not part of the 2021 National Defense Report. They did not prioritize the small equipment over large conventional assets for several years, which made their decisions costly. The Russian invasion of Ukraine was a wake-up call for Taiwan. It was an indication that a small country with no substantial defense assets can withstand the attack of a larger foe not for a week but for years. In early 2023, the decision-makers started slowly shifting back toward asymmetric warfare and its core principles. Currently, ODC is not explicitly used; however, its main ideas are included in Taiwan's strategies. This adds depth to Taiwan's strategy commitments. The temporary abandonment of ODC highlights the complex nature of doctrinal changes and illustrates that such shifts are not always universally accepted or embraced.

The most frequently discussed and favored is the Porcupine Strategy, with Admiral Lee as the main supporter. It is a broader plan that was discussed in detail in ODC. In 2008, William Murray first articulated the "Porcupine Strategy" for Taiwan's defense. This suggests that Taiwan ought to focus on defensive capabilities that prevent invading forces from achieving swift success. In a striking metaphor, strategic thinkers encouraged Taiwan's defense leadership to adopt a 'porcupine' posture for their country's protection, likening it to the rodent's formidable ability to deter predators with its array of sharp spines. The goal of this strategy is to avoid conflict and use asymmetric warfare tactics if the first part is not successful. Ukraine is a notable example of the success of an asymmetric defense strategy. Taiwan is

²⁵ *Ibid.*

trying to incorporate porcupine strategy concepts.

C. Challenges and Limitations

This subsection critically evaluates the key challenges Taiwan faced in adopting asymmetric warfare. They include: the struggle to welcome change, various threat perceptions, declining birth rates, unfavorable perceptions of the military, AVF struggles, challenges in personnel training, a limited defense budget, and technological gaps.

The first challenge that Taiwan encountered was the inability to welcome the new strategic developments freely within the military. They are used to large vessels, which, under the new asymmetric strategy, will not be largely available. Therefore, a cultural shift was also necessary within the armed forces to help them acclimate to the new era. The idea of ODC is to deny a rival a successful invasion and pursuing this objective can be problematic for some within Taiwan's defense institution. There is a possibility that traditional people will follow old ways (e.g., defense against blockade) rather than new, more effective ones, despite the advantages over old strategies.

Another point is Taiwan's demographic crisis. Birth rates are declining, which affects defense systems. There is a shortage of recruits and the strict military situation is not well-received by many citizens. This is yet another reason why AVF did not work effectively. The uncertainty within the military creates a sense of chaos, making it difficult to recruit and attract people. Military personnel expenses are significant since the AVF was accomplished. This puts strain on an already thin defense budget and does not allow for more funding for personnel training alongside other important aspects of the military.

On the other hand, symmetric warfare uses fewer resources than Taiwan's traditional assets. However, it still requires great financial backing. In this regard, the US aid is particularly relevant. Taiwan's defense budget remains notably low compared to China's, presenting a clear strategic disadvantage. Many scholars mention the United States as the main force to assist Taiwan in adopting asymmetric capabilities at a much faster rate than it currently is. The gaps in cyber defenses need to be urgently addressed as they

represent vulnerabilities that could be exploited in an attack. Developing such effective technology is a challenge for Taiwan. Understanding these challenges provides an important context for examining the relevance of strategy and implementation.

One might ask: Why is it important to examine these issues? The answer is multifaceted. Firstly, it shows the efforts that were employed to develop a relevant strategy. A strong strategy, however, remains theoretical without practical application, rendering it ineffective. Challenges and limitations directly impact Taiwan's ability to successfully adopt and implement asymmetric warfare. Without considering these factors, one can't truly evaluate the strategy's effectiveness. Pinpointing vulnerabilities is crucial for successful application of a new policy; without awareness of its own weaknesses, Taiwan risks leaving openings that could be exploited by adversaries. Additionally, this analysis highlights areas where external assistance - potentially from the United States - may be necessary. Ultimately, the success of Taiwan's asymmetric warfare strategy depends on developing capabilities, understanding the limiting factors, addressing vulnerabilities and leveraging external support.

VI. Conclusion

Current developments in the Taiwan Strait suggest the urgent need for a discussion about the importance of defense strategy. Security concerns skyrocketed with continuous military exercises, incursions in the ADIZ, median line crossings, and diplomatic pressures. This research demonstrated that Taiwan's turn towards asymmetric warfare with the adoption of the 2011 Defense White Paper was a rational, necessary and timely response to the pressures, threats and developments around the island.

Taiwan's shift was induced by an unfortunate internal environment, which included demographic issues, limited resources, economic decline, low defense budget, and lack of military-aged citizens. The decision was influenced by external factors as well, which played a considerable role in shaping Taiwan's foreign policies. The research outlines the role of China and the U.S. The superpower's strategic ambiguity has become insufficiently

effective in deterring China's growing capabilities and its accelerated unification process. China, with an increased defense budget, continuous military exercises, technological developments, incursions and crossings in ADIZ and median lines, alarmed Taiwan's defense institutions, which later on decided to finally make a non-traditional decision.

The importance of conversing about the reasons behind Taiwan's adoption of the Defense White Paper and therefore moving toward an asymmetric warfare strategy is immense due to several key reasons: 1. Continuous threat from China creates an unstable regional environment where nobody knows what could spark a military invasion. Understanding Taiwan's defense helps explain its goals and capabilities. 2. Emphasizing this topic gives the international community a chance to adopt better, more effective policies. 3. The doctrinal shift was a historical moment for Taiwan. With the developments in place, Taipei shows the world that it is capable of assimilating the challenges of the 21st century. 4. Most importantly, Taiwan's defense is not only its own. The stability of the region is dependent on it. This is a huge responsibility. Without external help, the end will not be favorable for anyone. 5. Providing US-China perspectives, their actions and responses, is beneficial for the research because it helps understand Taiwan's actions more clearly.

In conclusion, the value of this topic is multifaceted and especially prominent currently with China's sped-up unification process. The implications of the doctrinal shift are greater than was anticipated. It is focused on Taiwan's objectives and capabilities but also shows the importance of the island for the region. The stability of the Asia-Pacific is dependent on Taiwan's ability to defend itself against a powerful invasion. With the support of the United States, the asymmetric defense will be boosted and the process will be accelerated. However, without external assistance, the rate Taiwan is going, it is improbable that they will withstand even the first attack. The research provides examples that strengthen the hypothesis. The examples include: demographic and economic issues, low defense budget, lack of military-aged manpower, inability to quickly adapt to change and differences in threat perceptions.

Furthermore, while historically designed to maintain the balance, the United States' strategic ambiguity compelled Taiwan to asymmetric warfare. Taipei could not depend solely on Washington's commitments to maintain regional stability. Over time, it became insufficient to maintain China's growing military capabilities, economic enhancements and strong objectives. Beijing's incursions in the ADIZ, crossings of the unofficial median line, economic and diplomatic pressures, and threatening messages served as alarms, indicating the sped-up unification process, compelling Taiwan's defense institutions to abandon traditional strategies and make significant alterations.

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八、期刊譯著

- （一）中文：Author's full name 著，譯者姓名譯，《篇名》（篇名原文），《刊物名稱》，第 x 卷第 x 期，年月，頁 x 或頁 x-x。

- (二) 英文：Author's full name, "*Title of the Article*," trans. Translator (s) ' full Name, *Title of the Journal*, Vol. x, No. x, Month Year, p. x or pp. x-x.

範例

Kelvin Fong 著，王玉麟譯，《亞太區域潛艦概況》〈Submarines in the Asia-Pacific〉，《國防譯粹》，第 33 卷第 7 期，2006 年，頁 89-95。

九、專書論文或書籍專章

- (一) 中文：作者姓名，〈篇名〉，編者(群)姓名，《書名》(出版地：出版者，出版年)，頁 x 或頁 x-x。(初版無需註明版別)
- (二) 英文：Author's full name, "Chapter Title," in Editor/Editors' full Name (s) , ed (s) ., *Complete Title of the Book*, (Place of publication: Publisher, Year of publication) , p. x or pp. x-x.

範例

林正義、歐錫富，〈宏觀 2009 亞太和平觀察〉，林正義、歐錫富編，《2009 亞太和平觀察》(台北：中央研究院亞太區域研究專題中心，2011 年)，頁 3。

Kaocheng Wang, "Bilateralism or Multilateralism? Assessment of Taiwan Status and Relations with South Pacific," in Ming-Hsien Wong, ed., *Managing regional security agenda*, (New Taipei City: Tamkang University Press, 2013) , p. 29.

十、學術性期刊論文

(請依個別刊物實際出刊項目，完整臚列)

- (一) 中文：作者姓名，〈篇名〉，《刊物名稱》(出版地)，第 x 卷 x 期，年月，頁 x 或頁 x-x。(臺灣出版之期刊無需註明出版地，但若與其他地區出版期刊名稱相同者，仍需註明出版地，以利識別)
- (二) 英文：Author's full name, "Title of the article," *Name of Periodical*, Vol. x, No. x, Month Year, p.x or pp. x-x.

範例

汪毓璋，〈美近公布「威脅評估報告」之評析〉，《展望與探索》，第4卷第4期，2005年4月，頁92-97。

Randall L. Schweller, "Bandwagoning for Profit: Bring the Revisionist State Back in," *International Security*, Vol. 19, No. 1, June 1994, pp. 72-107.

十一、學位論文

(一) 中文：作者姓名，《學位論文名稱》，學校院或系所博士或碩士論文（畢業年份），頁 x 或頁 x-x。

(二) 英文：Author's full name, "Complete Title of Dissertation/Thesis," (Ph.D. Dissertation/Master's Thesis, Name of the Department, Name of the Degree-granting University, year of graduation), p.x or pp. x-x.

範例

馬振坤，《從克勞塞維茲戰爭理論剖析中共三次對外戰爭》，國立臺灣大學政治學研究所所博士（2002），頁1。

Stacia L. Stinnett, "*The Spratly Island Dispute: An Analysis*," (Master's Thesis, Florida Atlantic University, 2000), p.1

十二、研討會論文

(一) 中文：作者姓名，〈篇名〉，發表於○○○○研討會（地點：主辦單位，舉辦年月日），頁 x 或頁 x-x。

(二) 外文：Author's full name, "Paper Title," presented for Complete Title of the Conference (Place of conference: Conference organizer, Date of conference in month day, year), p. x or pp. x-x.

範例

許文堂，〈南沙與西沙-他者的觀點〉，發表於「七0年代東亞風雲-台灣與琉球、釣魚台、南海諸島的歸屬問題」學術研討會（臺北：台灣教授學會，2013年10月27日），頁1。

Wen-cheng Lin, “Cross-strait Confidence Building Measures,” presented for Comparing Different Approaches to Conflict Prevention and Management: Korean Peninsula and the Taiwan Strait Conference (Stockholm: Central Asia-Caucasus Institute Silk Road Studies Program, December 16-17, 2005), p. 1.

十三、官方文件

(請依個別刊物實際出刊項目，完整臚列)

- (一) 中文：官署機構，〈文件名稱〉(行政命令類)或《文件名稱》(法律類)，卷期(案號)，日期，頁 x 或頁 x-x。
- (二) 外文：Author’s Full Name, “Title of the Article,” Date, Section or Page Numbers.

範例

中華民國總統府，〈總統令〉，《總統府公報》，第 7426 號，中華民國 108 年 5 月 22 日，頁 3。

White House, “National Security Strategy of the United States of America,” December 18, 2017, p. 1.

十四、報刊、非學術性雜誌

(若為社論、短評、通訊稿或作者匿名，則可不列作者欄)

- (一) 中文報紙：作者姓名，〈篇名〉，《報紙名稱》(出版地)，年月日，版 x。(一般性新聞報導可省略作者和篇名，臺灣出版之報紙無須註明出版地。)
- (二) 中文雜誌：作者姓名，〈篇名〉，《雜誌名稱》(出版地)，年月日，頁 x 或頁 x-x。(無須註明第卷第 x 期。臺灣出版雜誌無須註明出版地)
- (三) 英文報紙：Author’s full name, “Title of the Article,” *Title of the Newspaper*, Date, Section or Page Numbers.
- (四) 英文雜誌：Author’s full name, “Title of the Article,” *Title of the Magazine*, Date, Page x or pp.x-x.

範例

張晏彰，〈臺美夥伴關係 印太安定力量〉，《青年日報》，2019 年 6 月 19 日，版 3。

陳文樹，〈澎湖空軍基地的設立和演進〉，《中華民國的空軍》，2019 年 6 月 12 日，頁 21。

Jason Pan, “Defense think tank inaugurated,” *Taipei Times*, May 2, 2018, p. 3.

Office of Defense Studies, “Commentary: 2012 Pentagon Report on Mainland China’s Military Development,” *Defense Security Brief*, July 2012, p. 9.

十五、網際網路資料

- (一) 請依照個別線上網站實際資訊，詳細臚列。
- (二) 引用網路版報紙的一般報導，無須註明版次，但須附上網址，其餘體例不變。
- (三) 引用電子報紙雜誌評論文章，或電子學術期刊論文，在頁碼後面註明網址，其餘體例不變，無頁碼者得省略之。
- (四) 直接引用機構網站的內容，請註明文章標題、機構名稱，日期與網址。
- (五) 中文：
 - 1. 專書：作者姓名，《書名》（出版地：出版者，出版年），《網站名稱》，網址。
 - 2. 論文：作者姓名，〈篇名〉，《刊物名稱》，第 x 卷第 x 期，年月，頁 x 或頁 x-x，《網站名稱》，網址。
 - 3. 官方文件：官署機構，〈文件名稱〉（行政命令類）或《文件 名稱》（法律類），卷期（案號），日期，頁 x 或頁 x-x，《網站名稱》，網址。
 - 4. 報導：作者姓名，〈篇名〉，《媒體名稱》，日期，網址。

範例

王業立編，《臺灣民主之反思與前瞻》（臺北市：臺灣民主基金會，2016 年），《台灣民主基金會》，<http://www.tfd.org.tw/export/sites/tfd/files/download/book20160830.pdf>。

舒孝煌，〈美陸戰隊 F-35B 前進遠征與輕型航艦部署〉，《國防情勢月報》，143 期，2019 年 5 月，頁 36，《國防安全研究院》，<https://indsr.org.tw/Download/%E5%9C%8B%E9%98%B2%E6>

%83%85%E5%8B%A2%E6%9C%88%E5%A0%B1-143.pdf。

中華民國國防部，《106 年國防報告書》，2017 年 12 月，頁 1，
《中華民國國防部》，<https://www.mnd.gov.tw/NewUpload/歷年國防報告書網頁專區/歷年國防報告書專區.files/國防報告書-106/國防報告書-106-中文.pdf>。

游凱翔，〈國防安全研究院掛牌 唯一國家級國防智庫〉，《中央社》
， 2018 年 5 月 1 日，
<https://www.cna.com.tw/news/aip1/201805010122.aspx>。

(六) 外文：

1. 專書：Author (s) ' full name, *Complete title of the book*
(Place of publication: Publisher, Year) , p. x or pp. x-x,
URL.
2. 論文：Author (s) ' full name, "Title of the article," *Name of
the Periodical*, Vol. x, No. x, Date, p.x or pp.x-x, URL.
3. 官方文件：Author's Full Name, "Title of the Article," Date,
Section or Page Numbers, URL.
4. 報導：Author's full name, "Title of the article," *Name of the
Media*, Month Day, Year, URL.

範例

Robert D. Blackwill, *Trump's Foreign Policies Are Better Than
They Seem* (New York: Council on Foreign Relations Press,
2019) , p. 1, Council on Foreign Relations, [https://cfrd8-
files.cfr.org/sites/default/files/report_pdf/CSR%2084_Blackwi
ll_Trump_0.pdf](https://cfrd8-files.cfr.org/sites/default/files/report_pdf/CSR%2084_Blackwill_Trump_0.pdf).

Ralph A. Cossa, "Regional Overview: CVID, WMD, and
Elections Galore," *Comparative Connections: A Quarterly E-
Journal on East Asian Bilateral Relations*, Vol. 6, No. 1, April
2004, p.1, Pacific Forum, [http://cc.pacforum.org/2004/04/cvid-
wmd-elections-galore](http://cc.pacforum.org/2004/04/cvid-wmd-elections-galore).

White House, "National Security Strategy of the United States
of America," December 18, 2017, p. 1, White House,

<https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf>.
Colin Clark, “Mattis’ Defense Strategy Raises China To Top Threat: Allies Feature Prominently,” *BreakingDefense*, January 18, 2018, <https://breakingdefense.com/2018/01/mattis-military-strategy-raises-china-to-top-threat-allies-feature-prominently>.

十六、第二次引註之格式

首次引註須註明完整之資料來源（如前述各案例），第二次以後之引註可採以下任一格式：

- （一）作者姓名，《書刊名稱》或〈篇名〉，或特別註明之「簡稱」，頁 x-x。
- （二）如全文中僅引該作者單一作品，可簡略為——作者，前引書（或前引文），頁 x 或頁 x-x。
- （三）某一註解再次被引述，簡略為——同註 x，頁 x 或 x-x。
- （四）英文資料第二次引註原則相同：op. cit., p.x or pp.x-x（前引書，頁 x 或頁 x-x。）
- （五）Ibid. p.x or pp.x-x.（同前註，頁 x 或頁 x-x。）

十七、文末之參考文獻

- （一）參考文獻原則上與第一次引述的註釋體例格式相同，惟書籍、研討會論文及博碩士論文無須註明頁數。
- （二）所有文獻依前述註釋類別排列，並依中文、英文、其他語文先後排序。
- （三）中文著作依作者姓氏筆畫排序，英文著作依作者姓氏字母排序。
- （四）將書籍專章列為參考書目時，依專章作者排序。
- （五）翻譯作品依翻譯語文類別，中文譯作按譯者姓氏筆畫排序，英文譯作按原作者姓氏字母排列。
- （六）同一作者有多篇著作被引用時，按出版時間先後排序。
- （七）每一書目均採第一行凸排 2 字元。