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ELSA B. KANIA AND IAN BURNS McCASLIN

# LEARNING WARFARE FROM THE LABORATORY— CHINA'S PROGRESSION IN WARGAMING AND OPPOSING FORCE TRAINING



MILITARY LEARNING AND  
THE FUTURE OF WAR SERIES

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The background of the entire page is a topographic map with brown contour lines. The map shows a large, irregularly shaped landmass, likely representing a region in East Asia, with various elevation contours and some internal features like rivers or coastlines.

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Cover: Chinese Navy submarines and warships take part in an international fleet review to celebrate the 60th anniversary of the founding of the People's Liberation Army Navy in Qingdao, Shandong province, April 23, 2009. (Photo by Guang Niu/Pool via Reuters)

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## LEARNING WARFARE FROM THE LABORATORY— China's Progression in Wargaming and Opposing Force Training

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# LEARNING WARFARE FROM THE LABORATORY— China’s Progression in Wargaming and Opposing Force Training

## Executive Summary

The Chinese People’s Liberation Army (PLA) is faced with the challenge of preparing for future warfare during peacetime as a force that lacks contemporary operational experience. Among the methods through which the PLA seeks to enhance its combat readiness are sophisticated wargaming and realistic, force-on-force exercises. Chinese military leaders regard wargaming (*bingqi tuiyan*, 兵棋推演) as an important technique by which to “learn warfare from the laboratory” for training purposes and to promote insights on the dynamics of future combat.<sup>1</sup> This style of learning is complemented by the PLA’s study of military history and emulation of the experiences and innovations of foreign militaries, including through creating “blue forces” that simulate potential adversaries against which to train.<sup>2</sup> Beyond improving its current capabilities and readiness, the PLA also aspires to achieve an edge in military competition, seeking to “design” the dynamics of and develop capabilities for future warfare.<sup>3</sup>

Wargaming is part of a cycle of military learning and experimentation that involves and informs exercises against opposing forces (OPFOR), as well as a range of other styles of training. While this report does not provide a comprehensive assessment of the PLA’s current training methods, our analysis examines select aspects of the PLA’s computerized wargaming and employment of blue (i.e., simulated adversary) forces in the context of the continuing transformation of PLA training. Over time, the PLA has improved the realism of its “actual combat training” (*shizhan hua xunlian*, 实战化训练) and undertaken exercises in increasingly challenging battlefield environments.<sup>4</sup> The lessons learned from wargaming can be tested in exercises, and the outcomes of exercises can shape the design for wargames.

PLA wargaming and development of their blue forces continue to be significantly influenced by emulation of the approaches of foreign militaries, particularly those of the US military. The combination of domestic and foreign influences has resulted in features unique to the PLA, reflecting distinct priorities, interests, and constraints. In wargaming, for example, the PLA appears to prefer and prioritize

computerized approaches over other forms, and it has attempted to leverage this cost-effective technique in training to address certain long-standing weaknesses, such as in command decision-making.<sup>5</sup> To that end, the PLA has scaled up wargaming in professional military education (PME), especially through programming at the PLA’s National Defense University (NDU). The history and political character of the PLA as the armed wing of the Chinese Communist Party (CCP) also appear to be a notable influence, demonstrated by the experimentation with political warfare in PLA wargaming.

Meanwhile, wargaming has become prominent and popularized across China, and the PLA has leveraged the commercialization of wargaming to improve its quality and realism. Ongoing advances in video games and innovations from the video game industry continue to provide China’s armed forces with new options for realistic, engaging wargames. Under the auspices of China’s national strategy for military-civil fusion (MCF), several technology companies have partnered with the PLA to develop new systems for wargaming and military simulations. Beyond PME efforts, wargaming competitions have become an important element of



national defense education, as thousands of military and civilian students across universities nationwide participate in annual wargaming competitions. This national initiative encourages patriotism and interest in military affairs among the public while fostering greater unity and understanding between military and civilian stakeholders.<sup>6</sup>

Increasingly, the PLA is pursuing innovation in the platforms and techniques used in wargaming, including the introduction of artificial intelligence (AI). The PLA has introduced “intelligentization” (*zhinenghua*, 智能化) as a priority for its military modernization. This strategic initiative includes the development of AI for military applications and leveraging wargaming platforms to advance technological experimentation. The progress to date includes PLA contests and competitions that have concentrated on developing AI systems for wargaming in complex scenarios. Starting in 2017, these efforts have seen the development of more powerful AI systems across years of competitions. The human-machine confrontation (*renji duikang*, 人机对抗) that can occur through such a virtual platform also could allow for improvements in planning and decision support systems for future joint operations. The increasing capabilities of AI systems in wargaming also allow for improvements in simulated adversaries.<sup>7</sup> Beyond the objective to improve the quality of their wargames for training purposes, there are scientists and strategists in the PLA who hope AI will become powerful enough to facilitate human planning and command decision-making in future warfare.<sup>8</sup>

The PLA’s OPFOR program has centered upon the creation of blue forces that are intended to imitate potential adversaries. These units are directed to serve as whetstones to increase the challenge of training, thereby contributing to the PLA’s efforts

to overcome its “peace disease.” While the PLA’s OPFOR efforts have been unique in their variety and potential creativity, the relatively fragmented development highlights the issues of coordination and standardization that have often impeded progress within the PLA. However, the increasing professionalism of these initiatives, including the focus on simulating the United States and its allies as anticipated adversaries, is an important dimension of PLA preparations to watch going forward.

This report starts by tracing the trajectory of wargaming within the PLA in modern Chinese history and then continues to examine the progression of PLA blue forces in its OPFOR program. The analysis initially reviews a series of recent wargaming competitions, examining the introduction of AI systems into wargaming and considering commercial contributions to wargaming. Our research also considers the progression of OPFOR exercises (exercises that involve a force tasked with representing an enemy) that have expanded and increased in sophistication with the use of improved blue forces. We examine what wargaming and OPFOR exercises can reveal about the PLA’s capacity to learn and adapt to the challenges of future warfare. In closing, we raise considerations and potential recommendations for US policy.

***Within the PLA, learning has at times been impeded by bureaucratic boundaries and fragmentation that prevented lessons learned from flowing smoothly across services and even between units.***

*Select Acronyms*

AI	artificial intelligence
AMS	Academy of Military Science
CAS	Chinese Academy of Sciences
CASIA	Chinese Academy of Sciences Institute of Automation
CAST	China Association for Science and Technology
CCP	Chinese Communist Party
CICC	China Institute of Command and Control
CMC	Central Military Commission
C4ISR	command, control, communications, computers, intelligence, surveillance, and reconnaissance
DoD	US Department of Defense
MCF	military-civil fusion
NDU	National Defense University
NUDT	National University of Defense Technology
OMTE	Outline of Military Training and Evaluation
OPFOR	opposing force or opposition force
PAP	People's Armed Police
PME	professional military education
PLA	People's Liberation Army
PLAAF	People's Liberation Army Air Force
PLAN	People's Liberation Army Navy
PLASSF	People's Liberation Army Strategic Support Force
PRC	People's Republic of China
RMA	Revolution in Military Affairs

## Relevant Terminology

Chinese	Pinyin	Translation & Explanation
实战化训练	shizhanhua xunlian	“actual combat training,” designed to be realistic and intended to improve readiness for combat through the use of actual forces
兵棋推演	bingqi tuiyan	“wargaming,” or “military simulation,” typically computerized
蓝军	lan jun	“blue force,” represents the opposing or enemy force during a wargame or exercise, often played by units or entities that have specialized training or knowledge to better imitate the tactics of adversaries
红军	hong jun	“red force,” represents the PLA in a wargame or exercise
红蓝对抗	honglan duikang	“red-blue confrontation,” a training exercise featuring a red force against a blue force
军事信息化	junshi xinxihua	“military informatization,” a strategic initiative in Chinese military modernization that has concentrated on developing information technology, including for C4ISR
军事智能化	junshi zhinenghua	“military intelligentization,” a new priority in Chinese military modernization that concentrates on the development of artificial intelligence as an integral element of the “system of systems” that will enable future warfare
军民融合	junmin ronghe	“military-civil fusion,” a national strategy that intends to leverage synergies between economic development and military modernization, creating an integrated national strategic system, including through collaboration between defense and civilian sectors in research and development, particularly for emerging technologies
对抗演练	duikang yanlian	“confrontation drills,” training that often involves training exercises between red and blue forces, though other forces may be involved
拿敌练兵	na di lianbing	“using the enemy to train,” the idea of learning from enemy forces by treating them as a kind of “blue force” and interacting with them in the real world
国防教育	guofang jiaoyu	“national defense education,” a national initiative directed by law that concentrates on promoting patriotism, ensuring that students and citizens learn basic military skills, popularizing knowledge on national defense, and cultivating reserve talents, among other objectives
战争设计	zhanzheng sheji	“war design,” a new concept in Chinese military science and research on warfare that focuses on recognizing and anticipating trends in the evolution of warfare

*Note: The definitions and explanations are the authors’ and based on contextual understanding of the use of these terms and concepts.*

## Introduction

US-China military competition is playing out during peacetime and under conditions of uncertainty about the changing character of conflict. These great power militaries each seek to prepare for the challenges of future warfare against the backdrop of a revolution in military affairs (RMA) caused by rapid advances in disruptive technologies. Under these conditions, the capacity to enable learning without fighting, undertaking peacetime innovation in anticipation of the dynamics of future battlefields, may prove critical to securing future operational advantage. However, the difficulty of reform and adaptation is especially acute without the existential imperatives of conflict and when long periods of peace erode combat readiness. Wargames and force-on-force training are critical elements of the complex endeavor of military learning and innovation.

This paper explores aspects of wargaming efforts within the PLA today. Across history, wargaming has enabled preparations for future conflict, including the testing of plans or concepts of operations. Traditionally, wargaming has also served as an important instrument in training and education. So too for the PLA, which has prioritized this practice of “learning warfare from the laboratory” (从实验室中学习战争).<sup>9</sup> In parallel, the PLA has undertaken a robust OPFOR program and introduced

a diverse array of blue forces to simulate potential adversaries in its efforts to promote “actual combat” training and overcome “peace disease,” a shortage of battle-tested personnel and experienced commanders resulting from the PLA’s dearth of recent conflicts.<sup>10</sup>

As the PLA pursues “military intelligentization” (军事智能化), wargaming also provides an arena to employ and explore applications of AI systems. Chinese military strategists, including several of the PLA’s leading experts in wargaming, were initially inspired by the defeat of top human players in the game of Go by AlphaGo, an AI system designed by Google’s DeepMind.<sup>11</sup> This milestone occurred in March 2016, years before the top experts in AI believed that the game could be mastered by machine learning. Such a compelling demonstration catalyzed efforts to accelerate the use of AI in wargaming and to develop systems to support and enhance command decision making. The data generated through simulations and wargaming might enable progression from virtual to real-world environments. So too, the capacity of AI to beat human opponents, whether in games or wargames, may influence the PLA’s outlook on its importance in future conflict and approach to operationalizing intelligentization on future battlefields.

## Wargaming in Military Learning

The PLA’s efforts in wargaming contribute to a cycle of learning and training related to and at times integrated with live exercises involving simulated potential adversaries, often the United States. Wargames can synergize with live exercises, which may test insights from games and inform future wargames.<sup>12</sup> The PLA has sought to integrate wargaming and operations research with training and the development of new doctrine and concepts of operations. However, the cohesiveness and integration of this process within the PLA are difficult to confirm and may be the focus of future reforms.

The PLA’s capacity to learn and improve its operational capability through training is critical to its future military power. Within the PLA, learning has at times been impeded by bureaucratic boundaries and fragmentation that prevented lessons learned from flowing smoothly across services and even between units.<sup>13</sup> PLA leaders regard the upgrading and transformation of training as critical to enabling the PLA to transition from “passive adaptation” to warfare to “actively designing” warfare.<sup>14</sup> This shift is seen by the PLA as being crucial to ensuring its capacity to fight and win in future conflicts.<sup>15</sup>

## Note on Terminology

Wargaming as a concept and practice has evolved across history and the globe. There is no single, agreed-upon definition of “wargame” or “wargaming” in the international professional military community. Often, degrees of disagreement and a variety of definitions appear even within militaries or even across a specific military institution.<sup>16</sup> Nonetheless, there are core features that date back to the days of *Kriegspiel* in the Prussian military, including the emphasis on dynamic interaction among two sides. Arguably, the game of “Go” (*weiqi*), which is thought to date back to as early as 2300 BC in China, could be characterized as a sort of proto-wargame due to its emphasis on stratagems and decision making.<sup>17</sup> Within the US military and wargaming community, the definition of wargames generally involves simulations against an opposing force that do not involve actual live forces.<sup>18</sup>

Colloquially, the phrase “wargame” is often used to describe military exercises between two forces, such as in live exercises; however, wargaming is technically an element of but also distinct from such real-world training.<sup>19</sup> At present, the idea of wargaming can encompass such disparate activities as a game on a physical board with hexes and pieces that represent units or weapons systems, a virtual or tabletop exercise in which players discuss moves between turns, or simulated operations within a more complex virtual environment in the style of a video game. This report primarily concentrates on computerized wargaming within the PLA, while also examining the “live wargames” involved in adversarial training. These are only two of many styles of training that the PLA is pursuing.<sup>20</sup>

Despite American and Chinese wargaming and exercises sharing many core concepts, the PLA has its own terminology, elements of which are different from those of the United States and much of the rest of the international military community. In China’s wargaming community, (*bingqi*, 兵棋) or literally “war chess,” is the typical phrasing, and (*bingqi tuiyan*, 兵棋推演) captures the practice of wargaming, which can be rendered literally as “war chess deductions.” The PLA has concentrated on computerized wargaming (*jisuanji bingqi*, 计算机兵棋),<sup>21</sup> and characterizes its efforts in wargaming, including at the campaign and strategic levels, as “wargaming confrontation” (*bingqi duikang*, 兵棋对抗).<sup>22</sup> At times, the PLA has also described wargames as “confrontation exercises” (*duikang yanxi*, 对抗演习), which highlights a degree of fluidity between wargames and force-on-force exercises in the PLA.<sup>23</sup>

The PLA similarly has its own lexicon for exercises that is distinct from that of the United States and foreign militaries in general. For instance, whereas “opposing force” (OPFOR) training typically describes training against a live opposing force, in the PLA, the usual terms for drills between opposing sides are “confrontation drills” (*duikang yanlian*, 对抗演练) or “red-on-blue confrontations” (*hong lan duikang*, 红蓝对

抗).<sup>24</sup> These types of training relate to the PLA's drive to enhance the realism and sophistication of its training, which is typically distinguished from wargames with the term “actual combat training” (*shizhan hua xunlian*, 实战化训练) to signify the participation of actual forces and attempts to create conditions evocative of the battlefield.<sup>25</sup>

The terms the PLA uses to designate the different forces in contention are also different. In many countries, the home/allied force is represented by the color blue (blue force), while the enemy force is represented by the color red (red force). The PLA reverses this color scheme: the home/allied force is referred to as the “red force” (*hongjun*, 红军), and the main enemy force is referred to as the “blue force” (*lanjun*, 蓝军). Relative to other militaries, where the typical terminology of “OPFOR” places the emphasis on the activity (training between opposing forces), PRC and PLA media place the emphasis on the simulated enemy rather than the activity itself. While activity-centric terms such as “confrontation training” are used, their frequency is less than that of references to “blue forces,”<sup>26</sup> to the point where the PLA's counterpart to OPFOR could be more accurately described as “BLUFOR.”<sup>27</sup>

Beyond and regardless of precise definitions of “wargames” and “exercises,” the boundary between the two forms of training is becoming increasingly blurred. In particular, advancing technology, the rising complexity of both training activities, and the merging of elements of both activities complicate distinctions between the two. This dynamic can be seen within the PLA in the form of networked training involving a number of military units and the growing use of simulated training, including online or with the use of virtual reality (VR) technology.<sup>28</sup> This trend should be expected to continue as the PLA pursues innovation in its methods of training.

## Historical Evolution of PLA Wargaming

China's initiatives in wargaming build upon a long global history and tradition, reflecting learning, emulation, and the exchange of practices. In modern Chinese history, the Chinese Communist Party (CCP) appears to have initially encountered wargaming from Soviet personnel during the 1920s. Sino-Soviet engagement resulted in CCP personnel receiving military education and training within the Soviet Union at civilian and military institutions during the 1920s and 1930s.<sup>29</sup> Even CCP leaders

just visiting Moscow on “Comintern or other business” may have encountered wargaming at least in passing, since their Soviet hosts “routinely organized military training” during such visits.<sup>30</sup> Soviet military officers also provided initial military education and training to Chinese Communist personnel inside China during much of the 1920s, primarily at military institutions such as the famous Whampoa Military Academy. Beyond Soviet staff, such institutions also included Chinese staff who had been

educated and trained in Chinese provincial or Japanese military institutions.<sup>31</sup> Similarly, during this time, several textbooks were compiled for use in China based on German and Japanese military materials.<sup>32</sup> Chinese Communist forces were able to put their wargaming lessons from the classroom to the test when cadets participated in the “mock battles” (force-on-force maneuvers) that were organized at least occasionally at Whampoa during that time.<sup>33</sup>

Wargaming in China was both directly and indirectly influenced by learning from foreign militaries. However, the international history of how modern wargaming came to the country is complex. Chinese interlocutors were not always encountering modern wargaming fully developed in each source country. For example, Japan was one of the sources from which Chinese students initially encountered materials and knowledge on wargaming. However, Japan itself was in the midst of adapting modern wargaming based on British and German antecedents at the time.<sup>34</sup> Wargaming history was even recounted in a television program, a “spy war drama” that dramatized the history and experiences of some of China’s early pioneers in modern wargaming during the Sino-Japanese war.<sup>35</sup> Beyond such portrayals, the degree to which foreign practices on wargaming were actually institutionalized at this stage is difficult to evaluate, and perhaps belied by often critical assessments of Chinese cadets by their Soviet advisers.<sup>36</sup> Despite this initial exposure, wargaming does not appear to have been leveraged at scale or in a systematic manner during the Chinese Civil War from 1927 to 1949.

After the founding of the People’s Republic of China (PRC) in 1949, the PLA started to progress from its origins as a rebel force to a Party army that acted as a national military. At this time, the PLA was relatively backward by most standards and continued to rely on aid and training from the Soviet Union to progress. However, as the PLA started to professionalize, wargaming began to be used often for educational, training, and planning purposes.

*Wargaming in China was both directly and indirectly influenced by learning from foreign militaries.*

This reintroduction of wargaming came from Chinese experts who had been trained by Soviet or American specialists. Wargaming was quickly put to use by the PLA only a year later in the Korean War. Soviet-trained PLA officers employed wargames to plan the initial successful deployment of the PLA, then fighting under the dubious but deniable moniker of the “Chinese People’s Volunteers,” in Korea.<sup>37</sup> Wargaming would also apparently play a role in at least some of the successful Chinese engagements that would follow.<sup>38</sup>

Chinese researchers exposed to foreign wargaming were instrumental in developing PLA military science, research, and wargaming. The influence of Qian Xuesen (钱学森), a military scientist and planner, has proven particularly enduring for his promotion of “systems engineering” (系统工程), a discipline that focuses on the study of complex systems.<sup>39</sup> Qian famously declared that “war is a science” and argued that: “In military science, the basic theoretical level is military science, the technical theory level is military operations research, and the application technology level is military systems engineering.”<sup>40</sup> As an American-educated scientist who worked with the US military and in defense research, Qian may have been exposed to early American thinking on “operations research,” a method for the study of military operations.<sup>41</sup> Upon returning to China, Qian became an early advocate for the use of computers by the PLA for combat simulations, promoting experimentation with planning, strategies, and evaluations of weapon effectiveness.

The PLA’s modernization, including any advancement in wargaming, was severely impeded by the chaos and violence of the PRC’s early decades, roughly from 1950 to 1980. Due to intense disruptions, notably from the Cultural Revolution (1966-1976), PLA professional military education (PME) was at best adversely impacted and sometimes effectively canceled for years at a time.<sup>42</sup> Beyond these domestic factors, the international environment also presented new roadblocks to PLA

progress during these decades. For example, while other Communist bloc countries benefited from being able to send personnel to Soviet military schools, the deterioration of PRC-USSR relations, which eventually culminated in the Sino-Soviet Split in the late 1950s, denied this option to the PLA for years.<sup>43</sup>

During the 1970s and 1980s, the PLA began to return to the United States as a model to develop indigenous wargaming capabilities and enhance the realism of its training. It was at this time that the PLA's commercial and academic access to the United States began to play an increasingly significant role in its ability to develop its own wargaming capabilities. The PLA's acquisition of American computerized wargames appears to date back as far as 1975, and several relevant academic exchanges occurred in the 1980s, including the first Sino-American Seminar on Methodologies in Defense System Analysis in 1987.<sup>44</sup> During the 1980s, the PLA was able to benefit from the degree of openness by the United States toward China "to gain a rather comprehensive understanding of US military gaming procedures," according to the analysis of one expert.<sup>45</sup>

Even after the introduction of new restrictions on military-to-military relations in the aftermath of the Tiananmen Square Massacre in 1989, the PLA's access to the US civilian market appears to have undermined US efforts to prevent American wargaming technology from being acquired by the PLA. As one expert observed: "Ironically, ... [wargames published for the US civilian market] had user interfaces far superior to those of the military games China was not permitted to buy" from the US military.<sup>46</sup> With the globalization and commercialization of wargaming technology, the resulting diffusion has continued to aid China's efforts to build up and improve its indigenous capabilities.

Once the US-China military-to-military relationship resumed in the 1990s, visits and exchanges would have a formative influence on wargaming in

the PLA. Tours of US training facilities during this time inspired the creation of Chinese counterparts in the field. For example, following a visit to a new wargame center at the Institute for Defense Analyses (IDA) during the mid-1990s, the PLA representatives, who were "[v]ery impressed," attempted to create their own version by 1999.<sup>47</sup> Another notable early tour was in 2000 when General Wang Zuxun, the president of the Academy of Military Science (AMS), traveled to the United States with a delegation that visited several locations, including the Pentagon and the Army's Training and Doctrine Command (TRADOC). At the time, "[t]he Joint Forces Command provided unclassified tours of its Joint Training Directorate (J-7) and Joint Training Analysis Simulation Center, but not the Joint Experimentation Battle Lab."<sup>48</sup> However, the export

of military simulations and wargaming systems/software was subject to export controls, which forced China to develop domestic options.

The PLA's study of foreign militaries continued and intensified in the aftermath of the Gulf War, which provoked PLA concerns about changes in the character of warfare.<sup>49</sup> In particular, the PLA attributed US success during the Gulf War in part to wargaming.<sup>50</sup>

The Gulf War attracted immense attention within the PLA as an initial instance of "high-tech warfare" with "informatization" as a core feature. The US military's employment of wargaming during its preparations, as well as planning that continued through the course of the conflict, attracted the PLA's attention at the time, as noted by Yang Nanzheng (杨南征), a PLA expert on the topic.<sup>51</sup>

As the PLA began to view the US military as an adversary, especially in the wake of the 1995-1996 Taiwan Straits Crisis, China's leaders elevated their prioritization of military modernization and learning. As the PLA started to prepare for war under "high-tech conditions," ultimately launching the strategy of "informatization," it elevated the importance of wargaming as a means of training and preparing for

*...the PLA's access to the US civilian market appears to have undermined US efforts to prevent American wargaming technology from being acquired by the PLA.*



future operations.<sup>52</sup> While the PLA continued to import critical components of modern wargaming from abroad, the PLA wargaming community struggled to convince the rest of the military to accept and appreciate the value of their work. For example, games such as “Joint 99” and “Red Star System” were introduced to PLA PME during this time.<sup>53</sup> However, skeptical attitudes from leaders appear to have limited their early expansion beyond the classroom.<sup>54</sup> “Leaders don’t trust it, officers aren’t familiar with it, and units don’t wish to use it,” as the situation was described in PLA media at the time.<sup>55</sup> However, cost-effectiveness became a strong appeal of virtual training and wargaming, especially when the PLA encountered resource constraints.<sup>56</sup> Lesser risks of injury or damage also proved to be an attractive draw of virtual systems.<sup>57</sup>

As part of an effort to improve and consolidate PLA wargaming, the Central Military Commission (CMC) officially launched the development of command training simulation systems and wargaming as of the late 1990s. Hu Xiaofeng (胡晓峰) was designated as the lead for this effort and subsequently transferred from the National University of Defense Technology (NUDT) to the National Defense University (NDU). The NDU would become a center of gravity for these efforts through creating in 1999 a joint operations laboratory that would pursue initiatives in military simulations and wargaming.<sup>58</sup> Hu Xiaofeng became and remains influential to this day, including in PLA efforts to explore the potential of AI in command and control.<sup>59</sup>

## SELECT TIMELINE OF MILESTONES IN THE MODERN HISTORY OF PLA WARGAMING

- 1997: Hu Xiaofeng transfers to NDU from the NUDT to develop battle command training simulation systems.
- 1999: PLA establishes its first joint operations laboratory at the NDU.
- 2000: General Wang Zuxun, AMS president, travels to the United States with a delegation that visited the Pentagon and the Army’s Training and Doctrine Command (TRADOC).
- 2007: The CMC decides to officially launch the first large-scale project for research and development of a computerized wargaming system under Hu Xiaofeng’s leadership.
- 2014: The PLA organizes extensive exercises and training using the large-scale computerized wargaming system designed by Hu Xiaofeng.
- 2014/5\*: Prior to the implementation of its reforms, the AMS organizes a wargame to test the PLA’s new leadership and command structure.
- 2017: The first annual “national wargaming competition” launches, including an AI wargaming initiative focusing on human-machine confrontation.
- 2018: The CMC Science and Technology Commission launched a series of contests that focused on “human-machine confrontation,” known as “Prophet·Warlike Sage” (先知·兵圣-2018) to develop AI systems for in wargaming.
- 2019: The wargaming platform “Mozi·Future Commander” (墨子·未来指挥官) becomes publicly available and starts to be used in national wargaming competitions.
- 2020: The CMC Equipment Development Department organizes a joint operation challenging involving the use of AI in wargaming, called “Stratagem at Heart, Jointness for Victory” (谋略方寸·联合制胜).

*Notes: Due to inconsistencies in reporting in PLA media, several of these dates (marked \*) are estimated or have been reported differently. See sourcing in the sections below.*

The initial success of the NDU team enabled major progress in the PLA's indigenous wargaming capabilities. By the early 2000s, the PLA started to introduce new wargames such as "Sharp Sword" (砺剑), a computerized wargaming program designed for the campaign level.<sup>60</sup> The team at NDU also produced wargaming-support software.<sup>61</sup> This progress started to enable new milestones for PLA training. For instance, the NDU in 2006 convened China's "first strategic confrontation exercise" (战略对抗演习) using the "Decisive Victory" (决胜) series,<sup>62</sup> a strategic simulation system.<sup>63</sup> This exercise was said to have constituted a significant advancement for the PLA. Previously, the PLA had been unable to carry out strategic exercises due to technical constraints that restricted their attempts to merely exploring "military tactics on paper" ("纸上谈兵") in too abstract of a manner to be useful previously.<sup>64</sup>

The CMC assigned Hu Xiaofeng's team to develop a large-scale wargaming exercise system as of 2007, and this endeavor continued for over seven years. Within the first three years of its release, the strategic wargame was used to train over 10,000 mid-level and high-level commanders, with a focus on joint operations.<sup>65</sup> Their efforts started to receive high-level recognition, even receiving PLA and national awards,<sup>66</sup> as well as personal recognition by Xi Jinping.<sup>67</sup> For the PLA, the use of computerized wargaming started to be recognized as critical to training commanders, especially because of the limited opportunities for actual operational experience.<sup>68</sup> As a result, the PLA's academic institutions started to use this technique more extensively in cultivating "new-type" commanders.<sup>69</sup> Nonetheless, even while producing and introducing its own wargames and related software for training and simulations, the PLA still used foreign, particularly US, systems and software to bolster its capabilities, such as the US adjudication software "Janus."<sup>70</sup>

Meanwhile, PLA computerized wargaming started to benefit from China's civilian gaming market

in the 2000s. Investments in gaming and recreational software increased significantly within Asia overall, generally overtaking expenditures in North America during the 2000s.<sup>71</sup> As China's technology industry became more dynamic and successful, Chinese citizens became increasingly engaged in modern gaming as both players and producers. The availability of such expertise and technology appears to have eased previously skeptical attitudes of and unfamiliarity with computerized gaming within the PLA, while also perhaps improving the skill of personnel at playing and producing these increasingly complex games.

Advancing technological capabilities have created options for the PLA to develop and leverage a relatively holistic approach to wargaming. The PLA has started to work toward incorporating a wide range of factors and elements of national power that can impact the outcome of a conflict scenario.<sup>72</sup> For years, the PLA has been incorporating non-military factors such as media and political, economic, and diplomatic

concerns in wargames using the NDU's system.<sup>73</sup> While the PLA has been incorporating "virtual news" into its wargaming, their training has also apparently incorporated media events and media actors.<sup>74</sup>

Meanwhile, for members of China's armed forces, video games have come to be regarded as beneficial to morale and training for smaller squads.<sup>75</sup> For example, the People's Armed Police (PAP) turned to foreign video games, such as the popular American-made series *Counter-Strike* (*Fankong Jingying*, 反恐精英).<sup>76</sup> In more recent years, China has been working to replace some foreign titles with its own more "politically correct" games such as *Glorious Mission* (*Guangrong Shiming*, 光荣使命). *Glorious Mission*, an online video game intended to improve combat skills and technological understanding, was released in 2011 by the PLA in partnership with Wuxi Giant Interactive Group, and involved a

***PLA computerized wargaming started to benefit from China's civilian gaming market in the 2000s.***

conflict scenario between China and Japan over the Diaoyu (Senkaku) islands.<sup>77</sup> A goal of the release of domestic games like *Glorious Mission* is to ensure that PLA personnel can train, as well as play recreationally, with Chinese forces and equipment, rather than largely Western ones.<sup>78</sup> A civilian version of the game was also released to the public in 2012 to support national defense education.<sup>79</sup> The civilian market, both domestic and foreign, has continued to benefit the Chinese armed forces by providing access to supporting technology, such as virtual reality (VR) headsets and gaming joysticks, which are now even being incorporated into some cadet training.<sup>80</sup>

Beyond training and education, the PLA apparently employed wargaming to inform the design of the major reforms that were launched in 2015. While the practice of wargaming at the PLA's Academy of Military Science is more opaque, the Academy of Military Science was reported to have launched a specialized wargame to explore the "operating process of the new leadership and command system" over a ten-day exercise, and this was reportedly "the first time in the history of the People's Army that computer simulation technology was used to assist reform research and demonstration."<sup>81</sup> As the PLA continues to pursue further reforms and explore new concepts of operations, wargaming is likely to continue to be used to facilitate such advances. Despite the progress and continued development of tactical, campaign, and strategic wargames by the centralized wargaming community, there appear to be only limited efforts in wargaming development across various services of the PLA, particularly when it comes to scenarios, technology, and platforms more specific to an individual service. For instance, the PLA Navy Military Training Equipment Research Institute has developed the strategic battle-level wargame "Chinese Fleet" (中国舰队).<sup>82</sup>

The PLA's modern practice of computerized wargaming continues to progress and increasingly focuses on preparing for future scenarios of joint operations. Increasingly, companies are contributing

through designing new systems, yielding a successful instance of military-civil fusion (MCF). In particular, Beijing Huashu Defense Technology Co. Ltd. (北京华成防务技术有限公司) has developed the Mozi Joint Operations Deduction System (墨子联合作战推演系统) for use in training and education.<sup>83</sup> This has been a major platform employed within the PLA and in national tournaments. The platform has also been available for public usage since 2019.<sup>84</sup> *Mozi* is described as a "human-in-the-loop joint operation deduction system, covering ground, sea, air, space, and electronic operations domains" that is "capable of supporting campaigns and tactical-level deductions and supporting the whole process of combat planning, combat organization, and force command."<sup>85</sup> This system was directly inspired by and developed to imitate *Command: Modern Air Naval Operations* (CMANO), a commercial wargaming platform used by the United States and NATO that features the major armaments and equipment of over 130 major countries.<sup>86</sup> Relative to previous wargames available to the PLA, *Mozi* is described as allowing for significant improvements in sophistication. Its design also provides a platform through which AI agents can be developed and integrated.<sup>87</sup>

Company involvement in PLA wargaming design continues to expand. Huashu is among the most successful examples of an emerging ecosystem of companies that support military wargaming and simulations, which also includes Huaru Technology (华如科技). Huaru specializes in the development of big data platforms and military simulations as well as wargames focused on space and cyber operations.<sup>88</sup> Jinan Chess Battle Network S&T Co. Ltd. (济南棋战网络科技有限公司) has developed a tactical wargame for land warfare that has been used in national competitions.<sup>89</sup> Beyond military affairs, wargames provide an important instrument as China continues to grapple with complex challenges in national security, including public health and biosecurity.<sup>90</sup>

## Wargaming Competitions and National Defense Education

Wargaming has become a prominent element of PRC initiatives in national defense education. The popularity of wargaming among students, both military and civilian, at various levels has made the practice a mechanism for enhancing users' knowledge of national defense. Computerized wargames could facilitate the identification of those who have particular proficiency with command and strategic decision-making. The endeavor of national defense education is a concern of national policy, as all Chinese college students are required to complete several weeks of military training for this program, yet the physical training involved often provoked controversy and resentment.<sup>91</sup> China's wargaming tournaments reflect this concern with national defense education and appear to be intended to generate public interest in military affairs by leveraging the appeal of the virtual medium.<sup>92</sup> Wargaming is seen by many Chinese experts and thinkers as a means to "stimulate student enthusiasm" for patriotic and martial endeavors while cultivating potential reserve forces.<sup>93</sup> "Military training should simulate warfare, so that students can understand modern warfare in military training, acquire more military knowledge, enhance their sense of responsibility and mission, and always defend national security and defend the country," as one commentator urged.<sup>94</sup>

China's universities have steadily become more active and enthusiastic participants in wargaming. Since 2014, a series of wargaming competitions regularly convened in Beijing has involved hundreds of students.<sup>95</sup> In 2015, the National Defense

Education Association organized a wargame at Tsinghua University that marked the anniversary of the Second Sino-Japanese War.<sup>96</sup> Tsinghua features a wargaming team as well as a dedicated laboratory for wargaming.<sup>97</sup> Wargames among Beijing universities also feature more recent global conflicts; the 2020 competition was based on the conflict between Azerbaijan and Armenia in Nagorno-Karabakh that had only just concluded weeks prior.<sup>98</sup>

Beyond local events, a series of national wargaming competitions has highlighted the PLA's prioritization of wargaming and its associated activities. These efforts are continuing to expand and becoming more specialized over time. The Nationwide Wargaming Grand Contest (全国兵棋推演大赛) has convened annually since 2017.<sup>99</sup> These major tournaments have been organized with guidance from the China Association for Science and Technology (CAST) Science Popularization Department and the National Defense Education Office; their sponsorship highlights the pragmatic function of these activities. Typically, the tournaments have occurred from spring to winter, starting with several thousand participants at universities nationwide before a final round featuring the top teams.<sup>100</sup> The size and scale of these wargames have continued to increase over time, as has the complexity of the platform and scenarios involved.

## National Wargaming Competitions (2017–2021)

Year	Wargame for Initial Round	Wargame for Finals Round	Estimated Number of Participants
2017	“National Defense Education Wargaming System” (国防教育兵棋推演系统)	“Armor Assault Group” (铁甲突击群)	>5,000
2018	“Armor Assault Group”	“Assault—Fleet Commander” (突击—舰队指挥官)	>12,000 players
2019	“Smart Weaponry (Zhirong) — Future Commander” (智戎—未来指挥官)	“Smart Weaponry — Future Commander”	>20,000 players
2020	“Smart Weaponry — Future Commander”	“Mozi—Future Commander” (墨子·未来指挥官)	>8,000 players
2021	“Mozi—Future Commander”	“Mozi—Future Commander”	TBD

Note: See the discussion that follows for sourcing on the points above. The names of the wargames are translated by the authors and could be rendered differently elsewhere.

**2017** The initial launch of this series of contests occurred in spring 2017.<sup>101</sup> The first round of the competition leveraged the National Defense Education Wargaming System (国防教育兵棋推演系统).<sup>102</sup> The finals convened at the Joint Operations College of the PLA’s National Defense University in Shijiazhuang introduced a new game called Armor Assault Group (铁甲突击群).<sup>103</sup> This wargame concentrated on a scenario of ground combat that involved tactical offensive and defensive confrontations designed by Jinan Chess Battle Network S&T Co. Ltd. (济南棋战网络科技有限公司).<sup>104</sup> In reflecting on the competition, a PLA National Defense University professor declared: “I hope that the new generation of soldiers can describe the nature of war more comprehensively and carry out relevant warfare predictions.”<sup>105</sup>

Notably, this competition also introduced “human-machine confrontation” in a special event that occurred alongside the finals. This contest was implemented with support through the China Institute of Command and Control (CICC), as well as the Chinese Academy of Sciences Institute of Automation (CASIA). CASIA is also known for its contributions to AI research and development and has provided important resources and platforms to promote the expansion of AI in wargaming.

**2018** The second National Wargaming Competition launched in May 2018. This tournament occurred over five months across two stages, again with support from CICC and CASIA. During the initial stage, 12,000 registered players participated via the online platform across 13 cities and provinces using the same game as the 2017 competition, Armor Assault Group.<sup>106</sup>

The teams that were successful in the initial rounds progressed to a national final that involved 100 players competing in a new “air-sea battle platform” called “Assault—Fleet Commander” (突击—舰队指挥官) that involved a historical scenario focusing on US-Japan naval battles during World War II.<sup>107</sup> This wargame focused on the fierce clashes between the US and Japanese navies during the Battle of Guadalcanal at Ironbottom Sound and included carriers, aerial combat, and anti-submarine operations.<sup>108</sup>

**2019** The initial rounds of the 2019 competition leveraged the Smart Weaponry—Future Commander (智戒—未来指挥官) system and concentrated on a scenario of joint operations.<sup>109</sup> This system is the civilian version of the Mozi Joint Operations Platform developed by Huashu Defense, which the PLA uses. Intelligent Weaponry—Future Commander allows for wargaming of sophisticated joint operations across air, sea, space, and electro-magnetic domains.<sup>110</sup>

The finals for this third National Wargaming Competition were convened in Beijing in 2019 and involved players from military academies and civilian universities nationwide.<sup>111</sup> The theme was “discovering innovative military commanding talents, exploring outstanding military intelligence

teams,” while also seeking to strengthen “patriotic support of the military” among young people.<sup>112</sup>

**2020** With the fourth national contest in 2020, this series was renamed the “Mozi Cup” and adhered to a similar format to the previous competitions.<sup>113</sup> This tournament introduced a special competition for creating AI systems at the finals, a “machine-machine confrontation” event in which 32 teams engaged in over 1,100 “intelligent game battles.”<sup>114</sup>

**2021** The 2021 tournament launched in spring 2021. This tournament elevated the emphasis on developing AI systems in wargaming.<sup>115</sup>

## AI in PLA Wargaming Initiatives

The PLA’s experimentation with AI in wargaming predates but was also inspired by the success of Google’s AI, AlphaGo, which defeated the world’s leading player Lee Sedol in the game of Go in the spring of 2016.<sup>116</sup> At the time, the PLA interpreted AlphaGo’s victory as a demonstration of the potential significance of AI in future wargames and command decision making. PLA researchers envisioned using AI for simulations and operational planning and analysis to model complex dynamics and interactions.<sup>117</sup> Since AlphaGo, advances in AI have continued to be tested and demonstrated through games. For instance, the Chinese company Tencent has created AI agents that can defeat human players of Starcraft II, a relatively complex and fast-paced real-time strategy video game.<sup>118</sup> AI systems have also beaten human players in games such as the card game Texas Hold’em.

The success of AI in Texas Hold’em was particularly significant because it marked the first major success

for AI in a game of incomplete information. Prior to this milestone, AI victories had primarily occurred in games or scenarios in which there is complete information, which plays to a machine’s strengths, including the capacity to process massive amounts of information and evaluate alternative courses of action at speeds and scales that humans cannot match. However, in a scenario where information is concealed, humans tend to be advantaged by their understanding of context and behavior, including questions of intention. Given that conflict or diplomacy are contexts in which the available information is decidedly incomplete, AI success in games like Texas Hold’em, while dramatically different in level of complexity from real-world events, are nonetheless significant, perhaps auguring future progress toward real-world AI applications.

The use of AI in wargaming has become the centerpiece of some national wargaming competitions in China. In September 2017, the CICC sponsored

the first Artificial Intelligence and Wargaming National Finals.<sup>119</sup> This tournament involved a human-machine confrontation between top teams and an AI system called CASIA-Prophet (先知) I.O, which was victorious over human teams by a score of 7 to 1.<sup>120</sup> After defeating the human players in the 2017 finals, Prophet I.O was described in state media as “a Chinese version of AlphaGo.”<sup>121</sup> As the Deputy Director of CASIA, Yang Yiping, described at the time that their work leveraged data recorded from 15,000 matches across the initial rounds of competition and the national finals. Using an approach that combined “knowledge-driven” and “data-driven” learning, Prophet I.O evolved across multiple versions in the initial half-year of its development leading up to the finals.<sup>122</sup> The only human player who won against Prophet I.O said the program demonstrated remarkable speed of reaction and accuracy in calculations.<sup>123</sup>

Despite such attention to and enthusiasm for AI, there is a great distance between a gameboard and the actual battlefield. Even the most complex and detailed battlefield simulations pale in comparison to the complexity of fog and friction that arise on an actual battlefield. However, the tactics, stratagems, and challenges of decision making that can arise in a game such as Go or a wargame are relatively analogous to those that might be used on the battlefield. Major General Hu Xiaofeng, along with other PLA researchers, was quick to explore the potential for integrating AI into China’s computerized wargames and military simulations to enhance their level of realism, including through the creation of simulated hostile forces that are artificially intelligent enough to provide rigorous challenges.<sup>124</sup>

Predictions that extrapolate the future utility of AI in actual combat based on wargaming should be regarded skeptically given the current technical limitations of AI. In 2017, CICC director Fei Aiguo (费爱国) said:

*Predictions that extrapolate the future utility of AI in actual combat based on wargaming should be regarded skeptically given the current technical limitations of AI.*

“AI + wargaming + networked command and control systems + unmanned systems is likely to constitute a new combat system in the future. In this system, AI + wargaming is the brain that assists people in decision-making; the control system is the nerve, and the unmanned system is the arm. The experience gained in wargames will further develop the AI; according to the rules of wargaming, AI will be able to provide advanced intelligent assisted decision-making, strategizing, anticipating the enemy, and winning the battle.”<sup>125</sup>

Nonetheless, continued advances in basic research and commercial applications, as well as military research that looks to leverage AI to improve situational awareness, point to the prospect that such a vision may be realized in the years or decades to come.<sup>126</sup>

The CMC Science and Technology Commission, which is responsible for driving China’s military science and innovation, has convened a series of “human-machine confrontation challenges” since late 2018. The Prophet Warlike Sage-2018 (Xianzhi Bing Sheng, 先知兵圣-2018) competition was open to universities, scientific research institutions, and technology companies and also featured an internal military competition.<sup>127</sup> The contest involved wargaming of human-machine and machine-machine confrontation in a ground combat scenario.<sup>128</sup> Each team that participated in the machine-machine category submitted an AI agent to compete. This initiative occurred through the Science and Technology Commission’s National Defense S&T Innovation Zone (国防科技创新特区).<sup>129</sup> The most successful teams were encouraged to participate in military projects in the future.<sup>130</sup> Chinese writers have highlighted this contest as a successful implementation of military-civil cooperation

that promoted national defense education.<sup>131</sup> The contest involved thousands of teams participating from across the whole military in 2020 and focused on “research by competition” and promoting “the transformation of military (artificial) intelligence into combat effectiveness.”<sup>132</sup>

CASIA, which has supported the competition and ongoing AI and wargaming developments, has also facilitated technology sharing by providing toolkits and training environments for research and development. CASIA has provided open access to the real-time strategy human-machine confrontation platform “Temple Calculations—Smart Victory” (庙算·智胜). This platform has been used in human-machine confrontation contests, and its interface allows for machines and humans to play both with and against each other.<sup>133</sup>

As the national wargaming tournaments included and promoted the use of AI in wargaming, these contests have facilitated the development and introduction of new AI agents. For instance, an AI system known as “War Skull” (战颅) succeeded in defeating human teams and other AI systems in the 2019 finals of the national wargaming competition.<sup>134</sup> War Skull was developed by a National University of Defense Technology team that is also exploring the applications of AI in future command and control.<sup>135</sup> NUDT’s War Skull won this special competition in 2020 as well, which commentary at the time described as creating a special “machine commander.”<sup>136</sup>

Through wargaming, the PLA is promoting advances in AI that could support and coordinate

joint operations. In 2020, the CMC Equipment Development Department organized a contest called “Stratagems at the Heart, Jointness for Victory” (谋略方寸·联合制胜) that focused on the development of AI algorithms trained for combat planning.<sup>137</sup> Beyond the competition, the ultimate purpose was attracting teams that could create a foundation for future developments in the field and receive funding to support the development of command systems.<sup>138</sup> The scenario involved machine-machine confrontation in directing a joint island offensive. The offensive requires the red (friendly) force to attack blue (enemy) force island command posts, across sea and air battlefields. The simulation requires the AI to direct target reconnaissance, electromagnetic countermeasures, and coordinated fire strikes.<sup>139</sup>

“This type of problem has always been regarded as the touchstone of top artificial intelligence technology, and is also known as the last high ground defended by human intelligence. The technical difficulty can be seen. Once technological breakthroughs are made, it will subvert the previous planning method of expert experience + rule knowledge, making the current human-oriented command and decision-making model inevitably shift to the direction of human-machine integration.”<sup>140</sup>

However, in the meantime, the PLA must continue to focus on continuing to train for real-world scenarios.

## Live Wargames for “Actual Combat” Training

During peacetime, live exercises against capable OPFOR can be a useful method to enhance realism in training while enabling the testing and application of lessons learned from the laboratory of wargaming. “Confrontation training is the closest method of military training to actual combat during peacetime,” as described in PLA media.<sup>141</sup> In its OPFOR

program, the PLA has benefited significantly from access to foreign examples and sources of knowledge. In particular, the PLA derived benefit from its access and exposure to US military practices during the latter stages of the Cold War, when the United States came to see China as an important counterweight to the Soviet Union. Through increasing



engagement, the PLA gained the invaluable opportunity to learn directly from the US military on training techniques.<sup>142</sup>

After PLA delegations visited US military facilities starting in the 1970s, these exchanges directly impacted China's approach to training and creation of an OPFOR program. For instance, after a visit to Fort Leavenworth in Kansas in 1972 to observe a live exercise involving a US force against an OPFOR that emulated the Soviet military, the PLA reportedly established a program called "Project 741" to create its first professional blue (opposition) force.<sup>143</sup> While this project is reported not to have been fully realized due to bureaucratic obstacles that impeded implementation,<sup>144</sup> this early effort appears to have nonetheless contributed to the later creation of the PLA's OPFOR (blue force) training program.<sup>145</sup> This prior visit was followed by several others, including to the National Training Center (NTC) at Fort Irwin in California, which also directed a major OPFOR program that simulated the Soviet military,<sup>146</sup> and Nellis Air Force Base in Nevada, which is the site of the US Air Force's premier air combat training center, professional OPFOR units, and the *Red Flag* OPFOR series, among others facilities.<sup>147</sup>

Although the disruption to PRC politics under Mao Zedong initially impeded reforms, Deng Xiaoping launched efforts to promote reform and mitigate weaknesses within the PLA through improved professionalism and by accelerating modernization. Reform was recognized as an urgent issue after China's poor performance during its 1979 invasion of Vietnam.<sup>148</sup> Starting in the 1980s, the PLA introduced initiatives to restore its education and training systems, as well as to improve training and enhance command and control. Unsurprisingly, the PLA, once known as the "Red Army," calls its own side the "red force" (*hongjun*, 红军), while the enemy force is the "blue force" (*lanjun*, 蓝军).

*The early visits to US OPFOR facilities by Chinese representatives sparked interest in these training methods across the PLA.*

This convention reverses the color scheme that the United States and many other militaries, particularly in Western countries, employ. The PLA's efforts to create blue forces finally broke ground in earnest after the approval of the construction of China's first blue force base in what was then the Nanjing Military Region in 1985.<sup>149</sup>

For training to be realistic and challenging, a thinking opponent that can simulate potential enemies with a high degree of fidelity is required. The introduction of such an opponent into training is regarded as "the highest form and limit of military training," according to PRC state media.<sup>150</sup> The path to creating a good "whetstone" upon which the PLA could sharpen itself was underway by April of 1986,<sup>151</sup> when the PLA officially established this first blue force training facility at Sanjie in Anhui Province.<sup>152</sup> The new facility was described as the "Eastern Fort Irwin" in an apparent reference to the PLA's source of inspiration in the US, which its representatives had visited the same year construction was approved.<sup>153</sup>

The PLA's "first professional simulated enemy unit" was created at this facility shortly thereafter.<sup>154</sup>

China's self-styled "Fort Irwin model" of training has centered upon a series of bases and units with dedicated blue forces.<sup>155</sup> Beyond China's "Eastern Fort Irwin," there is "China's Red Flag Range," named in reference to a nickname for Nellis Air Force Base, which hosts the US *Red Flag* OPFOR exercise series that significantly influenced the PLA Air Force.<sup>156</sup> Evidently, the early visits to US OPFOR facilities by Chinese representatives sparked interest in these training methods across the PLA, and several military regions and services eventually established their own similar training facilities.<sup>157</sup> These initiatives contributed to the cultivating of a cohort of personnel specialized in leading blue forces, which is said to have enhanced the quality and realism.<sup>158</sup>

Although China was subject to US sanctions after the PLA violently suppressed protests in Tiananmen Square in 1989, the fallout from this massacre caused only limited interruption to increasing engagement with the United States. By 1994, the PLA was again visiting Fort Irwin and Nellis Air Force Base through official military-to-military exchanges.<sup>159</sup> Even when restricted from the purchase of certain weapons and equipment or denied visits to US OPFOR facilities due to their sensitivity, the PLA still benefited from the relative openness of the US military. This ready availability of relevant information for study and reference, including detailed information on US OPFOR training and wargames, has likely contributed significantly to the PLA's study of and lessons learned from US military training, which improved Chinese efforts over the years.<sup>160</sup>

While the PLA's OPFOR program was directed and commissioned through national authorities, its early forays to create blue forces occurred with only limited centralized support or coordination to start. Typically, these efforts were undertaken across a variety of military regions, branches, units, and bases in a fragmented manner, without sufficient integration or systematic dissemination of best practices or lessons learned.<sup>161</sup> When a unit or base set out to create its own OPFOR, the resulting blue forces were typically established based on research and initiatives undertaken at local levels, often apparently without central resources or standards. The result has been a range of blue forces of varying quality.<sup>162</sup> The apparent shortfalls of exchange or interaction appear to indicate a lack of jointness across and even within services, a problem that recent reforms have started to address.<sup>163</sup>

The PLA's efforts to promote standardization and professionalization in training initiatives remain ongoing, including the 2009 Outline of Military Training and Evaluation (OMTE), which called for the PLA to "regularize the methods, procedures and standards for online training, base-ized training (*jidi hua xunlian*, 基地化训练) and confrontation training."<sup>164</sup> Nonetheless, the development of blue force knowledge and techniques continued to display only limited standardization. This dynamic highlights the PLA's persistent difficulty in sharing

or institutionalizing the learning process, which has forced the same solutions to be rediscovered by different branches and outfits.

Within the past decade, the prominent successes of the PLA's blue force based at Zhurihe in Inner Mongolia has elevated the level of priority and the prominence of these OPFOR activities.<sup>165</sup> The "wolves" of Zhurihe, a unit initially established in Inner Mongolia in 2012, were deemed ready for operations as a trained blue force as of January 2014.<sup>166</sup> Notably, Xi Jinping himself personally inspected Zhurihe during a major military parade in 2017.<sup>167</sup> The training at Zhurihe has infamously included staged assaults against a replica of Taiwan's Presidential Office Building.<sup>168</sup> The featuring of this blue force, which its first commander has emphasized intends to "study the enemies and act like the enemies," reflects the PLA's recognition of the potential importance of this modality of training in tackling long-standing weaknesses. Chinese leaders hope that this blue force and others like it will improve PLA operational capabilities that have not been tested in war for decades.<sup>169</sup>

The PLA, and even Xi Jinping himself as its commander-in-chief,<sup>170</sup> has warned of "peace disease." The disease represents potential military weaknesses caused by lax mentality and poor habits among soldiers and commanders that can occur during a lengthy period of peace.<sup>171</sup> PLA leaders view the rigor that real blue forces, when not held back, can inject into training as a critical "wakeup cure" for such "peace disease."<sup>172</sup> For decades, the PLA's training had been scripted and typically contrived such that the red force would always succeed.<sup>173</sup> With more capable blue forces and a more rigorous adjudication process came the possibility and actuality of losses to a simulated adversary, which rendered weaknesses painfully apparent, providing further impetus for addressing such issues.<sup>174</sup>

The PLA's blue force training reveals not only the Chinese military's concerns but also its predictions of potential adversaries and resulting contingencies. The primary direction and expected adversary that animates the PLA's military strategic guidelines and preparations for military struggle has evolved over time, but the current concentration is apparent:

in recent decades the PLA has focused the greatest degree of its attention to simulating and training against the US military and Taiwanese armed forces. US regional allies such as Japan have also received attention. The extensive reporting on a vast array of blue force initiatives in China highlights this trend.

The PLA often uses the phrasing “strong enemy” or “powerful adversary” (*qiangdi*, 强敌) to refer to the United States, such as in its directive on training issued in 2020.<sup>175</sup> Even early in the PLA’s blue force history, certain units have even been explicitly associated with specific US military units, such as the “professional simulated enemy unit” at the PLA’s first blue force facility, which has been called the “Green Beret” unit.<sup>176</sup> The simulation of the US military by Chinese blue forces has extended beyond simulating tactics and equipment to even wearing US military uniforms.<sup>177</sup> While the PLA’s efforts in training to fight Taiwan, the US military, and US allies in the region are hardly surprising, the PLA has also dedicated time, effort, and resources to simulating and training against other militaries, including using blue forces to simulate fighting against units from Vietnam, India, and Indonesia.<sup>178</sup>

## Innovations in PLA Blue Force Training

The PLA’s extensive initiatives and apparent enthusiasm for expanding its use of blue forces appear to exceed US efforts in scope and perhaps in sophistication. At present, the US military only maintains a small number of dedicated facilities for its OPFOR program, and the forces involved, while of high caliber, appear to be fewer in number than those across the PLA in its totality.<sup>179</sup> The PLA has dedicated significant investment to creating a growing number of high-quality blue forces across the services and their branches.<sup>180</sup> Other blue forces have been created to provide particular training regardless of service or branch. One example is the “cyber blue force” used to create more

sophisticated challenges of information operations targeting red forces in training.<sup>181</sup>

The increasing quality and specialization of the PLA’s blue forces have benefited from the integration of military academics and outside experts who bring critical knowledge to this effort. These experts include researchers, groups of “academic blue forces,” and specialists advising ad hoc blue force personnel called “blue force brains” and “blue force professors” on how to best simulate a certain foreign military.<sup>182</sup> The PLA leverages area experts who can bring useful insights on foreign forces from military academic institutions<sup>183</sup> as well as civilian experts and organizations.<sup>184</sup> Civilian involvement has also come to include the defense industry that provides a range of services, including and beyond technical support, with some personnel even being integrated into exercises as participants wearing plainclothes with “blue collars.”<sup>185</sup> These organizations include the China Electronics Technology Group (CETC), the China Aerospace Science and Industry Corporation (CASIC), and the China Academy of Engineering Physics (CAEP).<sup>186</sup> The active expansion in blue force simulations of US forces by the PLA stands in stark contrast to what appears to be a slower shift within the US military to start simulating the PLA as a potential adversary at its major OPFOR centers.<sup>187</sup>

The PLA has also started to incorporate new elements of national power into confrontation training. This expansive approach to conflict, including media, political warfare, and economic considerations, is consistent with the political character of the PLA and its outlook on “military struggle.”<sup>188</sup> For instance, PLA live exercises have started to integrate simulated journalists and press conferences. Participants in one live exercise by the

PLA Navy in 2014, which included a red force, blue force, and green force (i.e., secondary enemy force), each held press conferences in order to use “media propaganda to create favorable conditions for military actions.”<sup>189</sup> The media is being similarly incorporated into training in real-world flashpoints. In

*PLA live exercises have started to integrate simulated journalists and press conferences.*

live exercises in the South China Sea in 2017, participants including the PLA, militia units, and law enforcement agencies were tasked with navigating politically delicate situations, such as confronting blue force vessels “disguised” as fishing boats,<sup>190</sup> and dealing with journalists found in the company of the enemy, such as on a boat with “militants.”<sup>191</sup>

The PLA is focused on a new realm of military struggle in its blue force training, seeking to improve the capacity to achieve objectives with its armed forces during peacetime competition and ambiguous confrontation. Chinese military leaders recognize the complexity of linkages between modern political and military struggle, including “political and military interfusion, limited objectives of operations, [and] uncontrollability of the operational process,” as one PLA Navy publication characterized.<sup>192</sup>

The PLA’s attention to political objectives also manifests in the incorporation of simulated forces beyond the usual red-blue confrontation. These include “orange forces” (e.g., non-great power military), “green forces” (enemy allies or secondary enemy forces), and even “criminals.” Such third-party forces often attempt to “check” or “interfere” with the attempts by the red force to fight the blue force,<sup>193</sup> while the less traditional elements, such as “criminals,” cause problems in the rear area.<sup>194</sup>

This dynamic highlights PLA concerns with preventing “hostile foreign forces” from supporting its enemies. In one scenario, the Chinese red force had to maneuver their warplanes to “drive off” an orange force and issue “warnings in skilled English” in a 2017 PLA Air Force exercise in the Southern Theater Command. That command has primary responsibility for the South China Sea region.<sup>195</sup> Similarly, the use of a “green force” has been used to “simulat[e] an intervention by a strong enemy” in a confrontation exercise.<sup>196</sup> The phrase “strong enemy” is a euphemism in the PLA for the United States; the green forces often represent the US military when it is not the primary enemy but could

intervene.<sup>197</sup> Green force intervention scenarios have been used to teach students<sup>198</sup> and challenge and temper frontline units, as well as commanders in online command exercises.<sup>199</sup> The multiple opposing forces integrated into exercises highlight the PLA’s efforts to improve its capacity to cope with sudden changes and to be adaptive in navigating the potential entrance or involvement of another power in a conflict scenario.<sup>200</sup>

## Training Against the Enemy in Real-World Scenarios

Beyond wargames or training, the PLA appears to have started to pursue more extreme measures in real-world operational environments. The PLA has started to practice against foreign militaries during peacetime operations. In particular, elements of the PLA, especially the PLA Navy’s submarines, have been “using the enemy to train” (*na di lianbing*, 拿敌练兵) by engaging with real foreign vessels and aircraft, which essentially serve as the most realistic blue forces available. In one instance as early as 2014, the commanding officer of a submarine that encountered foreign warships and aircraft and used them for training stated subsequently: “We thought at the time, since there is a ‘free’ training partner, we cannot fail to live up to the ‘good intentions’ of others, so let’s make a good move!”<sup>201</sup> Such an outlook has been praised in state media for treating one’s adversary as a “whetstone” to become stronger.<sup>202</sup> Another submarine captain similarly emphasized: “In a sense, we submarine people [sic] should be grateful to the other side’s anti-submarine warships and aircraft

for being a ‘training partner.’”<sup>203</sup>

Ultimately, “the adversary is the most genuine ‘blue force,’” as state media has declared, and thus the practice is consistent with the PLA’s drive for actual combat training.<sup>204</sup> While risky and dangerous at times, the recurrence of this practice, as well as praise in PRC state media, implies it is intentional.

When the PLA starts to seek out foreign forces for use in training,

*Chinese military leaders recognize the complexity of linkages between modern political and military struggle.*

that practice may result in risky behavior.<sup>205</sup> There have been several incidents publicly reported in which PLA Navy submarines stalked and entered within weapons range of US carrier battle groups,<sup>206</sup> even entering into proximity to US carriers.<sup>207</sup> Other dangerous PLA interactions with foreign militaries have occurred and could be repeated, such as flying too close to other aircraft, “lasing” pilots, and probing foreign bases.<sup>208</sup> While critiques in response to such incidents typically characterize such behavior as indicative of inexperience and unprofessional conduct, the PLA’s attention to realism raises the possibility this pattern of behavior could be deliberate. While the question of the PLA’s conduct will merit more extensive consideration,

these practices have precedents in the PLA’s previous wartime experience, including during the Korean War. At the time, high-ranking members of the Chinese military leadership recognized and sought to maximize training value through combat experience with an actual enemy, using the battlefield as a “school” for “combat training” by rotating as many personnel as possible to the front lines.<sup>209</sup> Beyond questions about whether individuals recklessly violated norms of military professionalism,<sup>210</sup> the PLA appears to be probing how foreign militaries react to non-kinetic, but still potentially dangerous, activities. The PLA’s recent activities around Taiwan also appear to be testing foreign reactions, surveillance capabilities, and rapid response preparedness.<sup>211</sup>

## Concluding Reflections

As the PLA prepares for future warfare, wargaming and confrontation training against blue forces will remain critical to its learning and readiness. The historical trajectory and significant progression of these initiatives highlight the degree to which the PLA has emulated foreign militaries, especially the US military, in its efforts to catch up. However, the PLA’s capacity to learn and adapt by introducing unique initiatives and innovative developments demonstrates its organizational creativity. The PLA’s expansion of blue forces training reflects its concern with overcoming peace disease and progressing toward greater realism and rigor in its confrontation training, though its progress on those fronts remains mixed.

The PLA seeks to continue learning without fighting under peacetime conditions, and its use of wargaming as a laboratory for learning and the introduction of simulated adversaries in exercises provide critical insights. However, these initiatives are unlikely to capture the full complexities of modern warfare and may risk providing a distorted understanding or unrealistic expectations. Moreover, despite some apparent advances, the PLA’s ability to incorporate and institutionalize lessons learned from these activities is difficult to accurately assess.

Ultimately, the PLA’s objective is not only to prepare but also to anticipate and orient its efforts toward achieving an initiative in future warfare. “The PLA must broaden its strategic approaches to catch up, surpass and accelerate the transition from passively adapting to war to actively designing how a war is fought,” as CMC Vice Chairman General Xu Qiliang has declared.<sup>212</sup> The idea that “third-rate militaries imitate war, second-rate militaries deal with war, and a first-class military designs war,” is frequently referenced in PLA commentary.<sup>213</sup> The new turn to focus on “war design” (战争设计) elevates a PLA endeavor that seeks to study future warfare in order to facilitate efforts to create capabilities that could enable an edge on the future battlefield. For instance, the CMC has drawn “future warfare concept and scenario ideas” from local universities, scientific research institutions, and “military enthusiasts,” some of which may eventually be tested.<sup>214</sup> Evidently, the PLA aspires to become a world-class military on the cutting-edge of innovation, and its initiatives in wargaming and battlefield experimentation could support that endeavor.<sup>215</sup>

## Policy Considerations and Recommendations

The US must keep a close watch on PLA wargaming and OPFOR training to understand how China plans to fight its wars and counter the United States or its allies. Several aspects of the PLA efforts studied in this report provide considerations for the US Department of Defense (DoD).

- **Steady improvements in PLA wargaming could challenge and should provoke innovations and continued improvements within the US military and defense wargaming community.**
  - Experts have raised concerns over the past decade about gaps in US wargaming that need to be addressed.<sup>216</sup> The Office of the Secretary of Defense should continue to assess US wargaming activities within the defense establishment and national security community as well as in academia and among hobbyists.<sup>217</sup> Such a review could evaluate the state of “red teaming” and other adversarial training and research methods in the US military. Although elements of the US military have established their own programs and practices for red teaming,<sup>218</sup> there appears to be no standard curriculum or formalized compilation of best practices.<sup>219</sup> These programs should be regularly updated by sustained engagement with subject matter experts on potential adversaries.<sup>220</sup>
- The US Department of Defense should ensure greater access to computerized wargaming platforms. US military educational institutions should consider introducing wargaming at earlier stages in education and enhancing PME programming across multiple levels.
- **US leaders in charge of OPFOR units and training should closely examine the PLA when designing future programs.** Despite the long history of OPFOR in the US military, concerns have been raised about its adaptation over the past decade, including when it comes to simulating the PLA as a near-peer competitor.<sup>221</sup>
  - The US military has only recently started to prioritize OPFOR and related training for scenarios of potential conflict with a near-peer or peer force such as the PLA.<sup>222</sup> The DoD should consider expanding and modernizing OPFOR units and facilities while increasing the scale, complexity, and regularity of OPFOR exercises that simulate a peer competitor.
- **The DoD should increase the involvement of regional allies and partners in new OPFOR programs.** New and existing training must also account for non-kinetic actions and additional elements of national power, such as are being tested by the PLA in its own efforts.

# Endnotes

1. “The Chief Engineer of PLA Wargaming Systems: The accurate deductions of the US military’s attack on Iraq shocked China” [解放军兵棋系统总师：美军攻伊准确推演震撼中方], *China Science News* [中国科学报], May 10, 2013, available at <https://mil.news.sina.com dot cn/2013-05-10/1104724260.html>.
2. *Chinese Lessons from Other Peoples’ Wars*, ed. Andrew Scobell, David Lai, and Roy Kamphausen (Carlisle, PA: US Army War College Strategic Studies Institute, 2011), <https://apps.dtic.mil/sti/pdfs/ADA553490.pdf>.
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6. Ibid.
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16. This is noted by the US Naval War Colleges’ Wargaming Department on its website, along with just a few of the definitions. See “About Wargaming,” *US Naval War College*, accessed on March 13, 2021, <https://usnwc.edu/Research-and-Wargaming/Wargaming/About-Wargaming>.
17. Matthew B. Caffrey, Jr., “On Wargaming: How Wargames Have Shaped History and How They May Shape the Future,” *Naval War College Newport Papers*, No. 43, January 2019, p. 12.
18. An example of this view can be seen in the US Naval War College’s 2013 *War Gamers’ Handbook: A Guide for Professional War Gamers*. This handbook states that: “The WGD [(Wargaming Department)] uses the Perla (1990) definition, which describes war gaming as “a warfare model or simulation whose operation does not involve the activities of actual military forces, and whose sequence of events affects and is, in turn, affected by the decisions made by players representing the opposing sides” (Perla, 1990, p. 164). By doing so, this differentiates a war game from a training exercise, which uses real forces. The value of the war game is that decisions are not constrained by safety, rules of engagement (ROE), real-world territorial boundaries, or training objectives.” See *War Gamers’ Handbook: A Guide for Professional War Gamers*, ed. Shawn Burns, (Newport, RI: US Naval War College, 2013), p. 4.
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23. For one example, see Xu Sen, Luo Jinmu, and Zhang Qiang [许森, 罗金沐, 张强], “Chief of PLA Wargaming System: The Accurate Deduction of the US Military’s Attack on Iraq Shocks China” [解放军兵棋系统总师：美军攻伊准确推演震撼中方], *China Science Daily* [中国科学报], May 10, 2013, available at <http://webcache.googleusercontent.com/search?q=cache:s-nuQ-JAfiHYJ:mil.news.sina.com.cn/2013-05-10/1104724260.html+&cd=1&hl=en&ct=clnk&gl=pt&client=firefox-b-1-d>.
24. The authors have taken “对抗性训练” to be generally analogous to “对抗演练” in most contexts, and have often translated “对抗性训练” as “confrontation training.”
25. “Xi Jinping: Comprehensively strengthen actual combat military training, comprehensively improve training level and ability to win” [习近平：全面加强实战化军事训练 全面提高训练水平和打赢能力], *Xinhua* [新华], November 25, 2020, available at [http://www.xinhuanet dot com/politics/leaders/2020-11/25/c\\_1126786066.htm](http://www.xinhuanet dot com/politics/leaders/2020-11/25/c_1126786066.htm).

26. In addition to being tacked onto the titles of many jobs, organizations, publications, etc., involved in confrontation training, in Chinese media describing confrontation training, it is often the case that no 'activity term' ("confrontation training," "red-on-blue confrontation," etc.) is used but that the involvement of a blue force is mentioned instead to indicate what kind of activity is being discussed.
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28. James Mulvenon, "'True is False, False is True, Virtual is Reality, Reality is Virtual': Technology and Simulation in the Chinese Military Training Revolution," in *The "People" in the PLA: Recruitment, Training, and Education in China's Military*, ed. Roy Kamphausen, Andrew Scobell, and Travis Tanner (Carlisle, PA: US Army War College, September 2008), p. 49-90.
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30. Alexander Pantsov, *The Bolsheviks and the Chinese Revolution 1919-1927* (Honolulu, HI: University of Hawai'i Press, 2000), p. 166.
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166. For the set up date, see "China's first Blue Army gives PLA some bitter lessons," *People's Daily*, July 25, 2015, [http://www.xinhuanet.com/english/photo/2015-07/25/c\\_134445708.htm](http://www.xinhuanet.com/english/photo/2015-07/25/c_134445708.htm). For the retraining and operational dates, see Gary Li, "The Wolves of Zhurihe: China's OPFOR Comes of Age," *China Brief*, Vol. 15, Is. 4, February 20, 2015, 4.
167. "Xi to inspect troops at military parade to mark PLA's 90th birthday," *Xinhua*, July 30, 2017, [http://news.xinhuanet.com/english/2017-07/30/c\\_136483473.htm](http://news.xinhuanet.com/english/2017-07/30/c_136483473.htm).
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169. See also: Viola Zhou, "8 things to know about China's biggest army training base," *The South China Morning Post*, July 24, 2017, <https://www.scmp.com/news/china/diplomacy-defence/article/2103593/8-things-know-about-chinas-biggest-army-training-base>.
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172. Ni Wenxin [倪文鑫], "Actual Combat Training Must Focus on Tomorrow's Battlefield — What the Military Region Air Forces Training Made Realistic to Actual War Can Tell Us About Joint Training" [实战化训练必须聚焦明天的战场—军区空军实战化训练对联合训练的启示], *People's Front* [人民前线], October 25, 2013, 4.
173. Unpublished conference paper for the 2018 CAPS-RAND-NDU PLA Conference presented by Ian Burns McCaslin and Daniel W. Peck, "'50 Shades of Blue': Similarity and Diversity in PLA Confrontation Training and Blue Forces," p. 41-42.
174. Unpublished conference paper for the 2018 CAPS-RAND-NDU PLA Conference presented by Ian Burns McCaslin and Daniel W. Peck, "'50 Shades of Blue': Similarity and Diversity in PLA Confrontation Training and Blue Forces," p. 42-45.
175. "Commentator of the People's Liberation Army Daily: Keep an eye on strong opponents and grasp military training" [解放军报评论员: 紧盯强敌对手 大抓军事训练], *PLA Daily* [解放军报], January 3, 2020, <http://theory.people.com.cn/n1/2020/0103/c40531-31533848.html>.
176. This is an apparent reference to the US Army's famous Green Berets, who are known to train and lead foreign forces abroad. The choice of the Green Berets by the Chinese may also be an acknowledgement that the PLA's modern blue force program was sparked by the US military showing the PLA how to train better. See Zhao Feipeng, Ni Minzhi, Peng Shimin, Cheng Chuanjun [赵飞鹏, 倪敏芝, 彭世民, 程传军], "Our Adversary is the PLA — Unlocking the Mystery of the PLA's First Professional Simulated Enemy Unit" ["我们的对手是解放军"—揭秘解放军第一支专业化敌军模拟部队], *China Youth Daily* [中国青年报], September 23, 2005, [http://zqb.cyol.com/content/2005-09/23/content\\_1180710.htm](http://zqb.cyol.com/content/2005-09/23/content_1180710.htm).
177. Unpublished conference paper for the 2018 CAPS-RAND-NDU PLA Conference presented by Ian Burns McCaslin and Daniel W. Peck, "'50 Shades of Blue': Similarity and Diversity in PLA Confrontation Training and Blue Forces," 19-20.
178. For one example of this by the PLA Air Force, see Bai Zhanda [百战刀], "Who Does the Chinese Air Force's Imaginary Enemy Simulate, the J-20 Pilot's Shoulder Patch Reveals an Important Clue" [中国空军假想敌模拟谁歼20飞行员臂章透露重要线索], *Sina Military Affairs* [新浪军事], January 2, 2018, <http://mil.news.sina.com.cn/jssd/2018-01-02/doc-ifyqefvx0481434.shtml>. For one example of this by the PLA Air Force, see Keluoliaofu [科罗廖夫], "Indonesia Warplanes Flying with H-6 Series Accidentally Exposes China's Trump Card Unit" [印尼战机伴飞轰6系乌龙却意外曝光中国这支王牌部队], *Sina Military Affairs* [新浪军事], October 18, 2017, <https://mil.sina.com.cn/sd/2017-10-18/detail-ifymvuyt3427982.d.html?vt=4>.
179. While it is difficult to get an accurate figure for how many dedicated and semi-dedicated personnel, units, and bases are involved with blue force work in the PLA, there appears to be a significant number, though they are of varying quality.
180. For a detailed examination of blue forces across the services and branches of the PLA, see the unpublished conference paper for the 2018 CAPS-RAND-NDU PLA Conference presented by Ian Burns McCaslin and Daniel W. Peck, "'50 Shades of Blue': Similarity and Diversity in PLA Confrontation Training and Blue Forces," p. 47-125.
181. "English-Language News: How to Say 'Cyber Blue Force' in English" [新闻英语: “网络蓝军” 英语怎么说], *China Daily Online* [中国日报网], May 30, 2011, <http://edu.sina.com.cn/en/2011-05-30/114561053.shtml>. This was also widely reported in English at the time. Hannah Beech, "Meet China's Newest Soldiers: An Online Blue Army," *Time*, May 27, 2011, <https://world.time.com/2011/05/27/meet-chinas-newest-soldiers-an-online-blue-army/>.
182. Sometimes teachers are joined by their students in this role. Perhaps the best example of this force is the PLA Army's "Academic Blue Force" [Yuanxiao Lan Jun, 院校蓝军] at what is now called the Army Command College. See Hu Chunhua, Dai Feng, and Feng Guoxiong [胡春华, 代烽, 冯国雄], "Six Showdowns: What Has the Academic Blue Team Done?" [6次对决: “院校蓝军” 打出了什么], *PLA Daily* [解放军报], December 13, 2013, <http://mil.news.sina.com.cn/2013-12-13/0450754661.html>.
183. This can be seen with the PLA Navy's "Blue Force Brain" [Lan Jun Dano, 蓝军大脑] program. See the unpublished conference paper for the 2018 CAPS-RAND-NDU PLA Conference presented by Ian Burns McCaslin and Daniel W. Peck, "'50 Shades of Blue': Similarity and Diversity in PLA Confrontation Training and Blue Forces," p. 69-71, 91-92. This can be seen with the PLA Rocket Force's "blue force professor" [蓝军教授] program. See Xiao Pan, Han Lei, and Cao Fan [肖盼, 韩磊, 曹繁], "Wang Zhijun, Standing in the Classroom, Planning the Battlefield" [王志军: 站在课堂课“战场”], *Rocket Force Daily* [火箭兵报], January 9, 2018.
184. The US military, for instance, has notably long and even increasingly relied on civilian contractors and experts to support OPFOR. See Joseph Trevithick, "USAF Reveals Timelines And Basing Plans For Its Huge Adversary Support Contract," *The Drive*, June 6, 2018, <https://www.thedrive.com/the-war-zone/21363/usaf-reveals-timelines-and-basing-plans-for-its-huge-adversary-support-contract>.
185. Fan Jianghuai and Wu Yonghua [范江怀, 吴永华], "Blue Force: Not Seeking To Own But Seeking To Use — Observations From Interviews at a Navy Joint Training Base (Part I)" ["蓝军": 不求拥有但求所用——海军某联合训练基地采访见闻 (上)], *PLA Daily* [解放军报], July 9, 2018, 5.
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187. For instance, see Mario J. Hoffmann, “Modernizing the Army’s OPFOR program to become a near-peer sparring partner,” *US Army*, October 2, 2018, [https://www.army.mil/article/211842/modernizing\\_the\\_armys\\_opfor\\_program\\_to\\_become\\_a\\_near\\_peer\\_sparring\\_partner](https://www.army.mil/article/211842/modernizing_the_armys_opfor_program_to_become_a_near_peer_sparring_partner).
188. Even “culture” is being incorporated as a factor into the PLA’s increasingly realistic and complex training during peacetime. See Huang Zijuan and Yan Jiaqi [黄子娟、闫嘉琪], eds., “How to Practice the Way to Victory in Confrontation Training to Make the Scope of Exercises More Practical” [对抗演练如何练出制胜之道让演习范围更切实], *PLA Daily* [解放军报], July 12, 2016, <http://military.people.com.cn/n1/2016/0712/c1011-28546413.html>.
189. Shen Shu and Wang Yuanyuan [沈抒, 王元元], “Examination Venue? Battlefield! — An Eye-Witness Account of a Pre-graduation Joint Exercise at the Command Academy” [考场? 战场! — 直击指挥学院毕业联合演习], *People’s Navy* [人民海军], February 10, 2014, 4.
190. Liu Xin and Pan Xiaoyuan [刘鑫, 潘小员], “Improving the Joint Iron Fist Through Practice — A Base of the Southern Theater Navy Organizes and Conducts an Exercise in Defensive Operations in Its Area of Jurisdiction” [磨砺联合制敌的铁拳 — 南部战区海军某基地组织开展辖区防卫作战演练, 纪实], *People’s Navy* [人民海军], August 8, 2018, [http://www.xinhuanet.com/mil/2018-07/14/c\\_129913285.htm](http://www.xinhuanet.com/mil/2018-07/14/c_129913285.htm).
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217. Commercially available games focused on warfare have made significant leaps in complexity and scale, as well as in the dedication and innovation of those that play them. One example is EVE Online. See Mason Sansonia, "EVE Online Sets Record For Biggest PvP Battle in History," *Game Rant*, October 9, 2020, <https://gamerant.com/eve-online-record-biggest-pvp-battle-ever/>; "EVE Fanfest 2016 - Life as a Fleet Commander," *Eve Online*, May 3, 2016, <https://www.youtube.com/watch?v=ngzISL-jcTE>; "EVE Fanfest 2015: The Art of War in New Eden," *EVE Online*, March 27, 2015, <https://www.youtube.com/watch?v=vLAHCp2T4Po>.
218. For an example, see: "Maritime Commander's Red Team Handbook," *Navy Warfare Development Command*, 2011, [https://www.act.nato.int/images/stories/events/2011/cde/rr\\_navyhandbook.pdf](https://www.act.nato.int/images/stories/events/2011/cde/rr_navyhandbook.pdf).
219. For instance: "The Red Team Handbook," *TRADOC G-2 Operational Environment Enterprise*, 2019, [https://usacac.army.mil/sites/default/files/documents/ufmcs/The\\_Red\\_Team\\_Handbook.pdf](https://usacac.army.mil/sites/default/files/documents/ufmcs/The_Red_Team_Handbook.pdf).
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221. In recent years, the US OPFOR program has been relatively understaffed, even cutting dedicated OPFOR units. There has also been experimentation with and expansion of red forces that are privatized and of uncertain effectiveness. See Jamie Hunter, "Inside The Air Force's Elite Aggressor Program With One Of Its Top Pilots," *The Drive*, December 14, 2020, <https://www.thedrive.com/the-war-zone/37991/>
- playing-the-bad-guy-inside-the-air-forces-elite-aggressor-program-with-one-of-its-top-pilots; Tyler Rogoway, "USAF's Dubious Priorities Results In Axing Of F-15 Aggressor Squad," *Foxtrot Alpha*, September 14, 2014, <https://foxtrotalpha.jalopnik.com/usafs-dubious-priorities-results-in-axing-of-f-15-aggre-1633886869>; Joseph Trevithick, "USAF Reveals Timelines And Basing Plans For Its Huge Adversary Support Contract," *The Drive*, June 6, 2018, <https://www.thedrive.com/the-war-zone/21363/usaf-reveals-timelines-and-basing-plans-for-its-huge-adversary-support-contract>.
222. For example, in 2016, the 64th Aggressor Squadron at Nellis Air Force Base was allowed to use a paint scheme to help simulate China's J-20 fighter. See Tyler Rogoway, "Nellis AFB Wing Boss Talks To Us About His Novel Aggressor Paint Job Facebook Contest And More," *The Drive*, January 21, 2019, <https://www.thedrive.com/the-war-zone/26090/nellis-afb-wing-boss-talks-to-us-about-his-novel-aggressor-paint-job-facebook-contest-and-more>. In past years, there were some concerns from officers that went through training at OPFOR facilities, like those at Fort Irwin, whose requests to incorporate Chinese weapons and equipment into training (even those being used by terrorists against troops in the field) were strongly rebuffed as "aggressive," given that it might "antagonize" China by training against it, despite the fact that the PLA had been doing such training against the United States for decades. The US Army's OPFOR program started to discuss its intention to reorient its OPFOR program to focus on near-peer adversaries around 2018. See again: For instance, see Mario J. Hoffmann, "Modernizing the Army's OPFOR program to become a near-peer sparring partner," *US Army*, October 2, 2018, <https://www.army.mil/article/211842/modernizing-the-armys-opfor-program-to-become-a-near-peer-sparring-partner>.

