



The Graveyard of Command Posts: What Chornobaivka Should Teach Us about Command and Control in Large-Scale Combat Operations

指揮所日暮途窮——師自喬爾諾巴伊夫卡 村落戰例論大規模作戰任務之指揮管制

譯者簡介



陳駿穎中校，國防大學國防管理學院89年班，國防大學國防管理學院財管所95年班，美國海軍陸戰隊後勤軍官班2012年班；現任國防大學管理學院人資組教官。



張弘盈中校，國防大學國防管理學院92年班，國立清華大學公共政策與管理研究所108年班；現任國防大學管理學院人資組教官。



羅德駿中校，指職軍官89年班，國防大學空軍指參學院99年班、國防大學戰爭學院102年班；現任國防大學空軍學院軍事作戰組教官。

作者：米爾福德·「比格斯」·比格爾二世(Milford “Beags” Beagle Jr.)中將為美陸軍聯戰中心指揮官，負責整合陸軍現役部隊的現代化工作，他曾派駐夏威夷與韓國，擁有堪薩斯州立大學的碩士學位。

傑森·史萊德(Jason C. Slider)准將，現任美陸軍卓越任務指揮中心主任，曾任美陸軍訓準部副參謀長，擁有美空院戰略研究碩士學位。

馬修·亞洛(Matthew Arrol)中校，現任美陸軍佛羅里達州哈爾伯特機場聯合支援組指揮官，具美陸院學資及東密西根大學企管碩士學位。

資料來源：美國軍事評論雙月刊(Military Review)，2023年5-6月，頁10-24。

In Ukraine, the village of Chornobaivka is legendary.¹ Songs are written about it.² Throughout 2022, the small town and its airfield on the outskirts of Kherson were a meatgrinder for Russian forces.³ From its original occupation in February to its liberation in

1~3 於下頁。

November, Ukrainian strikes rained down with a precision and lethality rarely seen in war and allowed a scrappy defender to take down a regional leviathan.⁴ Patriotic enthusiasm aside, closer inspection of this hard-won victory reveals that lurking beneath the wreckage of Russian ambitions in the Kherson Oblast is a warning about the vulnerability of legacy command posts that the United States and its allies would do well to heed.

在烏克蘭，人們傳頌喬爾諾巴伊夫卡(烏克蘭文：Чорнобаївка, 英文：Chornobaivka)¹的傳奇。²綜觀2022年這座小鎮及其位於赫爾松州(Kherson)郊區的機場(如圖1)，對俄軍而言就是一座「絞肉機(meatgrinder)」。³從最初2月俄軍占領至11月烏克蘭收復該地，這期間烏軍對俄軍實施罕見之精準且致命打擊，使得烏方以堅韌的防守者身分，擊敗俄軍這區域性巨人。

⁴然撇開愛國情操不談，嚴密審視這場艱苦取得的勝利，會發現籠罩於俄羅斯野心的赫爾松州廢墟下，隱藏著一個值得美國及其盟友深思熟慮的警訊，那就是傳統指揮所的脆弱性。



圖1 衛星影像顯示烏軍攻擊後，俄軍占領的烏克蘭赫爾松國際機場發生大規模火災，並有多架航空器遭到摧毀

The story of Chornobaivka is one of relentless assault on command and control

資料來源：Planet，經 Twitter 發布，譯者轉引。

- 1 “Зеленський: Чорнобаївка увійде в історію. Інформаційне агентство” [Zelenskyu: Chornobayivka will go down in history], Ukrainian Independent Information Agency, 20 March 2022, accessed 14 March 2023, <https://www.unian.ua/war/zelenskiy-chornobajivka-uvyide-v-istoriyu-novini-vtorgnennya-rosiji-v-ukrajinu-11751448.html>.
- 2 Фольклорний гурт “Святовид” (ЗСУ) – Чорнобаївка/Chornobaivka (with English subs), YouTube video, posted by “ListenPlay&Enjoy,” 3 May 2022, accessed 14 March 2023, <https://www.youtube.com/watch?v=cVg8iKwc25I>; ЧОРНОБАЇВКА (Chornobaivka), YouTube video, posted by “Анімаційні історії,” 12 April 2022, accessed 14 March 2023, <https://www.youtube.com/watch?v=X6Itg1km3cg>; Alcohol Ukulele - Чорнобаївка [Alcohol ukulele - Chornobaivka], YouTube video, posted by “Alcohol Ukulele,” 31 March 2022, accessed 15 March 2023, <https://www.youtube.com/watch?v=SK2mIKNcWNY>.
- 3 譯者註：meatgrinder在軍事情境中是一種隱喻，指的是極為殘酷且傷亡慘重的戰場。
- 4 Zhanna Bezpiatchuk, “Ukraine War: Chornobaivka Airbase, Symbol of Russian Defeat,” BBC News, 29 November 2022, accessed 14 March 2023, <https://www.bbc.com/news/world-europe-63754797>.

characterized by a systematic attack on Russian command posts at scale and across all tactical echelons.⁵ Over the span of eight months, the Ukrainian fires strike complex successfully attacked the headquarters of Russia's 8th Combined Arms Army, the 49th Combined Arms Army, the 22nd Army Corps, the 76th Guards Air Assault Division, the 247th Guards Air Assault Regiment, and their subordinate elements over twenty-two separate times.⁶ These attacks significantly degraded the Russians' ability to plan and conduct coordinated operations on the western side of the Dnieper River. The loss of effective command and control sapped Russian momentum and prevented Russians from consolidating gains, which ultimately led to their expulsion. In the process, Ukraine struck down high-level Russian leadership, killing Lt. Gen. Yakov Resantsev, commander of the 49th Combined Arms Army, and nearly killing Lt. Gen. Andrey Mordichev, commander of the 8th Combined Arms Army.⁷

- 5 David Axe, "In Southern Ukraine, Kyiv's Artillery Drops Bridges and Isolates a Whole Russian Army," *Forbes* (website), 29 July 2022, accessed 14 March 2023, <https://www.forbes.com/sites/davidaxe/2022/07/29/in-southern-ukraine-kyivs-artillery-dropsbridges-and-isolates-a-whole-russian-army/?sh=4>
- 6 "Чорнобаївка, де ЗСУ 6 разів знищили окупантів, увійде в історію воєн, - зеленський" [Chornobayivka, where the armed forces of Ukraine destroyed the occupiers 6 times, will go down in the history of wars, - Zelenskyy], РУДАНА, 20 March 2022, accessed 14 March 2023, <https://rudana.com.ua/news/chornobayivka-de-zsu-6-raziv-znyshchyly-okupantiv-uviyde-v-istoriyu-voyen-zelenskyy>; Julie Coleman, "Ukraine Says It's Killed one of Russia's Top Generals in Ukraine," *Business Insider*, 25 March 2022, accessed 14 March 2023, <https://www.businessinsider.com/ukraine-claims-its-killed-one-of-russias-top-generals-inukraine-2022-3>; Jay Beecher, "Update: Ukrainian Rocket Strike MILITARY REVIEW May-June 2023 23COMMAND POSTS FOR LSCOKilled Twelve Russian Officers near Kherson," *Kyiv Post* (website), 13 July 2022, accessed 14 March 2023, <https://www.kyivpost.com/post/2295>; "Пекло для рашистів на півдні України: вражаюча кількість знищених об'єктів та техніки армії РФ за одну добу" [Hell for Russian soldiers in the south of Ukraine: An impressive number of destroyed objects and equipment of the Russian army in one day], *Defense Express*, 6 August 2022, accessed 14 March 2023, https://defence-ua.com/news/peklo_dlja_rashistiv_na_pivdni_ukrajini_vrazhajucha_kilkist_znischenih_objektiv_ta_tehniki_armiji_rf_za_odnu_dobu-8452.html; "Ворожий склад з боеприпасами та командний пункт 247 десантно-штурмового полку знищено в Чорнобаївці, - ОК 'Південь'" [The enemy warehouse with ammunition and the command post of the 247th Airborne Assault Regiment were destroyed in Chornobayivka, - ОК "Pivden"], *Censor.net*, 23 August 2022, accessed 14 March 2023, https://censor.net/ua/news/3362604/vorojyyi_sklad_z_boyeprypasamy_ta_komandnyyi_punkt_247_desantnoshturmovogo_polku_znyscheno_v_chornobayivtsi.
- 7 Olena Roshchina, "Another General: Commander of Russia's 49th Army Killed by Ukrainian Armed Forces, Says Arestovych," *Ukrayinska Pravda*, 25 March 2022, accessed 14 March 2023, <https://www.pravda.com.ua/eng/news/2022/03/25/7334482/>; Ben Tobias, "Russian General Yakov Rezantsev Killed in Ukraine," *BBC News*, 26 March 2022, accessed 14 March 2023, <https://www.bbc.com/news/world-europe-60807538>

喬爾諾巴伊夫卡戰例是樁刻意對敵方指揮與管制(command and control, C2)發動致命攻擊的故事，其特點是烏方綜合運用各戰術階層部隊的大規模行動，並對俄方指揮所進行系統性的打擊。⁵ 8個月內，烏方以綜合火力成功打擊俄方第8聯合兵種軍團、第49聯合兵種軍團、第22集團軍、第76近衛空中突擊師、第247近衛空中突擊團等單位的指揮部，總計超過22次。⁶ 這些攻擊顯著削弱了俄羅斯在第聶伯河(Dnieper River)西岸規劃和協調作戰的能力。喪失有效的指揮與管制(C2)使得俄方推進力降低，亦阻止其鞏固占領地，最終導致遭烏方驅逐。於此過程，烏方擊殺俄方領導高層，擊斃第49聯合兵種部隊指揮官雅科夫·列桑采夫中將，並差點擊斃第8聯合兵種部隊指揮官安德烈·莫爾迪切夫中將。⁷

Beyond Kherson, this pattern has been similar if less concentrated. Ukrainian attacks on command posts across the country have led to stunning attrition among senior Russian military leaders.⁸ This reflects a programmatic approach to striking at the capability and will of the Russian forces by removing their source of purpose, motivation, and direction. By any measure, the Ukrainians' success is impressive. More than 1,500 officers have been killed in Russia's war on Ukraine, including ten general officers and 152 colonels and lieutenant colonels.⁹

在赫爾松州以外地區，此類模式相似但較不集中。烏克蘭對全國各地指揮所發動之攻擊，導致俄羅斯軍事領導高層的驚人傷亡。⁸ 這反映了烏軍透過削弱其目標、士氣和指揮效能，系統性打擊俄軍能力和意志。無論從任何角度來看，烏克蘭的成功都令人印

8 Phelan Chatterjee and Sam Hancock, "Ukraine War: Exiled Governor Reports Strike on 'Wagner HQ,'" BBC News, 12 December 2022, accessed 14 March 2023, <https://www.bbc.com/news/world-europe-63933132>; David Axe, "The Ukrainians Keep Blowing Up Russian Command Posts and Killing Generals," Forbes (website), 23 April 2022, accessed 14 March 2023, <https://www.forbes.com/sites/davidaxe/2022/04/23/the-ukrainians-keep-blowing-up-russian-command-posts-and-killing-generals/?sh=5f78a6f9a350>; John Varga, Tom Watling, and Katherine McPhillips, "Zelensky Launches Christmas Revenge Attack on Russian HQ before Jet Explodes," Express, 27 December 2022, accessed 14 March 2023, <https://www.express.co.uk/news/world/1713889/ukraine-live-war-zelensky-russian-hq-hit-kherson-region-putin-belarus-mig-31-fire>.

9 William Booth, Robyn Dixon, and David L. Stern, "Russian Generals Are Getting Killed at an Extraordinary Rate," Washington Post (website), 26 March 2022, accessed 14 March 2023, <https://www.washingtonpost.com/world/2022/03/26/ukraine-russian-generals-dead/>; Will Stewart and David Averre, "Putin 'Has Lost 160 Generals and Colonels among 1,500 Officers', Ukrainian Military Official Claims," Daily Mail Online, 28 November 2022, accessed 14 March 2023, <https://www.dailymail.co.uk/news/article-11477163/Putin-lost-160-generals-colonels-1-500-officers-Ukrainian-military-official-claims.html>.



象深刻。俄烏戰爭至今，已有超過1,500名俄軍軍官喪生，包括10名將官和152名上、中校。⁹

Some suggest the Russian experience at Chornobaivka and elsewhere can be explained by the Russians' inability to overcome challenges in professionalism, training, and communications, and a fundamentally different philosophical approach to command and control.¹⁰ Pinning Russian woes solely on ineptitude, while true to some extent, downplays the effect Ukrainians are having in systematically dismantling their enemy's command-and-control system through multidomain targeting. Furthermore, the Ukrainians are achieving these effects without the benefit of a substantial air force or extensive long-range fires.¹¹ Limiting this problem to failures in Russian military leadership ignores the fact that technologies and capabilities exist today that can enable and deliver devastating effects on command and control. U.S. adversaries, including the Chinese, have made attacking our command-and-control systems a stated objective.¹²

有些觀點認為，俄羅斯在喬爾諾巴伊夫卡及其他地區的經驗可歸因於其無法克服專業素養、訓練和通信方面的挑戰，以及在指揮與管制(C2)上所採取之根本不同的哲學方法。¹⁰ 將俄羅斯的困境僅歸咎於其無能，雖在某種程度上是真實的，但這亦低估了烏克蘭藉由多領域定位方式，有系統地瓦解敵方指揮與管制(C2)系統的努力。其次，烏克蘭更在沒有足夠空優或廣泛遠程火力支援的情況下，達成了這些成效。¹¹ 僅將此歸咎於俄羅斯軍事領導階層的失敗，忽視了當前科技和能力可以對指揮與管制(C2)系統造成毀滅性影響的事實。包括中國在內的美國對手們，已將攻擊我們的指揮管制系統定為明確目標。¹²

- 10 Tom Nagorski and Joshua Keating, "Ukraine Mystery: Why Have So Many Russian Generals Been Killed?," Grid News, 7 April 2022, accessed 14 March 2023, <https://www.grid.news/story/global/2022/04/08/ukraine-mystery-why-have-so-many-russian-generals-been-killed/>; Austin Wright, "Why Russia Keeps Losing Generals," Foreign Policy (website), 20 July 2022, accessed 14 March 2023, <https://foreignpolicy.com/2022/07/20/why-russia-keeps-losing-generals-ukraine/>.
- 11 Sebastian Seibt, "Devastating Strike on Russian Military Base in Ukraine Exposes 'Gross Criminal Incompetence,'" France 24, 4 January 2023, accessed 14 March 2023, <https://www.france24.com/en/europe/20230104-devastating-strike-on-russian-military-base-in-ukraine-exposes-gross-criminal-incomp>
- 12 Jeffrey Engstrom, *Systems Confrontation and System Destruction Warfare: How the Chinese People's Liberation Army Seeks to Wage Modern Warfare* (Santa Monica, CA: RAND Corporation, 2018), accessed 14 March 2023, https://www.rand.org/pubs/research_reports/RR1708.htm.

Specifically, command posts are targeted because they have become easily targetable. Contemporary tented command posts-with their radio frequency emitting antennas, dozens of generators and vehicles, and extensive support requirements-are easily targetable to even the untrained eye. During large-scale combat operations, these command posts can be easily seen by an ever-expanding array of sensors and just as easily struck by complementary effects throughout the depth and breadth of the battlefield. For anything as ostentatious as a modern command post, no true sanctuary exists.¹³ While we may be quick to point fingers at the Russians, Western command posts have significant challenges with survivability. Even where efforts have been made to improve the mobility of command posts, our inability to hide the multispectral signatures of these massive structures coupled with persistent battlefield surveillance and precision weapons negates any benefit achieved and likely renders a second strike unnecessary.¹⁴ At higher echelons, this survivability problem is exacerbated.¹⁵

具體而言，指揮所會成為攻擊目標，正是因其變得易於被鎖定。當前的帳篷式指揮所，由於配備大量發射無線電頻率的天線、數十台發電機和車輛，且後勤支援需求龐大，即便是缺乏專業訓練的人員，也能輕易辨識指揮所並加以打擊(如圖2、3)。在大規模戰鬥行動中，這些指揮所極易被日益增多的感測器陣列所偵測，並同樣容易遭受遍布戰場縱深與廣度的各類火力與作戰效應打擊。對於像現代指揮所這般大張旗鼓的設施而言，其實就算是建造出牢不可破的避難場所也難以倖存。¹³ 儘管我們能快速指出俄羅斯的問題，但西方指揮所同樣面臨嚴峻的生存挑戰。縱然已著手提升指揮所之機動性，然由於無法隱藏這些大型結構的多光譜特徵，再加上戰場監視技術的進步與精確打擊武器的運用，使得所有機動性帶來的優勢幾乎被完全抵消，甚至讓敵軍無需發動第二波攻擊。¹⁴ 在更高層級的部隊，這種生存能力問題將更為嚴峻。¹⁵

13 Mykhaylo Zabrotskyi et al., "Preliminary Lessons in Conventional Warfighting from Russia's Invasion of Ukraine: February-July 2022," Royal United Services Institute, 30 November 2022, accessed 14 March 2023, <https://rusi.org/explore-our-research/publications/special-resources/preliminary-lessons-conventional-warfighting-russias-invasion-ukraine-february-july-2022>.

14 Samuel Northrup, "New Army Vehicles Being Developed to Counter Modern Threats," Army.mil, 3 April 2019, accessed 14 March 2023, https://www.army.mil/article/219567/new_army_vehicles_being_developed_to_counter_modern_threats.

15 Michael Greenberg, "It's Time to Fix the Command Post: Optimizing Headquarters' Mobility, Survivability, and Interoperability for the Future Fight," Modern War Institute at West Point, 19 August 2020, accessed 14 March 2023, <https://mwi.usma.edu/its-time-to-fix-the-command-post-optimizing-headquarters-mobility-survivability-and-interoperability-for-the-future-fight/>.



The battle for Chornobaivka brings into focus a theory of warfare, introduced during the Nagorno-Karabakh War of 2020, that lays bare the lethality and transparency of the modern battlefield through the concerted employment of multidomain effects on the command-and-control warfighting function.¹⁶ It reveals an imperative to rethink command posts for this new era of warfare. In the face of this immediate threat, the U.S. Army must transform command and control to incorporate the tenets of multidomain operations (MDO) as it transitions to this new operating concept across all warfighting functions. To fight and win on the modern battlefield in large-scale combat operations, Army command posts can and must become more flexible, agile, and resilient while not sacrificing effectiveness. Otherwise, our command posts will be a place our leaders go to die.

喬爾諾巴伊夫卡之役聚焦於一種戰爭理論，該理論在2020年納戈爾諾-卡拉巴赫戰爭期間提出，它透過多領域效果對指揮與管制(C2)協同運用作戰職能，暴露出現代戰場的致命性和透明性。¹⁶ 這揭示為肆應新戰爭時代而重新思考指揮所之迫切性。面對此迫在眉睫的威脅，美國陸軍必須改革

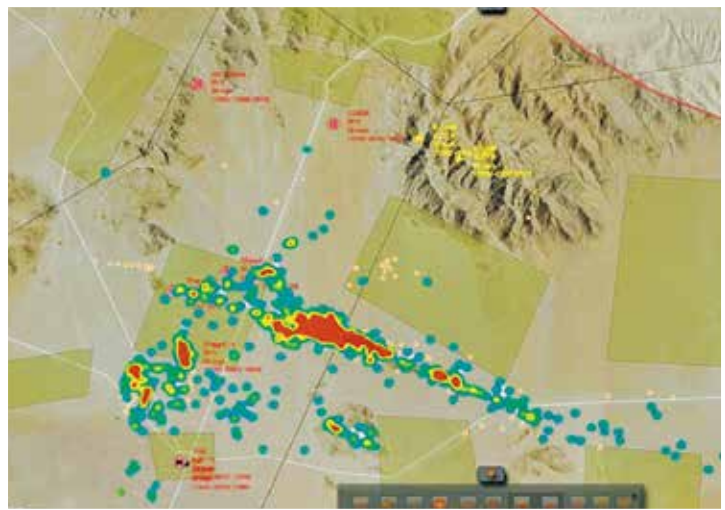


圖2 衛星影像顯示，美國陸軍一個旅級戰鬥隊在加州歐文堡國家訓練中心進行訓練時的電子訊號發射特徵

資料來源：美國陸軍；譯者轉引。



圖3 美國陸軍當前的戰術指揮所配置，因其規模龐大與電子訊號特徵顯著，已成為戰場上的重大弱點

資料來源：美國陸軍；譯者轉引。

16 John F. Antal, 7 Seconds to Die: A Military Analysis of the Second Nagorno-Karabakh War and the Future of Warfighting(Philadelphia: Casemate, 2022).

指揮與管制(C2)系統，將多領域作戰(multidomain operation, MDO)原則融入到新的作戰理念中，並在其所有作戰職能中實施這一理念。要在現代戰場上的大規模戰鬥行動中取勝，陸軍指揮所必須且可以變得更靈活、敏捷和有韌性，與此同時又不能犧牲效能。否則，我們的指揮所將成為領導者的亡命之地。

An understanding of how our command posts need to evolve must begin with an appreciation for the role command posts play in our Army. Having defined their function and current form, it will then be possible to illustrate how that form is unfit for its purpose and at odds with the tenets of MDO. This will enable a discussion on a better approach to facilitating multidomain command and control, with near-term goals and an objective end state optimized for large-scale combat operations.

要理解指揮所需要如何進化，首先必須認識到指揮所在當前軍隊中所扮演的角色為何。一旦界定指揮所之功能與當前形式後，就可以說明此形式為何不適合其目的，且與多領域作戰(MDO)的核心原則相悖。這將有助探討改善多領域作戰指揮與管制(C2)運作模式，並據此規劃短期目標與最終達成符合大規模作戰需求的所望戰果。

Army Techniques Publication 6-0.5, Command Post Organization and Operations, broadly defines a command post as “a unit headquarters where the commander and staff perform their activities” and states that “the commander alone exercises command within a CP [command post] or elsewhere.”¹⁷ This statement reinforces the purpose of a command post: to “assist commanders in the exercise of mission command.”¹⁸ For those unfamiliar with the term, “mission command” is a philosophical concept in the U.S. Army that represents an approach to command and control that “empowers subordinate decision making and decentralized execution appropriate to the situation.”¹⁹ While not every nation or service views command and control the same, most view the purpose of the command post similarly, as a tool for enabling the commander’s process for understanding, visualizing, describing, directing, leading, and

17 Army Techniques Publication 6-0.5, Command Post Organization and Operations Army (Washington, DC: U.S. Government Publishing Office [GPO], 1 March 2017), 1-1, accessed 14 March 2023, [https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ATP%206-0_5%20\(final\).pdf](https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ATP%206-0_5%20(final).pdf).

18 Ibid.

19 Field Manual (FM) 6-0, Commander and Staff Organization and Operations (Washington, DC: U.S. GPO, 16 May 2022), 1-3, accessed 14 March 2023, https://armypubs.army.mil/epubs/DR_pubs/DR_a/ARN35404-FM_6-0-000-WEB-1.pdf.



assessing operations. Any suitable and acceptable form of command post must achieve these criteria.

美國陸軍技術書刊(技術手冊/技令專書)6-0.5《指揮所組織與作戰》中指出：廣義之指揮所為「指揮官和參謀執行作業的單位總部」，並指出「指揮官單獨在指揮所(CP)或其他地方行使指揮」。¹⁷此一陳述強調了指揮所的目的：為了「協助指揮官執行任務式指揮(mission command)」。¹⁸對於不熟悉這個術語的人來說，「任務式指揮」是美國陸軍的一項哲學概念，代表了一種指揮與管制(C2)的方法，即「根據情況適當的賦予下級決策權和分散執行權」。¹⁹雖然不同國家或軍種對指揮與管制(C2)的理解可能有所差異，但大多數皆認同指揮所的核心目的，即作為支援指揮官決策程序的工具，使能夠理解、洞悉、描述、指導、領導及評估作戰行動。任何合適且可接受的指揮所形式皆須滿足上述標準。

Wrong Tool for the Job of Commanders Today

At its core, the current command-and-control dilemma reflects an imbalance in the functional requirements for command posts to be both effective and survivable. Throughout history, as the complexity and scale of war has expanded, so too has the organization, composition, and proliferation of command posts. Commanders and their staffs have tailored these structures to provide the best means to control formations in the chaos of war, deliver good decisions faster than the enemy, and increase effectiveness by leveraging the experience and leadership of the commander. In the nineteenth century, industrial-level warfare bred industrial models for command posts as well as the accompanying bureaucracy to manage them.²⁰ In many ways, this approach persists even two hundred years later, as represented by the Napoleonic Staff Model, which remains the predominant organizational design.²¹

指揮官現有工具難竟其功

當前指揮與管制(C2)困境在其核心上反映了指揮所功能需求上的不平衡，這些需求乃是為了使指揮所同時具備效率和生存能力。隨著歷史演進，戰爭規模與複雜度不斷擴

20 Frederick Winslow Taylor, *The Principles of Scientific Management* (New York: Harper & Brothers, 1911).

21 John F. Price Jr., "Napoleon's Shadow: Facing Organizational Design Challenges in the U.S. Military," *Joint Force Quarterly* 68 (1st Quarter, 2013): 48-52, accessed 14 March 2023, https://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-68/JFQ-68_48-52_Price.pdf.

大，指揮所的組織、架構和普及程度也隨之增長。指揮官及其參謀群已根據這些結構進行調整，以提供在戰爭的混亂中更有效地管控部隊，俾能比敵人更快地作出良好決策，並藉著指揮官的經驗和領導力提高效能。在19世紀，工業級戰爭孕育了指揮所的工業模型以及管理指揮所的相應官僚體系。²⁰從許多方面來說，即便在兩百年後的今日，這種編組仍是慣用模式，正如典型的拿破崙式參謀體系，依然是指揮所規劃的設計主流。²¹

In the early twentieth century, the rise of airpower greatly improved the effectiveness of armies but complicated control and created a need to synchronize a third domain that would be subsequently joined by two others in the twenty-first century. A commander's need for control and knowledge across all these areas created a demand for human and technical decision-support tools. While this initially manifested in the form of an ever-expanding functionally dedicated staff, today it also appears in the form of computer servers and the digital applications required for processing and discerning meaning from the sea of data in which our operations are now awash.²² This insatiable demand for decision-quality information to enable understanding and commander visualization has only increased over time. In the current form, these tools and staff weigh on the agility of the command-and-control system and increase its vulnerability by orders of magnitude.

20世紀初，空權的崛起大幅提高軍隊的效能，與此同時卻使管制變得更加複雜，並催生對協同第三戰域的需求，在21世紀後又新增另外兩個領域。指揮官對這些領域的管制和獲取知識的需求，促使對人力和技術決策支援工具的迫切呼籲。雖然這最初呈現在不斷擴充的專業功能參謀人員群的形式，但在今天它也以電腦伺服器 and 數位化應用程式的形式出現，這些應用程式用於處理並理解作戰行動中所充斥的海量數據。²²對於能夠幫助指揮官理解和洞悉戰場優質決策訊息的無止境需求，隨著時間推移而不斷增加。在當前形式中，這些工具和參謀群對指揮與管制(C2)系統的敏捷性造成了壓力，並將其脆弱性增加了數個量級。

To increase survivability, commanders sought to protect their command posts by reducing their size, hardening them, splitting them up, camouflaging them, increasing their mobility,

22 Jaspreet Gill, "At Project Convergence, Data Management Is Army's Biggest Challenge," *Breaking Defense*, 15 November 2022, accessed 14 March 2023, <https://breakingdefense.com/2022/11/at-project-convergence-data-management-is-armys-biggest-challenge/>.



and actively defending them against all manner of threats including air, cyber, and electronic attack.²³ Advancing technology has been on both sides of this dilemma. It has provided communications, automation, and information technology to compress the structure of command posts and make them more productive. However, technology also created a gateway into further functionality and capability that added size and structure counterproductive to survivability. Generally, this ebb and flow of effectiveness and survivability has been incremental, with actions and reactions reflected in doctrine, material, and design more evolutionary than revolutionary.

為了提高生存能力，指揮官們採取了多種策略來保護指揮所，包括縮小規模、加固結構、進行分割、偽裝、提高機動性，以及積極防禦空中、網絡和電子攻擊等多種威脅。²³ 先進科技一直存在於這兩難的困境，它提供了通信、自動化和資訊科技，以壓縮指揮所的架構，同時更具有高效能；然而，科技也為進一步的功能與能力開闢了大門，這增加了指揮所的規模和結構，卻與提高生存能力的目標相悖。整體而言，作戰效能與存活能力之間的此消彼長，多以漸進方式發展，其影響與對應措施反映在作戰準則、裝備與設計上，屬於演進式的調整，而非革命性的變革。

Sometimes, evolution includes mutations that, if left unchecked, can metastasize into a vulnerability that requires a revolution to correct. Such is the case with U.S. command posts over the last twenty years, which have been rendered unfit for their purpose given the speed, complexity, and lethality of large-scale combat operations. Since 2001, the absence of an observable and aggressive threat allowed our command posts to gradually mutate during the Global War on Terrorism. Over the succeeding thirteen years following the invasion of Afghanistan, command posts progressively diverged further and further from a suitable model for large-scale combat operations. At the same time, their organization and systems allowed commanders to have unprecedented levels of control and situational awareness.²⁴ At times, this threatened the Army's very leadership philosophy of mission command by enabling micromanagement by command posts that were overpeopled, overprocessed, overnetworked,

23 Stew Magnuson, "Army Scrambles to Make Command Posts Survivable," National Defense (website), 1 December 2017, accessed 14 March 2023, <https://www.nationaldefensemagazine.org/articles/2017/12/1/army-scrambles-to-make-command-posts-survivable>.

24 Jeremy Horton and Ted Thomas, "Adapt or Die: Command Posts - Surviving the Future Fight," Army.mil, 27 May 2020, accessed 14 March 2023, https://www.army.mil/article/235968/adapt_or_die_command_posts_surviving_the_future_fight.

and understressed.²⁵

有時，演化亦包括突變，若不加控制，這些突變可能會轉化為需要一場革命來糾正的弱點。美國指揮所過去20年間的情形就是如此，由於大規模戰鬥行動的速度、複雜性和致命性，使其變得不適合其原有目的。自2001年起，在全球反恐戰爭期間，由於缺乏明顯的積極威脅，我們的指揮所逐漸發生變異。在隨後入侵阿富汗的13年中，指揮所逐漸偏離適合大規模戰鬥行動的模型。與此同時，其組織和系統使指揮官擁有前所未有的控制能力和情境意識。²⁴有時，這甚至威脅到陸軍的任務式指揮(mission command)領導哲學，因為指揮所過度人員配置、過度流程化、過度網絡化以及壓力不足，從而使微觀管理的情形發生。²⁵

Within the U.S. Army, one of the main reasons this gap expanded is because our entire doctrine, organization, training, materiel, leadership, personnel, and facilities (DOTMLPF) enterprise was oriented on lower tactical echelons to provide the forces and capabilities required for counterinsurgency operations. As an example, within the U.S. Army Training and Doctrine Command, the combat training centers evaluated the command posts of brigade combat teams for nearly two decades using a rubric that promoted a comprehensive and process-driven approach to targeting that previously existed only at the division level or above. This incentivized commanders to develop ponderous infrastructure to support capabilities for integrating complex operations without adequately punishing them for the resulting loss of flexibility, agility, and survivability.²⁶ Those combat training center “lessons,” appropriate though they were for that time and mission, inculcated an entire generation of leaders with a sense of invulnerability inconsistent with highly dynamic, mobile, and lethal warfare against a capable enemy. The United States was not the only nation to adopt this approach; our NATO allies who dutifully participated in counterterrorism and counterinsurgency operations around the world followed suit.²⁷

- 25 Justin T. DeLeon and Paolo G. Tripodi, “Eliminating Micromanagement and Embracing Mission Command,” *Military Review* 102, no. 5 (September-October 2022): 88-98, accessed 14 March 2023, <https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/September-October-2022/DeLeon-Tripodi/>.
- 26 U.S. Army Center for Army Lessons Learned (CALL), *National Training Center Operations Group Fire Support Handbook* (Fort Leavenworth, KS: CALL, November 2020), accessed 14 March 2023, <https://usacac.army.mil/sites/default/files/publications/21558.pdf>.
- 27 Federico Clemente Clemente, Jan Willem Streefkerk, and Marcel Scherrenburg, *The Future of the Command Post*, part 1 (Utrecht, NL: NATOC2COE, January 2019), accessed 14 March 2023, <https://c2coe.org/download/the-future-of-the-command-post-part-1/>.



在美國陸軍內部，此差距擴大的主要原因之一是，因為整體之準則、組織、訓練、裝備、領導統御、人員與設施(doctrine, organization, training, materiel, leadership, personnel, and facilities, DOTMLPF)，長期聚焦於較低層級的戰術單位，以提供執行反叛亂作戰所需的兵力與作戰能力。例如，在美國訓練部內，戰鬥訓練中心利用一套評分標準評估旅級戰鬥群指揮所將近20年，此標準促進了一種全面且以流程為驅動的目標制定方法，此方法之前僅在師級或更高層級存在。這種方式也造成指揮官為能有效整合複雜環境的作戰需求，只著重建置龐雜的基礎設施，卻未能全盤檢討，因此輕忽了指揮所該有的應變力、敏捷力和生存能力(如圖4)。²⁶ 這些戰鬥訓練中心所傳授的「經驗教訓」，雖然在當時的環境與任務需求下是適切的，卻讓整整一代指揮官養成了一種與高度動態、機動性強且殺傷力極高的戰爭模式不符的無敵錯覺。美國並非唯一採取這種方法的國家，我們的北約(NATO)盟國亦加以效法，跟從美軍積極參與全球範圍內的反恐與反叛亂作戰。²⁷

Even our adversaries, hoping to replicate successes in Operation Iraqi Freedom and concerned with their own expeditionary regional entanglements, expanded the sizes of their headquarters at tactical echelons.²⁸ Ironically, commander's experience, knowledge, and intuition today are backstopped by an unprecedented system of functional experts and technical tools that significantly reduces their decision risk but exponentially increases risk to mission and their personal safety. While there is not space here to fully examine all the implications



圖4 無人機(UAV)拍攝的指揮所俯視影像。許多軍隊今日仍普遍採用的指揮模式，將車輛與帳篷集中部署於單一地點，以維持對機動部隊的指揮與管制，然而這種可預測的部署方式，在現代戰場上已成為一大弱點

資料來源：美國陸軍；譯者轉引。

28 Nick, Mordowanec, "Intelligence Report Reveals 3 Intrinsic Russian Tactical Unit 'Weaknesses,'" Newsweek (website), 29 November 2022, accessed 14 March 2023, <https://www.newsweek.com/intelligence-report-reveals-3-intrinsic-russian-tactical-unit-weaknesses-1763215>.

of this period for command and control, each component of DOTMLPF must be evaluated independently to assess our experience since 2001 and its effect on the command-and-control system and our command posts. Today, our command posts have mutated away from the lean, mean, killing machines we need and are instead fat and ponderous.

即使是我們的對手，也希望複製伊拉克自由行動中的成功，並關注他們自己的遠征區域糾葛，因而擴大其戰術層級指揮部規模。²⁸諷刺的是，指揮官當前的經驗、知識和直覺，都得到前所未有的功能專家和技術工具系統的支持，這顯著降低了他們的決策風險，但卻使任務和個人安全的風險成倍數增加。雖然本文沒有足夠的空間來全面探討這一時期對指揮與管制(C2)的所有意涵，但必須獨立評估DOTMLPF的每個組成部分，以評估自2001年以來之經驗及其對指揮與管制(C2)系統和指揮所的影響。如今，我們的指揮所已經變異，不再是我們所需的精簡、高效的殺戮機器，反而變得臃腫和笨重。

Putting the Right Tool in the Hands of Commanders

Change is coming. The release of the U.S. Army's capstone doctrine, Field Manual 3-0, Operations, in October 2022 codifies a significant departure for all warfighting functions from legacy foundations and seeks to drive the Army to sustained dominance of the land domain while operating in multiple domains in the twenty-first century.²⁹ Recognizing the challenges of the current environment, MDO emphasize that command posts, as an element of the command-and-control system, must adhere to the tenets of agility, convergence, endurance, and depth. To optimize our command posts, we must reduce our reliance on the physical dimension (the material), increase our utilization of the information dimension (the data), and maximize our relationship with the human dimension (our leaders). These three mandates provide the framework for a new rubric to assess and evaluate command posts across the Army's training programs. To develop a new foundation for command and control, examining each of the tenets of MDO will help distinguish what truly constitutes an acceptable, suitable, and complete command post design; one that is both effective and survivable in large-scale combat operations against a capable enemy.

為指揮官配備適當工具

變革將至。美國陸軍於2022年10月發布的最高作戰指導準則《野戰教則3-0作戰

29 FM 3-0, Operations (Washington, DC: U.S. GPO, 1 October 2022), 1-3, accessed 14 March 2023, https://armypubs.army.mil/epubs/DR_pubs/DR_a/ARN36290-FM_3-0-000-WEB-2.pdf.



篇》，正式確立所有戰鬥職能從傳統基礎向全新作戰概念的重大轉變，其主旨在推動陸軍於21世紀多領域作戰中持續主導地面戰場。²⁹ 面對當前作戰環境的挑戰，多領域作戰(MDO)強調，指揮所作為指揮與管制(C2)系統的一環，必須符合敏捷力、聚合力、耐久力和縱深力的作戰原則。為了提升指揮所效能，我們必須減少對實體層面(裝備)的依賴，增強對資訊層面(數據)的運用，並最大化人因層面(意指指揮領導)的影響力。這三項要求構成新標準，用以衡量與檢視陸軍訓練計畫中指揮所效能。要建立指揮與管制(C2)的新基礎，須檢視多領域作戰(MDO)的各項原則，以釐清何種指揮所設計符合要求同時又適切完整，並在大規模戰鬥中對抗強敵時兼具作戰效能與生存能力(如圖5)。

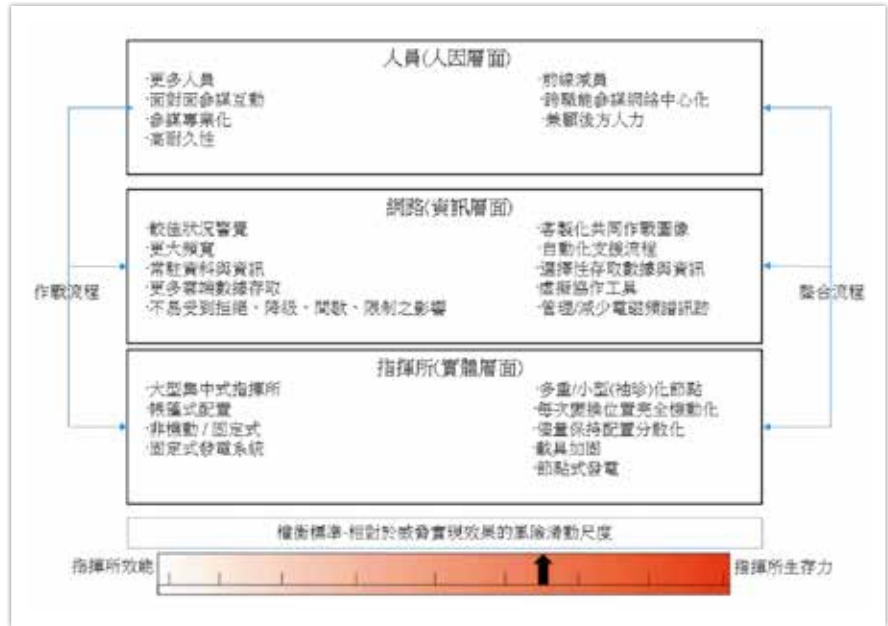


圖5 現行指揮所型態示意圖

Agility. By the Army's definition of agility, "the ability to move forces and adjust their dispositions and activities more rapidly than the enemy," our current command posts are not providing us with any demonstrable advantage.³⁰ Agility denotes speed and the nimbleness to change quickly. At present, our command posts are locked in an endless cycle of the work required to establish, disestablish, displace, and emplace to remain survivable and keep pace with operations. This alone disrupts operational tempo and degrades decision advantage even without enemy interference. Increasing mobility by divesting tentage and transitioning to vehicle mounted systems will help but not eliminate this problem. Increasing mobility will not change the fact that when our command posts arrive at their new location, they will not be more than what they were before.

敏捷力。根據美國陸軍對敏捷性的定義，即「比敵方更迅速地調動部隊、調整部隊

資料來源：1.美陸軍卓越任務指揮中心。
2.譯者轉繪。

30 Ibid., Glossary-3.

部署和活動的能力」，我們目前的指揮所並未為我們提供任何明顯的優勢。³⁰ 敏捷性意味著速度和迅速改變的靈活性。目前，我們的指揮所陷入一種困境，即在建置、解散、轉移和部署以保持生存能力並跟上作戰節奏所需之作業的無盡循環中。這本身就打亂了作戰節奏，即便沒有敵方干擾，也已降低決策優勢。通過削減帳篷並轉向車載系統來增加機動性將有所幫助，但無法根除這個問題。提高機動性並未改變一個事實：當我們的指揮所抵達新位置時，它們的實際功能並沒有比之前更有優勢。

For example, a brigade command post cannot rapidly become a division command post, even though a brigade command post may have to assume those roles and functions with less capability if the division command post is destroyed. If we organize our command posts around what is truly important, the commander's processes, then we can be indifferent about what provides those processes. If we envision our command posts as less of a place or a thing and more as a service, it may be possible to vastly increase our agility. What happens if a corps, division, or brigade commander arrives, takes control of any command post, and receives the capability of the appropriate echelon with a push of a button? What if command posts at higher tactical echelons were truly fungible based on connectivity and accessibility of data? What if, instead of tents and dozens of vehicles and generators, the command post capability could be delivered in a footprint the size of a personal security detachment (three to four vehicles)?³¹ This approach to achieving the tenant of agility could be a game changer and enhance the commander's ability to achieve decision advantage in a hyperactive environment. In MDO, decision advantage is leveraged to enable convergence of joint and Army capabilities.

例如，儘管在師級指揮所遭到摧毀後，旅級指揮所可能必須承擔其職能與任務，但由於作戰能力受限，無法迅速轉變為師級指揮所。若我們將指揮所的架構圍繞指揮官決策程序這一核心要素進行組織，那麼提供該決策程序的載體形式將變得無關緊要。若我們將我們的指揮所視為不僅是一個場所或物體，而更像是一項服務，我們應能大幅增加敏捷性。如果一個軍團、師或旅指揮官到達後，接管任一指揮所，並通過按一個按鈕獲得適當層級的能力，會發生什麼？如果高戰術層次的指揮所真正基於連接性和數據可訪問性而具靈活互換性呢？如果，指揮所可以在個人安全小隊(3~4輛車)大小的占地面積

31 John Antal, "Sooner Than We Think: Command Post Survivability and Future Threats," 4 August 2022, in The Convergence: An Army Mad Scientist Podcast, episode 62, 44:13, accessed 14 March 2023, <https://theconvergence.castos.com/episodes/62-soonerthan-we-think-command-p>



內提供其能力，而不再是需要帳篷、數十輛車輛和發電機呢？

³¹ 採取這種實現靈活性的方式可能會改變遊戲規則，並增強指揮官在高活躍環境中實現決策優勢的能力。在多領域作戰(MDO)中，決策優勢被用來實現各聯合軍種與陸軍自身的能力整合(如圖6)。



圖6 設置於M1087 可展開式箱型車的指揮所整合基礎設施系統(Command Post Integrated Infrastructure System, CPI2)

資料來源：美國陸軍；譯者轉引。

Convergence. Newly introduced in Field Manual 3-0, the tenet of convergence is “an outcome created by the concerted employment of capabilities from multiple domains and echelons against combinations of decisive points in any domain to create effects against a system, formation, decision maker or in a specific geographic area.”³² In part, convergence is achieved through combined joint all-domain command and control and therefore must be a driving factor in the composition of future command posts. Convergence reminds us that, far from giving up capability at echelon to simplify our activities, any acceptable command post design must be able to achieve even greater effectiveness through more robust integration and interoperability. Command posts that connect sensors, shooters, and decision-makers enabled by machine learning and artificial intelligence will transform the legacy kill chain into a kill web to create “exploitable opportunities that enable freedom of action and mission accomplishment.”³³

聚合力。在《野戰教則 3-0》中首次強調的聚合力原則是指「藉由我方多重領域和部隊階層作戰能力的協同運用，找出敵方某種領域中的決勝點組合，並針對其個別系統、部隊、決策者或特定地理區域施予重大影響」。³² 聚合力的部分實現方式來自聯合全域指揮與管制(combined joint all-domain command and control, CJADC2)，因此它必須

32 FM 3-0, Operations, Glossary-5.

33 Christian Brose, *The Kill Chain: Defending America in the Future of High-Tech Warfare* (New York: Hachette Books, 21 April 2020); FM 3-0, Operations, 3-3.

成為未來指揮所編組的關鍵驅動因素。聚合力提醒我們，絕不是為了簡化作戰活動而削弱各層級的作戰能力，任何可接受的指揮所設計都必須藉由更強大的整合性和互通性來提升作戰效能。具備機器學習與人工智慧輔助的指揮所，能連結傳感器、射手和決策者，將傳統的擊殺鏈轉變為擊殺網，進而創造「有利戰機，確保行動自由與任務達成」。³³

This mandate for data integration positions decision-quality data that enables commander's processes (e.g., understanding, visualization) at the heart of the modern command post. To retain agility and enable the constant flow of the right data to the right leaders, command posts can no longer rely on legacy stove-piped systems, on-site servers, and the accompanying support mechanisms as the primary means to support decision-making. Instead, we must migrate to the cloud and leverage data mesh and data fabric concepts to ensure data is secure, organized, and available in a manner that is usable for commanders and their staffs. For those unfamiliar, data mesh and data fabrics are complementary approaches to data management that enable connectivity and accessibility. A data mesh is a decentralized data architecture that federates data production, management, and sharing within and among domains.³⁴

這項資料整合的要求將能確保決策數據的品質，滿足現代指揮所的關鍵工作，也就是有效支援指揮官決策程序(如理解、洞悉等)。為了保持敏捷性並確保正確數據不斷流向適當的指揮官，指揮所不能再依賴傳統的封閉式系統、內建伺服器及其配套支援機制作為決策支援的主要手段。相反，我們必須遷移到雲端運算，並利用數據網格(data mesh)和數據經緯(data fabric)的概念來確保數據的安全性、組織性與可用性，使指揮官及其參謀能夠有效運用。對於不熟悉這些概念的人來說，「數據網格和數據經緯」是相輔相成的數據管理方法，能夠提升數據的連結性與普及性。數據網格是一種高度去中心化的數據架構，能在單一領域內部和不同領域之間，實現數據的生產、管理和共享的聯合化運作。³⁴

A data fabric is a domain within the data mesh that automates data integration and enables connectivity and access to find, create, and widely share data products across the breadth and depth of the battlespace, including with joint, allied, and partner forces. These data management concepts within the civil sector enable endurance and agility of our command posts, reducing

34 “What Is a Data Mesh?,” IBM, accessed 14 March 2023, <https://www.ibm.com/topics/data-mesh>.



reliance on single platforms or repositories that have the potential to be trapped and isolated as a result displacing command posts or the effects of enemy actions. Here we begin to see the shift away from the physical dimension and toward the informational, which requires significantly different approaches and skill sets to facilitate operations.

數據經緯是「數據網格」中的一個領域，負責自動化數據整合，並實現數據的連結與讀取，使作戰空間內的數據資源可被迅速查找、建立與廣泛共享，進而提升聯合作戰部隊、盟軍及友軍部隊的數據運用效能。這些在民用領域內的數據管理概念使我們的指揮所能持續且靈活運作，減少對可能因為指揮所的位移或敵方行動的影響而被困隔離的單一平台或儲存庫的依賴。從這裡，我們開始看到從實體層面向資訊層面的轉變，這需要顯著不同的方法和技能集來促進運作。

In data-centric command posts, commanders may rely on development, security, and operations professionals who could expedite the secure development and integration of new applications on operational timelines and forward at the point of need.³⁵ These data professionals will replace the legacy employment of the operations sergeants responsible for configuring and organizing the network-centric command posts we have today. This would essentially provide commanders with the flexibility to fine tune their command-and-control system based on unique mission requirements and leader preferences. To remain survivable, we must also divest command posts of the physical collocation of anything delivered “as a service” (aaS). This includes communications (CaaS), radios (Raas), and especially, knowledge (KaaS). For those unfamiliar with the as-a-service model, aaS is a disruptive business approach that outsources the burden of ownership-based sustainment that requires the functional expertise and infrastructure to operate and maintain. Those past practices reinforce dependencies on legacy systems and skill sets, which stagnates innovation.³⁶

在以數據為中心的指揮所中，指揮官可能依賴開發、安全和作戰等專業人員，以加速新應用程式的安全開發與整合，確保其能在作戰時程內部署，並在需要時支援前線。³⁵ 這些數據專業人員將取代傳統上由作戰士官負責配置與管理網路化指揮所的職能。這實際上讓指揮官能夠根據特定任務需求與指揮風格靈活調整指揮與管制(C2)系統。為確保指揮所之生存能力，我們必須降低對實體部署的依賴，並轉向「即服務」(as-

35 “What is DevSecOps?,” IBM, accessed 14 March 2023, <https://www.ibm.com/topics/devsecops>.

36 Daniel Newman, “Why the ‘As-A-Service’ Model Works so Well for Digital Transformation,” Forbes (website), 27 June 2017, accessed 14 March 2023, <https://www.forbes.com/sites/danielnewman/2017/06/27/why-the-as-a-service-model-works-so-well-fordigital-transformation/?sh=7ed867b86490>.

a-service, aaS)模式，以縮減指揮所的實體存在規模。這包括通信(communications as-a-service, CaaS)、無線電(radios as-a-service, Raas)以及知識(knowledge as-a-service, KaaS)等數位化服務模式。對於不熟悉即服務模式的人來說，即服務(aaS)是一種突破性的業務運作模式，透過外包所有權維持(ownership-based sustainment)的負擔，將運作與維護所需的專業技術與基礎設施交由外部管理。傳統做法過度依賴舊有系統以及技能組合，導致創新發展受限。³⁶

The aaS approach enables rapid adoption of emerging technology and mobility, and it opens the door to competition among providers, which ensures our soldiers have the very best capability available. Consider, for example, the unique and creative ways that the Ukrainians are using Starlink's capabilities without owning the satellites and the associated skill sets and support infrastructure. However, decreasing commanders' reliance on the physical dimension in favor of the information dimension will increase survivability by reducing the overall command post signature and the need to aggregate staffs in a single location. To achieve the full potential of convergence, command posts will need to adapt to such an extent that they will be unrecognizable to the generation of leaders that fought in Iraq and Afghanistan.

即服務(aaS)模式能加速新興科技的採用與提升機動性，同時引入供應商間的競爭機制，確保部隊能獲得最先進的作戰能力。例如，俄烏戰爭時烏克蘭部隊巧妙運用星鏈(Starlink)系統的通訊能力，無需擁有衛星、相關技能組合或支援基礎設施，便能靈活發揮其戰場效能，展現出創新且獨特的應用方式。然而，減少指揮官對實體層面的依賴，轉而青睞資訊層面，將通過減少整體指揮所的顯著性以及減少在單一地點集中參謀的需要來增加生存能力。若要發揮聚合力的全部效果，我們必須將指揮所比照這樣做出大幅度的改革，但對曾在伊拉克和阿富汗作戰的那一代領導者來說，指揮所面貌的轉變是超乎他們想像的事。

Endurance. Endurance, defined as “the ability to persevere over time throughout the depth of an operational environment,” is the next critical tenet of MDO.³⁷ While more capable and agile command posts provide apparent benefits toward endurance, preserving that command-and-control capability over time will occur in the harshest and most-lethal conditions imaginable. Command posts must demonstrate resilience and persistence in temporary isolation and under austere conditions. This also implies that even highly mobile command posts must be

37 FM 3-0, Operations, Glossary-6.



protected in a way that our current expandable vans and tentage are not. They must be armored, and we must develop solutions that deliver scalable capability to units where hardening command posts will be difficult, including our airborne and light expeditionary forces. To this end, we should pursue command post capabilities that are multimodal, with vehicle-mounted capability that can be quickly and easily dismounted to occupy hardened structures and blend into dense urban terrain. Command posts must also be capable of masking their signature to complicate an adversary's targeting by concealing their visual, thermal, electronic, acoustic, and soon, their quantum signatures.³⁸

耐久力。耐久力被定義為「在整個作戰環境的深度中，長時間的堅持能力」，是多領域作戰(MDO)的下一個關鍵原則。³⁷ 儘管更具能力和敏捷性的指揮所明顯有助於提高耐久力，但隨著時間的推移，在可想像的最惡劣和最致命的條件下保持這種指揮與管制能力將成為一項挑戰。指揮所必須在臨時孤立和嚴苛條件下展現韌性和持久力。這也意味著，即使是高度機動的指揮所，也必須以我們目前的可擴展廂型車和帳篷所沒有的方式進行保護(如圖7)。它們必須加裝裝甲，並開發出適用於那些難以加固指揮所的部隊(特別是空降和輕型遠征的部隊)的靈活應用方案。為此，我們應該追求多模式的指揮所能力，擁有可快速輕易拆卸的車載能力，能夠占領固定結構並融入密集城市地形的能力。為使對手的目標定位變得更加困難，指揮所還必須能夠掩蓋其主要特徵，包括隱藏其視覺、熱能、電子及聲學，甚至牽涉到未來的量子特徵。³⁸

Ultimately, if we can reduce the size and structure of command posts at all echelons to a few tactical armored vehicles, the extraordinary signature of our high-tactical and operational command posts will fade into the normalized electromagnetic spectrum and



圖7 指揮所基礎設施整合(CPI2)的設計使師部具備可擴展性、模組化與敏捷性，同時減少戰術作戰中心所需的實體空間

資料來源：美國陸軍；譯者轉引。

38 Michiel van Amerongen, "Quantum Technologies in Defence & Security," NATO Review, 3 June 2021, accessed 14 March 2023, <https://www.nato.int/docu/review/articles/2021/06/03/quantum-technologies-in-defence-security/index.html>.

background clutter of a battlefield where armored vehicles are ubiquitous. In this way, we may deny the enemy the ability to discern priority and high-value targets, a valuable skill in an environment that may be characterized at times by a shortage of precision munitions. This approach reinforces the Sun Tzu dictum that “all warfare is based on deception” and applies it to our command posts, thereby setting the tone we hope is reflected in the operations they direct.³⁹

最終，若能將各層級的指揮所其規模和結構減少到幾輛戰術裝甲車，則高層級戰術和作戰指揮所之顯著特徵，將融入戰場上無所不在的裝甲車輛之中的正常電磁頻譜和背景雜訊。如此方式，可能會剝奪敵人辨識優先和高價值目標的能力，這在可能時常缺乏精準彈藥的環境中是一項寶貴技能。這種方法強化了孫子兵法中「兵者，詭道也」之原則，並將其應用於我們的指揮所，從而為其指揮的作戰設定為我們希望展現的基調。³⁹

We must also not forget that survivability, whether physical, informational, or human, is just one aspect of endurance. Endurance also has a sustainment aspect, which implies that whatever command-and-control system is fielded, it must be capable of operations for an indefinite period. In the past, this may have implied a mountain of logistics and personnel to support work-rest-maintenance cycles. In the future, this problem may be overcome by simply transferring mission command to any one of many distributed command-and-control nodes within a constellation of distributed nodes in much the same way industry manages global workflows.

我們也不應忽視，無論在實體層面、資訊層面或人因層面的生存能力，都僅是耐久力的一環。耐久力還包括後勤支援層面，這意味著無論部署何種指揮與管制系統，都必須具備長期持續作戰的能力。在過去，這可能意味著需要大量後勤與人力資源來支援「工作、休息與維護(work-rest-maintenance)」的週期。然在未來，或許可通過將任務式指揮(mission command)轉移至分散式指揮與管制網絡中的任一節點來克服這個問題，其運作方式與產業界管理全球工作流程之模式類似。

Depth. Finally, in assessing future command posts against the remaining operational tenet, depth, we can measure the ability of command posts to “extend our operations in time, space

39 Sun Tzu, *The Art of War*, with introduction by B. H. Liddell Hart, trans. Samuel B. Griffith (Oxford: Oxford University Press, 1971), 66.



or (cognitive) purpose.”⁴⁰ In the expanded multidomain operational framework, this suggests a command-and-control node that optimizes its effectiveness to exploit or create opportunities in a way that offsets the hyperactive nature of large-scale combat operations to give the commander a comparative advantage.

縱深力。最後，在根據剩餘的作戰原則評估未來指揮所時，縱深力可以用來衡量指揮所「在時間、空間或(認知)目的上延伸作戰之能力」。⁴⁰ 在更全面的多領域作戰(MDO)框架中，指揮與管制節點必須優化其效能，以有效創造或利用戰機從而抵消大規模作戰的高度動態特性，並為指揮官帶來相對優勢。

This advantage is also achieved through the integration of combined joint all-domain partners, offensive and defensively. It enables the delivery of effects across all three dimensions, human, physical, and informational, and throughout the entirety of the operational framework while simultaneously protecting its own combat power. These complementary efforts allow friendly forces to apply combat power against enemy capabilities to achieve advantages in time and space. The results can also disrupt the cognitive depth of an enemy, by interrupting or extending their decision cycle, further generating advantageous conditions for a friendly commander. The combined effects across the temporal, spatial and cognitive aspects of depth extend the operational reach of friendly forces.

這種優勢同時還藉由整合聯合全域合作夥伴的攻防能力實現。它使得不管在人力、實體和資訊這三個層面上，乃至於整個作戰框架中發揮效果成為可能，同時可以保護自身作戰力量。這些互補的努力讓友軍部隊對敵方施展戰力，從而在時間和空間上獲得優勢。這些結果還可以藉由干擾或延長敵人的決策週期，擾亂敵方的認知深度，進一步為友軍指揮官創造有利條件。作戰縱深在時間、空間與認知層面上的綜合作戰效應，能夠延伸友軍的作戰覆蓋範圍。

The Human Dimension

War, now and in the future, is and will remain a human endeavor. The fact that command posts exist at all speaks to the limits of the commander's unaided human capacity for understanding and decision-making as well as the need to amplify the effectiveness of their leadership beyond their physical reach. Thus, the importance of the human dimension and

40 FM 3-0, Operations, Glossary-6

psychology in command and control during large-scale combat operations cannot be overstated. In examining the value of any current or future command post model, the proximity of leaders matters more so when employing the U.S. Army's command-and-control philosophy, mission command, which places such a great emphasis on trust, shared understanding, intent, and subordinates' initiative.⁴¹ During large-scale combat operations, commanders must have the ability to be physically present to provide leadership but also to quickly move to where they are needed to gain understanding.

人因層面

戰爭，無論是現在還是未來，本質上皆屬於人類的行為。指揮所其存在本身就反映了指揮官在未經輔助的狀況下，其對事物理解和決策能力的侷限性，同時也反映出指揮官須突破自身實體範圍，以強化領導效能的需求。因此，在大規模戰鬥行動中指揮和管制的人因層面及其心理影響的重要性，不應被過分強調或擴大解釋，但也絕不能忽視。在評估任何現行或未來指揮所模式的價值時，指揮官與部隊之間的親近感與認同感具有重要影響，尤其是在運用美國陸軍的指揮與管制理念——任務式指揮(mission command)時更為明顯，該理念高度強調了信任、共同理解、指揮意圖以及部屬的主動性，使指揮官的臨場影響力成為關鍵因素。⁴¹ 在大規模作戰中，指揮官必須能親臨現場以發揮領導作用，同時也須具備快速機動至關鍵位置，以掌握戰場態勢的能力。

From a morale and motivational standpoint, leaders, especially in the land domain, must be seen to share the hardships and danger of those they lead. The trust and cohesion necessary for mission command is derived from a commander's personal stake and involvement in the conduct of operations. Currently, this occurs in a physical sense through "battlefield circulation" and presence at unit locations, which is both time consuming and potentially high risk. Alternatively, a commander can virtually bridge the proximity challenge through voice communications, but this approach provides limited context and may not always meet the psychological needs of subordinates under stress. At Chornobaivka, insufficient communications were one of the reasons Russian senior leaders were deployed so far forward, even for the simplest operations. Considering this, a command post should have assured and redundant communications that enable a sense of proximity between commanders and staff and

41 Scott Schroeder (command sergeant major, retired, U.S. Army Forces Command), in discussion on command and control with author Matthew Arrol, 6 December 2022.



the leaders and the led. Given these challenges and desirable characteristics, imagining a future command post is difficult, but not impossible.

從士氣和激勵的角度來看，特別是在地面作戰領域，指揮官必須讓部隊看到他們與所率領的官兵共擔艱辛與風險。任務式指揮所需的信任和凝聚力，源自於指揮官在作戰行動中的親身投入與參與。目前，指揮官通常藉由「戰場巡視」和親臨部隊駐地來實現此點，此法既耗時且可能伴隨高風險。或者，指揮官亦可通過語音通訊來虛擬化解親近感的挑戰，但此方法所能提供的情境資訊有限，且在部屬承受壓力時，未必能滿足其心理需求。在喬爾諾巴伊夫卡，溝通不良是導致俄羅斯高階領導者即便是為執行最簡單的作戰行動，仍被派赴至前線的原因之一。有鑑於此，指揮所應具備可靠且具備備援機制的通訊能力，以確保指揮官與參謀，以及指揮者與受指揮者之間的親近感。儘管這些挑戰與理想特性使得構想未來的指揮所變得困難，但並非不可能實現。

Organizational Design and Employment of an Objective Command Post

To avoid our own Chornobaivka and provide command and control that possesses the characteristics of agility, convergence, endurance, and depth, an effective and survivable command post must exist in a nonphysical construct. We must aggregate and integrate functions, processes, and capabilities but not the people, equipment, and things that have historically been associated with delivering them. While this may seem to violate the feasibility criteria of course of action development, deeper analysis reveals the technology currently exists, and the world of online gaming is showing us the way. To meet the tenets of MDO, we must rely heavily on both augmented and virtual reality. The Army is already experimenting with both technologies but has yet to fully pursue their utility in the command-and-control space.⁴²

理想指揮所的組織設計與運用

為了避免我們重蹈俄軍在喬爾諾巴伊夫卡戰例之悲劇覆轍，並使指揮與管制(C2)系統結合敏捷力、聚合力、耐久力和縱深力等特性，所以每座指揮所必須隱身於一個非實體建物中才能有效運作且存活。我們必須匯集和整合各項功能、流程與作戰能力，但不

42 Lisa Daigle, "Army Goes Deep into VR/AR for Training and Combat," Military Embedded Systems, 17 October 2022, accessed 14 March 2023, <https://militaryembedded.com/radar-ew/sensors/army-goes-deep-into-vrar-for-training-and-combat>.

應再依賴傳統上與其運作相關的人員、裝備與實體設施。雖然這似乎違反了行動方案發展的可行性標準，但深入分析顯示，相關科技業已存在，而線上遊戲領域正為我們提供方向。為了符合多領域作戰(MDO)的原則，我們必須高度依賴擴增實境(augmented reality, AR)和虛擬實境(virtual reality, VR)科技。美國陸軍已開始測試上述兩項科技，然尚未完全發揮其於指揮與管制(C2)領域的應用潛力。⁴²

In a virtual world, commanders could replicate, expand, traverse, and interact as needed with their entire physical command post and never have to leave the room or vehicle they are in. They could move between command posts seamlessly and be present wherever and whenever needed. One vision of future Army command posts could be a proliferation of small three-to-four-armored vehicle command-and-control nodes that represent what was formerly a “functional staff tent” in the legacy structure. These nodes would be broadly distributed and mobile on the battlefield. Supported by software and hardware engineers, commanders and staffs would be able to organize these nodes around a variety of tasks, time horizons, or crossfunctional areas.

在虛擬世界中，指揮官可以根據需要複製、擴增、穿越並與其整個實體指揮所互動，而無需離開他們身處的房間或車輛。他們可以無縫地在不同的指揮所之間移動，並在需要時隨時隨地出現。未來陸軍指揮所的一種願景可能是許多小型的3~4輛裝甲車輛組成的指揮與管制(C2)節點，這些節點可代表傳統結構中原本的「功能性參謀帳篷」。這些節點將在戰場上廣泛分布且具有機動性。在軟、硬體工程師的支援下，指揮官和參謀能夠根據各種任務、時間範圍或跨職能領域組織這些節點。

These distributed command-and-control nodes would be connected and able to conduct operations in the physical environment. Enabled by augmented reality, commanders and staffs could also access an immersive virtual space and whichever command-and-control echelon they needed. This would allow commanders to initialize, configure, and connect to a constellation of command posts and maintain access all data, knowledge, and decision support tools within the data mesh. By flooding the area of operations with a constellation of command-and-control nodes dispersed over wide areas and employing masking techniques to reduce their battlefield signatures, the effectiveness of the most capable enemy's targeting processes would be minimized.

這些分散式指揮與管制(C2)節點將相互連接，能夠在實體作戰環境中執行作戰任務。此外，在擴增實境(AR)的輔助下，指揮官和參謀亦可進入沉浸式虛擬空間，且依舊



需隨時介入所需的各級指揮與管制(C2)架構。這將使指揮官能啟動、設定並連接到一系列指揮所，同時在數據網格持續運用所有數據、知識和決策支援工具。藉由在作戰區域廣泛分散部署指揮與管制(C2)節點，並採用掩蔽技術來降低其在戰場上的可識別性，則可有效減弱敵方最精準的目標定位能力。

If command-and-control nodes operated alongside tactical maneuver elements of similar design, it would further exacerbate the enemy's targeting dilemma. Unfortunately, assured communications would be even more critical in this approach and would require significant bandwidth. However, recent developments in space-based capability and the science of quantum communications indicate that bandwidth may not be a limiting factor in the foreseeable future.⁴³

如果指揮與管制節點能與設計類似的戰術階層戰鬥部隊並行運作，將進一步加劇敵方的目標選擇困境。遺憾的是，此法確保通信的重要性會更加突出，並須仰賴大量頻寬支援。然而，基於近期在太空能力和量子通信科學方面的進步顯示，頻寬在可預見的未來可能不再是限制因素。⁴³

Quantum solutions might also allow us to discard our reliance on legacy antennas and the risks associated with electromagnetic signatures on the modern battlefield. Aside from communications, this approach will require significant work from developers and the synthetic training community to achieve an “Avatar” level of virtual reality where commanders and staff forget that they are interacting in a virtual world.⁴⁴ The advantage of a commander who is able to project their presence anywhere on the battlefield without having to be physically present would be revolutionary. The path to the objective end state described here is resource intensive and will take focused and directed guidance from senior Army leadership, partnership with industry, and political buy-in. But it can and must be done.

量子技術也可能使我們能摒棄對傳統天線的依賴，且減少在現代戰場上與電磁特徵相關的風險。除了通信外，這種方法還需要開發人員和模擬訓練社群進行大量工作，以實現指揮官和參謀幾乎忘記自己正於虛擬世界中互動的「阿凡達」級虛擬現實體驗。⁴⁴ 一位能夠在戰場上任何地方投射自己存在感而不必實際在場的指揮官將是革命性

43 “NIST-Led Research Shows Advantages of Quantum-Enabled Communications for Internet,” National Institute of Standards and Technology, 28 October 2022, accessed 14 March 2023, <https://www.nist.gov/news-events/news/2022/08/nist-led-research-shows-advantages-quantum-enabled-communications-internet>.

44 Avatar, directed by James Cameron (Los Angeles: 20th Century Studios, 2009).

的變革。要達成這裡所描述的最終目標，需要投入大量資源，並需要得到陸軍高層的積極指導與產業界的合作，還有政府的支持。這個過程固然充滿挑戰，但我們也必須能夠完成它。

Think Big, Start Small, Go Fast, and Institutionalize: A Practical Demonstration

The magnitude of the change suggested above will inevitably draw criticism and opposition and require early “wins” to gain support and momentum. A successful effort to introduce this idea into our command-and-control system will need to start small and demonstrate utility through experimentation. A good test case for a multidomain-operations-capable command post relying on virtual and augmented reality would be to experiment with an organization constantly challenged to maintain physical and functional integration in an operationally dynamic environment, the division joint air-ground integration center (JAGIC). This small, thirty-person command-and-control node is comprised of both Army and Air Force personnel and liaison elements executing a variety of functions. Currently, they must come together to manage the employment of joint effects effectively and efficiently in the close fight.

大處著眼、小處著手、劍及履及、照章行事——實例驗證

上述建議的重大興革勢必招致批評和反對，我們需要及早經營「贏面」，才能獲得大家的支持及帶動風潮。要成功將這個概念導入指揮與管制(C2)系統，必須從小規模試驗開始，透過實驗驗證其實用性，再逐步推動應用。一個適合作為測試案例的指揮所模型，是具備多領域作戰(MDO)能力，並依靠虛擬實境和擴增實境的指揮架構。這樣的適合試驗對象之一為師級聯合空地整合中心(joint air-ground integration center, JAGIC)。該單位長期面臨高動態作戰環境中，維持實體與功能整合的挑戰。聯合空地整合中心(JAGIC)為一個由30人組成的小型指揮與管制(C2)節點，其中包括有陸軍和空軍成員以及連絡官，負責執行多項作戰任務。目前，該單位須整合指揮資源，確保在近距離戰鬥環境中能夠高效協調聯合作戰效果。

Despite their value, the problem these organizations inherently have is that, in garrison, they do not exist. When needed for training and operations, JAGICs are formed from the division and air support operations squadron staffs. As such, they are very difficult to form, train, and maintain to a high degree of proficiency, much less expertise, given the demands of



manning cycles and garrison activities aligned against them. In this case, a virtual JAGIC could serve as a microcosm for a full command post. Thus, the experiment would simultaneously address an existing real-world and persistent readiness challenge and chart a path toward improved command post capabilities for the entire Army.

儘管該實驗頗有研究價值，但基本的問題是，這些組織架構並非在平時駐地時就已編成。當需要進行訓練和行動時，聯合空地整合中心(JAGIC)是從師部參謀人員與空中支援作戰中隊參謀臨時編組而成。因此，鑑於人員輪調週期與駐防任務的影響，聯合空地整合中心(JAGIC)的編組、訓練與維持高水準戰備狀態都極為困難，更遑論達到專業精通的程度。於此情境下，虛擬聯合空地整合中心(JAGIC)便可作為完整指揮所的縮影，藉此進行測試。因此，這項實驗不僅能解決當前現實且持續存在的戰備挑戰，同時也能為整體陸軍改進指揮所能力指點迷津。

Conclusion: Whistling Past Chornobaivka?

Oft in the lone church-yard at night I've seen, By glimpse of moonshine chequering through the trees, The school-boy, with his satchel in his hand, Whistling aloud to bear his courage up ...

Scottish Poet Robert Blair, 1745⁴⁵

結論——視若無睹，走過喬爾諾巴伊夫卡？

經常在夜晚的孤獨教堂墓地裡，我見到了，月光透過樹木間斑駁地照射下，一位手提書包的學童，大聲吹著口哨來鼓舞自己的勇氣……

蘇格蘭詩人羅伯特·布萊爾，1745年作⁴⁵

Any casual visitor to the Army's National Training Center these days, with a watchful eye on the Ukrainian war through their Twitter feed, can attest that U.S. Army command posts are going to struggle in that environment. While the Army may not be able implement a revolutionary new command post structure optimized for large-scale combat operations overnight, neither is it helpless if faced with the imminent prospect of war, even against an adversary as capable as the Chinese. Every day, commanders can start preparing for that environment, assessing their command posts from the standpoint of conducting MDO during large-scale combat operations and with a realistic appreciation for the threat. Leaders at division

45 Robert Blair, "The Grave," All Poetry, accessed 14 March 2023, <https://allpoetry.com/The-Grave->.

level and above can help by doing more of the heavy lifting of joint integration, targeting, and other enabling processes for those at the tactical edge.

如今，任何曾造訪美國陸軍國家訓練中心的觀察者，若同時透過Twitter動態消息關注烏克蘭戰事，就能察覺到美國陸軍指揮所在這類戰場環境中將面臨嚴峻挑戰。雖然美國陸軍可能無法一夜之間推動一種針對大規模戰鬥行動優化的革命性指揮所結構，但這並不代表在戰爭迫在眉睫時毫無作為，即便對手是如中共這般具備強大作戰能力的敵軍。指揮官應從現在開始，著手為此種作戰環境做好準備，從多領域作戰(MDO)與大規模戰鬥行動的角度，審視自身指揮所的運作模式，同時以現實威脅情境作為評估基礎。師級以上指揮層級應承擔更大的責任，透過強化聯合作戰整合、目標打擊規劃及其他關鍵支援作戰流程，減輕前線戰術單位的負擔，以提升整體作戰效能。

At the same time, the Army must stay focused on the future. The technology is either here, or on the near horizon, to make everything discussed in this article possible. Given the state of the security situation in the world, it is unlikely that we have time to address the challenges of our command posts through incremental changes. The U.S. Army and the West must respond to the lessons of Chornobaivka with a sense of urgency, leadership, and unity of purpose on the modernization of our command post systems.

與此同時，陸軍必須保持對未來的關注。相關技術要麼已經成熟，要麼即將問世，足以實現本文所探討的一切構想。鑑於當前世界安全形勢，我們不太可能有足夠時間透過漸進式變革來解決指揮所所面臨的挑戰。美國陸軍和西方盟友必須在喬爾諾巴伊夫卡的教訓中汲取經驗，並以緊迫感、領導力及統一目標推動指揮所系統的現代化改革。

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