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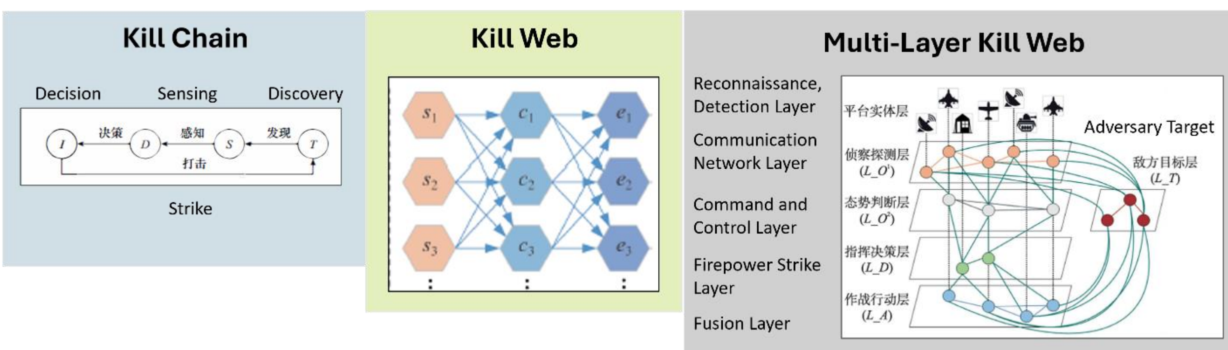
EXPLORING PRC RESEARCH ON KILL CHAINS AND KILL WEBS
HOW MIGHT IT HELP THE PLA?



A CNA Report

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ABBREVIATIONS

AI	artificial intelligence
AMS	(PRC) Academy of Military Sciences
C2	command and control
C4ISR	command, control, communications, computers, intelligence, surveillance, and reconnaissance
CAS	(PRC) Chinese Academy of Sciences
CASI	China Aerospace Studies Institute
CASIC	(PRC) China Aerospace Science and Industry Corporation
CETC	(PRC) China Electronics Technology Group Corporation
COA	course of action
DARPA	Defense Advanced Research Projects Agency
DME	digital mission engineering
DoW	Department of War
ISR	intelligence, surveillance, and reconnaissance
LEO	low Earth orbit
LLM	large language model
LOE	line of effort
NUDT	(PRC) National University of Defense Technology
PLA	People's Liberation Army
PRC	People's Republic of China
OODA	observe, orient, decide, act
USSF	US Space Force

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Executive Summary

Background

A key aspect of the evolution of modern warfare is the development of kill process constructs, such as kill chains, kill webs, or kill meshes. First articulated by U.S. Air Force General John Jumper, a *kill process* refers to the steps a military must take from locating a target to delivering an effect. Since the term was first articulated, militaries around the globe have engaged in efforts to reduce the time it takes to move "from sensor to effector" (or more colloquially, "from sensor to shooter") and to increase the flexibility and resilience of these processes.

Analysts from the People's Republic of China (PRC), many affiliated with China's military and national security apparatus, have closely observed the development of kill process constructs in the U.S. and assessed what this development might mean for China's military. These analysts also incorporate these constructs into discussion of Chinese military issues, such as People's Liberation Army (PLA) assessments of its operations, equipment, systems, and capabilities.

The threat from PRC kill processes to U.S. forces is described in the 2025 Department of War (DoW) *China Military Power* report and has been highlighted by leaders of the U.S. Space Force. Despite the threat PRC kill processes pose to U.S. forces, PRC-produced research on kill processes is underexamined by US-based scholars.

The purpose of this report is to examine research produced by analysts affiliated with China's military and national security apparatus discussing kill processes. The report will describe key themes, identify the main research lines of effort (LOEs), and explore what this research suggests about how far along the PRC and PLA are in conceptualizing, developing, and deploying kill processes in military operations.

Key terms

Kill chain: A sequence of steps that connects specific nodes (e.g., sensors, networks, weapon systems) to achieve a desired kinetic or nonkinetic effect on a target.

Kill web: A collection of multiple sequences of steps and nodes that provides multiple pathways to accomplish a desired kinetic or nonkinetic effect on a target.

Kill mesh: A collection of many potential pathways and diverse systems and nodes that requires algorithms to determine sequences to achieve outcomes. Kill meshes are more resilient than chains and webs, but their sequences may be less predictable.

Kill process: A CNA term used to refer collectively to kill chains, webs, and meshes.

FINDINGS

Examining PRC research

Research on kill process constructs appears to be a priority in the PRC and PLA. Researchers affiliated with China's military and national security apparatus are engaged in intense research efforts on kill processes. Over the course of our research, we identified a large and relatively recent dataset of PRC writing on kill processes and related concepts. Much of the research was undertaken by researchers associated with civilian government– or military-affiliated institutions. Moreover, almost half of the articles we identified indicated that the research received some level of civilian government or military funding.

PRC kill process–related research described in this dataset contains the following LOEs:

- **Building kill processes.** PRC researchers describe the fundamental building blocks and logic of kill processes, the types of kill sequences, and rules that must be followed. They also experiment with generating kill webs.
- **Modeling the nodes and systems involved in kill processes.** PRC analysts use mathematical modeling and network modeling techniques to improve the performance of kill webs.
- **Evaluating the capability of kill processes.** PRC researchers establish metrics to assess the validity, applicability, effectiveness, and performance of kill chains.
- **Simulating how kill processes perform.** PRC researchers use simulations to verify effectiveness, generate data, calibrate models, and test their research in scenarios.
- **Developing technologies to enable kill processes.** PRC researchers describe the development of some technologies that would enable connections between sensors, command units, weapons, and platforms to improve the PLA's kill processes.

Adopting a U.S. concept for a PRC problem set

PRC writers depict kill processes as U.S. constructs and argue that kill processes will shape future warfare. These authors emphasize the importance of kill processes in modern operations. Their research shows intention to adopt these constructs and apply them to PRC problem sets.

PRC writers closely follow the evolution of U.S. military thinking underlying kill process concepts. They also closely follow discussion of U.S. operational concepts, such as the U.S. Navy's Naval Integrated Fire Control-Counter Air, the Defense Advanced Research Projects Agency's Mosaic Warfare, and DoW's Joint All-Domain Command and Control.

PRC writings on kill processes treat the U.S. as an implied pacing threat. PRC analysts use U.S. military constructs and technologies as a reference point. Often, when PRC analysts describe what the PRC needs to develop, the desired capabilities are described relative to U.S. capabilities and include an implied requirement that the PRC be able to close its kill chain faster than the U.S. can close its own.

PRC views of kill processes and modern warfare

Kill process research resonates with PRC researchers in part because it aligns with and complements PLA views on the changing character of warfare that emphasize increasing levels of complexity, integration, artificial intelligence (AI), and autonomy.

- The PLA envisions warfare evolving through three stages (mechanization, informatization, and intelligentization).
- PLA strategists describe a shift from confrontation that formerly was platform centric to one that is system centric and involves system-on-system confrontation.
- The PLA's evolving doctrine emphasizes integrated joint operations, all-domain operations, and multidomain precision warfare while leveraging whole-of-nation resources.

Future kill webs are part of an intelligent, systems-focused approach to warfare. From PRC researchers' perspective, in addition to improvements to individual sensors, platforms, and equipment, this approach to warfare requires the following technological improvements:

- The ability to enable diverse connections across sensors, platforms, humans, and systems
- The ability to fuse disparate and multisource data
- The ability to accommodate the scope and scale of data collection and transmission
- The ability to process and analyze data in a way that supports decision-making and command and control (C2)
- The ability to intelligently generate future kill webs systems that have desired characteristics in terms of accuracy, capability, resiliency, and speed

In this context, kill process–related research serves an important function for PRC and PLA analysts. The PLA is facing system-wide challenges in preparing for future war. By combining the logic of kill process research with new methodologies and technologies, PLA researchers can move beyond narrowly focusing on the performance of any particular platform or sensor in a single domain, and can think holistically and systemically about how different nodes function together across domains and—in theory—across civilian and military systems to improve the PLA's ability to conduct intelligent warfare, joint operations, and system-on-system confrontation.

PRC researchers aspire to use enabling technologies such as AI, big data and cloud computing, communication, networking, commercial order management, and uncrewed platforms to develop future kill webs that are:

- Capable of aggregating capabilities
- Accurate (precise)
- Adaptable
- Complex
- Dynamic
- Effective (capable, reliant)
- Rapid (fast, quick, efficient)
- Resilient (self-healing)

- Cross-domain capable
- Distributed
- Redundant (robust)
- Self-organized

PRC researchers in this field identify challenges that China and the PLA must address and ways that they hope kill process research will mitigate these challenges. The following table summarizes these challenges and mitigation measures.

Challenge that justifies kill process research	How kill process research will mitigate weaknesses and challenges
Shortening kill process timelines	• Enabling advance planning and preparation • Informing procurement
Identifying key nodes	• Improving targeting of reconnaissance, communication, C2, and strike nodes, as well as time-sensitive targets
Optimizing C2	• Adjusting force deployment • Better allocating resources, tasks, and equipment • Improving C2 (e.g., providing ideas for process design, supporting operational planning, helping commanders and decision-makers incorporate intelligent decision-making solutions)
Coordinating operations across platforms	• Experimenting with how to integrate new platforms and new forces into operations • Improving interoperability, integrated operations, and crewed-uncrewed teaming

Source: CNA.

Progress toward adoption

When examining PRC kill process research, it is useful to think of the PRC adoption of kill processes as part of a three-phase process:

1. **Conceptualization.** During this phase, analysts are thinking about the concept of kill processes and how to incorporate them.
2. **Developing.** During this phase, the defense research and development (R&D) complex is engaged in developing concrete technologies and capabilities to enable kill processes.
3. **Deploying.** During this phase, the military would deploy and use kill processes in military operations.

Using this construct as a lens to view our data, we make the following observations:

The bulk of our data captures PRC analysts' efforts to conceptualize kill processes. This is not surprising for two reasons: (1) conceptualization efforts are captured most easily in academic journals and tend to be the type of content that these journals publish, and (2) conceptualization efforts represent thoughts under consideration rather than policy decisions. Thus, the content is less sensitive and therefore more likely to be publicly accessible.

Within the PRC defense R&D complex, some evidence exists of PRC pursuit, development, and patenting of technologies (e.g., hardware, software, cloud-based capabilities) needed to actualize these capabilities.

Currently, our dataset of PRC-published kill process–related research does not contain detailed discussion portraying that China's military has operationalized kill webs. Other than a brief Ministry of National Defense statement about optimizing kill chains in recent PLA exercises, the closest reflections of operationalization we see in PRC-published research are discussions about simulations, which is also not surprising. However, more in-depth discussions of how kill processes are operationalized are likely highly sensitive and thus less likely to appear in PRC-produced publications.

Statements in the 2025 DoW *China Military Power* report and by leaders for the U.S. Space Force suggest that PRC publications do not fully represent China's progress in operationalizing kill processes. PRC kill process research suggests that aspirations in the PRC defense R&D complex are much greater than are current PLA demonstrations of capabilities. PRC researchers are attempting to use the U.S. kill process construct to help the PLA assess its operations, equipment, systems, and capabilities; identify weaknesses and inefficiencies; and identify how to make improvements in a wide range of areas (e.g., acquisition of new technology, platforms, and sensors or changes in C2).

Conclusion

PRC and PLA research on kill processes has the potential to lead to changes in the short and long term:

- In the short term, how the PLA uses the results of kill process research may inform planning, processes, and decisions that allow the Chinese military to adjust its practices for procurement, deployment of forces, allocation of resources, and C2, for example.
- In the long term, PRC efforts to construct sensor and communication networks (e.g., for civilian emergency response in times of peace or national defense mobilization in conflict) and fuse civilian and military resources and capabilities in support of national security may serve as a foundation to realize kill process capabilities.
- However, PRC writings contain descriptions of challenges related to the development and operationalization of kill processes, and it is unclear how difficult these challenges will be to address.

For U.S. analysts, this may be a valuable time to monitor PRC and PLA writing about kill processes to see how the discussion evolves, to watch for the types of data that emerge about kill processes, and to prepare to identify improvements in PLA operations that result from the PLA adopting and innovating this construct.

1.0 Introduction

A key aspect of the evolution of modern warfare is the development of kill process constructs, such as kill chains, kill webs, or kill meshes. First articulated by U.S. Air Force General John Jumper, a *kill process* refers to the steps a military must take from locating a target to delivering an effect on that target.[1] In the years since that first articulation, militaries around the globe have tried to reduce the time it takes to move "from sensor to effector" (or more colloquially, "from sensor to shooter") and to increase the flexibility and resilience of these processes.

Writings from the People's Republic of China (PRC) and the People's Liberation Army (PLA) depict kill processes as U.S. constructs that will shape all future warfare.[2] These writings express a consensus view that to be prepared to meet the needs of future intelligent, system-on-system confrontations with the U.S. as the primary adversary, the PRC needs to understand, adopt, adapt to, and get ahead of U.S. thinking on kill webs. PRC analysts demonstrate an intent to use kill process concepts as a lens through which they can assess and improve PLA operations, equipment, and systems; prepare for future intelligent, system-on-system confrontations; and counter U.S. kill processes. Recently, the analysts have sought to use these constructs to improve defensive operations in a counter-intervention scenario. They focus on several types of operations, including the following: improving naval and maritime operations, coordinating air-ground operations, conducting air defense operations (notably missile defense and countering uncrewed systems), and integrating space-based sensors with operations. However, many of the improvements discussed could also improve the PLA's long-range strike capabilities and its command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) infrastructure.

1.1 Background

The threat from PRC kill processes to U.S. forces is described in the 2025 Department of War (DoW) *China Military Power* report and has been highlighted by leaders of the U.S. Space Force (USSF). According to that 2025 report, China's improving intelligence, surveillance, and reconnaissance (ISR) satellite capabilities and growing number of satellites provide targeting support for long-range kill chains by allowing China to monitor U.S. and allied military assets and activities throughout the Pacific.[3] Similarly, recent statements by leaders of the USSF have highlighted China's progress from kill chains to kill webs to kill meshes; the leaders have also highlighted the threat this progress poses for U.S. forces.

The Threat from PRC Kill Processes

During the past two years, leaders of the USSF have highlighted China's progress advancing its kill processes and the threat that this progress poses for U.S. forces:

- **October 2024.** Brigadier General Anthony Mastalir, then commander of USSF Indo-Pacific: "China has invested heavily in its long-range strike capabilities, and the U.S. Space Force is working to identify the vulnerabilities in China's kill chains should conflict arise....Understanding how those kill chains are formed and how the PRC closes a kill chain to generate firepower beyond the second island chain with accuracy, with precision, with lethality, is the first step in learning how to break that kill chain."[4]
- **March 2025.** Vice Chief of Space Operations General Michael Guetlein: "The Chinese ISR capabilities are becoming very capable. They have gone from what we used to call a 'Kill Chain' to a 'Kill Mesh.'"[5]
- **July 2025.** General B. Chance Saltzman, Chief of Space Operations: The PLA "has fielded satellite-enabled, space-based targeting of terrestrial forces. This kill web has extended the range and accuracy of PLA weapons to hold U.S. forces at risk." General Saltzman also warned that the PRC's kill web is a critical concern and that the USSF would have the difficult task of defeating this kill web should the U.S. and China go to war.[6]

Despite the threat the PRC kill process poses to U.S. forces, PRC-produced research on kill processes is underexamined by US-based scholars. We found a few articles that provide a superficial examination of one or two pieces of PRC-produced research but no systematic analysis of the larger body of literature.[7] This report seeks to fill part of this gap.

1.2 Purpose

The purpose of this report is to examine the growing body of PRC-produced research on kill processes. The report is divided into the following sections:

- Section 2.0 provides background about how kill process research aligns with and complements evolving PLA concepts of future warfare.
- Section 3.0 describes the vision that PRC and PLA analysts articulate for future kill processes, including how they will evolve, what characteristics they will possess, and what technological enablers will be required.
- Section 4.0 examines reasons PRC researchers think kill process research is important.
- Section 5.0 highlights the PRC's prioritization of kill process research.
- Section 6.0 discusses the multiple LOEs in PRC kill process–related research and development (R&D).
- Section 7.0 assesses how far PRC research efforts on kill processes have advanced in terms of conceptualizing (i.e., thinking about the concept and how to incorporate it), developing (i.e., developing concrete technologies and capabilities to enable it),

and deploying (i.e., operationalizing and using) these processes in military operations.

1.3 Definitions

No official definitions for "kill chain," "kill web," or "kill mesh" appear in the DoW's joint dictionary of military terms.[8] Nonetheless, the terms are widely used and understood within the U.S. military. Based on prior research, The CNA Corporation (CNA) uses the following definitions:

- **Kill chain:** A sequence of steps that connect specific nodes (e.g., sensors, networks, weapon systems) to achieve a desired kinetic or nonkinetic effect on a target. Often, each node connects to only one other node. As a result, the chains can be brittle; if one node breaks, the entire chain breaks.
- **Kill web:** A collection of multiple sequences of steps and nodes to achieve a desired kinetic or nonkinetic effect on a target. In a kill web, one node can connect to a handful of nodes, which provides multiple pathways to accomplish an engagement. Compared to a kill chain, it is inherently more resilient.
- **Kill mesh:** A collection of large numbers of potential pathways using a diverse array of systems or nodes. Because of the large numbers of systems or nodes involved, algorithms are required to determine how to make outcomes possible. Kill meshes are more resilient than both chains and webs; however, the sequence through which outcomes are achieved may be less predictable.[9]

1.4 Data

This project leverages CNA's expertise in Chinese language research and analysis. CNA gathered and examined publicly available data published in Chinese about kill processes between 2020 and approximately May 2025. These data include the following types:

- Approximately 85 scientific, technical, and military journal articles from publications that focus on topics such as aerospace, defense, engineering, systems, and technology
- Approximately 25 newspaper articles
- Approximately 35 patents that have been filed, granted, or are pending for PRC authors and institutions (most appeared between 2020 and 2025)

2.0 Kill Process Research Aligns with Evolving PLA Concepts of Future War

Kill process research resonates with PRC researchers because it aligns with and complements evolving PLA concepts of war, confrontation, and doctrine, including the following:

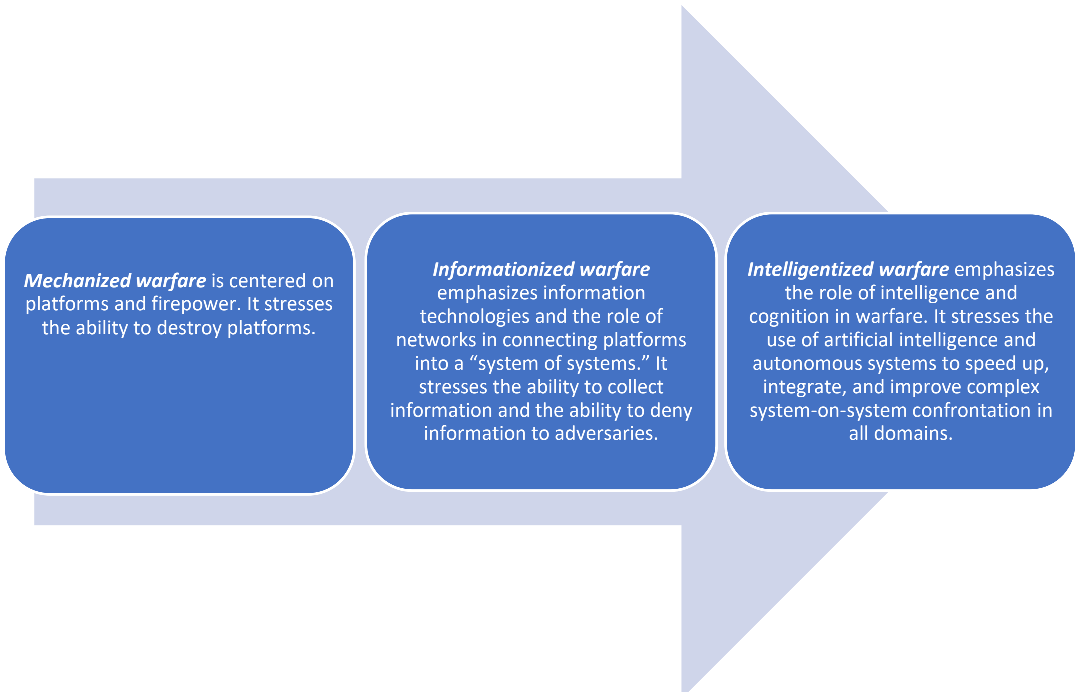
- The PLA vision for the evolution of warfare that progresses through three stages (mechanization, informatization, and intelligentization)
- The PLA concept of system-on-system confrontation
- The PLA's evolving doctrine, geared toward joint operations, multidomain battlespaces, information-driven and precision-focused combat, and the use of whole-of-nation resources

In this context, kill process–related research serves an important function for PRC and PLA analysts. Rather than focusing narrowly on the performance of any particular platform or sensor in a single domain, it provides them with a tool for thinking holistically about how different nodes function together across domains and—in theory—across civilian and military systems to improve the PLA's ability to conduct intelligent warfare, joint operations, and system-on-system confrontation.

2.1 Kill process research aligns with PLA vision of three stages of warfare

At the 20th Communist Party of China National Congress in October 2022, Chairman Xi Jinping described a vision for the evolution of warfare that involves a progression through three stages: "mechanization" or "mechanized war" (从机械化战争), "informatization" or "informationized warfare" (信息化战争), and "intelligentization" or "intelligentized warfare" (智能化战争).[10] This was not the first time these terms and concepts had been mentioned in an official capacity (e.g., PRC national defense white papers in 2015 and 2019 had also hinted at or referred to these stages), but the distinctions between them, and the concept of intelligentization in particular, have evolved quickly during the past decade.[11] Figure 1 provides basic descriptions of these stages.

Figure 1. PRC distinctions across mechanized, informationized, and intelligentized warfare



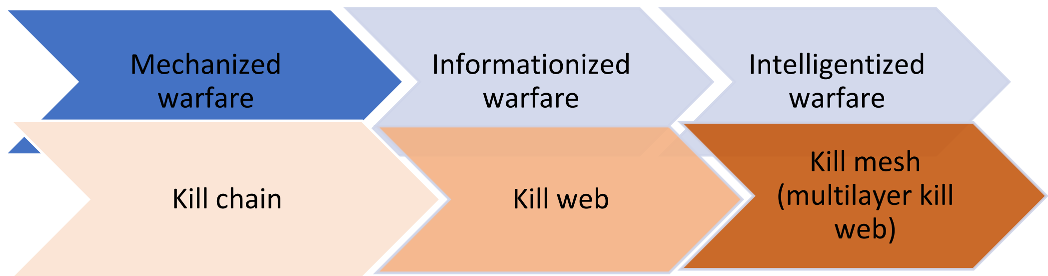
Source: CNA; Kevin Pollpeter, Amanda Kerrigan, and Andy Ilachinski, *The PLA and Intelligent Warfare: A Preliminary Analysis*, CNA, CRM-2021-U-030806-Final, 2021, https://www.cna.org/reports/2021/10/The-PLA-and-Intelligent-Warfare-A-Preliminary-Analysis.pdf; Xinhua News Agency, "Study the 'Decision' Daily Questions and Answers | How to Understand the Construction of a Modern Management System for Weapons and Equipment (学习《决定》每日问答 | 如何理解构建武器装备现代化管理体系)," People's Republic of China Government website, Nov. 11, 2024, https://www.gov.cn/zhengce/202411/content_6986137.htm; Liu Yangyue (刘杨钺) et al., "Ideological Front: Demand Combat Power from Technological Innovation (思想战线丨向科技创新要战斗力)," PLA Daily (解放军报) article posted on the Ministry of National Defense (国防部) website, June 13, 2024, http://www.mod.gov.cn/gfbw/jmsd/16315563.html.

PRC kill process researchers cite this evolution in positioning the significance of their research. They also frame these stages of warfare as consistent with thinking on the evolution of kill processes.[12] These distinctions are important in understanding how kill process–related research can align with these stages of warfare:

- The concept of kill chain (i.e., a single sequence) aligns with the stage of mechanized warfare.
- The concept of a kill web (i.e., a collection of sequences across sensors, networks, and platforms) aligns with the stage of informationized warfare.
- The concept of a kill mesh (in unofficial PLA parlance, a multilayer or hypernet kill web) aligns with intelligentized warfare.

Figure 2 offers a visual representation of these parallels.

Figure 2. Kill process alignment with PRC stages of warfare



Source: CNA.

In some cases, PRC researchers frame the changes in the evolution of warfare in terms of the contrast between earlier 21st-century wars and future wars, but the emphasis on the need to transition from kill chains to kill webs and kill meshes is consistent. PRC analysts describe earlier 21st-century wars as having been asymmetric (i.e., with a clear gap between adversaries) and low intensity, involving one or multiple domains, leveraging point-to-point strikes, and having strike windows that take hours. In contrast, future warfare, according to these analysts, will be marked by the following characteristics: complex system confrontation between peer and near-peer adversaries; high degrees of intensity, uncertainty, and dynamism; all-domain or cross-domain operations; and highly time-sensitive, rapid strikes. [13] PRC researchers use kill process research to help prepare for future war.

2.2 Kill process research resonates with the PRC concept of system confrontation

When PRC writers study kill processes, another way that they describe the significance of their research is how it relates to the transition from wars that were confrontations between platforms or networks to wars that are a confrontation between systems, emphasizing system- on-system confrontation.[14] An author affiliated with a PRC laboratory focused on complex aircraft system simulation describes this change from the perspectives of platform-centric war (a method of combat based on the platform's own resources), network-centric war (a method of combat that relies on the network to connect various distributed platforms to achieve information sharing and combat coordination), and system-centric war (a method of combat that relies on a reliable combat system to flexibly and responsively carry out autonomous and immediate killing, effectively destroy the enemy's combat system, and achieve combat objectives, which is done not by killing living forces on a large scale but by destroying the system through the application of kill chains and networks).[15]

A PRC article by authors associated with the National University of Defense Technology (NUDT) College of Systems Engineering (国防科技大学系统工程学院) expands on this by defining the term "system confrontation" and explaining the role of kill processes in it. According to the authors, system confrontation (体系对抗) is "large-scale joint operations between two mutually hostile, massive operational systems" in which the objective is to disrupt the adversary's operational system and preserve one's own. The authors stated that the overall operational capability of either side is a combination of the capabilities of nodes (perception, command, communication) in the kill process, the behaviors of the nodes, and the reaction cycle or length in the process. Thus, the authors emphasize the importance of thinking about the kill chain and the operational system as a large-scale, complex, heterogeneous network.[16]

2.3 Kill process research aligns with evolving PLA doctrine

The PRC body of research on kill processes is aligned with key aspects of the PLA's evolving military doctrine. This alignment is not directly stated in the research, but it is implied in how the relevance of the work is described. Several key milestones in evolving PLA doctrine have preceded a steep increase in PRC kill process research, including the following:

> In December 2025, in reflecting about PLA exercises over the course of the year, a Ministry of National Defense spokesperson noted the PLA's emphasis on optimizing kill chains, promoting cross-domain integration of forces, and honing the capabilities of combat systems-of-systems.[17]

- **2020.** As noted in prior CNA research, on November 13, 2020, China's official Xinhua News Agency announced that Beijing had issued the *Guidelines on Joint Operations of the Chinese People's Liberation Army (Trial)*.[18] According to a Ministry of National Defense spokesperson, the guidelines are a foundational document that serves as the "capstone" of the PLA's "combat doctrine system."[19] The content of the guidelines is not public; however, it is designed to provide the PLA with a force-wide common approach to the PLA's current conception of modern warfare.[20]
- **2021.** According to the 2025 DoW *China Military Power* report, in 2021, PLA writings began to contain discussions of multidomain precision warfare (MDPW) as a new "core operational concept," which represents an evolution in PLA thinking about potential future conflict with the US. Discussions of MDPW coincide with broader research about the role operational concepts play in solving operational problems, guiding future force design, and connecting strategic military guidance with military doctrine.[21]
- **2022.** According to the same 2025 DoW report, in 2022, the PLA began revising the military strategic guidelines (军事战略方针), which the Central Military Commission issues to set general principles and concepts for the use of force in

> support of Beijing strategic objectives. The report states that the revisions may stem from a renewed PLA focus on the trend of intelligentization and great power competition with the US. The report notes that the revisions are probably intended to guide the PLA to respond to conflicts through whole-of-nation mobilization, involving a clash of national systems, an integration of civilian and military power, and war unfolding in all domains.[22]

With these developments in mind, the data suggest that the PRC and PLA view kill processes and related research as an important way to improve the PLA's ability to implement these guidelines and execute integrated joint operations, all-domain operations, and multidomain precision warfare while leveraging whole-of-nation resources.

During the past five years, PLA officers have emphasized the importance of streamlining the command chain, the kill chain, and the support chain to improve China's ability to conduct future warfare, optimize joint operations, and improve strategic deterrence. Table 1 shows several examples of this emphasis that include almost identical language; the examples are provided in the context of quotes from Xi Jinping or in discussions of the significance of the 20th National Congress of the Communist Party of China or the PLA's centenary goals. These commonalities suggest that these individuals may be drawing on more formal directives in how they frame the need to focus on streamlining the kill chain in the context of joint operations.

Table 1. Examples of statements by active duty members of the PLA on the need to streamline kill chains

Speaker	Reference to Kill Processes
Shen Zhihua, a Major General and Director of the Academy of Military Sciences' Military Political Work Institute	To ensure the PLA's ability to fight and win wars in informatized and intelligent warfare, Shen argues that the PLA needs to "optimize the joint operations command system and focus on streamlining the command chain, the kill chain, and the support chain."
Li Yiguo, PLA Air Force Shijiazhuang Flight Academy	Directly following a quote by Xi Jinping, Li states that build a high-level strategic deterrence and joint operations system, officers and soldiers in the armed forces should focus on streamlining the command chain, the kill chain, and the support chain.
Zhang Wenjie, Professor and Doctoral Supervisor, National Defense University's National Security College	Like Li, Zhang states that to build a high-level strategic deterrence and joint operations system, the PLA must streamline the command chain, the kill chain, and the support chain.
Wang Shijie, Party Secretary and Political Commissar of the Beijing Armed Police Corps	Wang claims that to adapt to modern and high-end warfare and improve integrated joint operational capabilities, the PRC needs to address bottlenecks in the command chain, the intelligence chain, the kill chain, and the support chain.

Source: CNA; Shen Zhihua (沈志华), "Accelerate the Building of the People's Liberation Army into a World-Class Military (加快把人民军队建成世界一流军队)," *Study Times* (学习时报), Chinese Communist Party News (中国共产党新闻网), Nov. 11, 2022, accessed Mar. 4, 2026, http://dangjian.people.com.cn/n1/2022/1111/c117092-32563928.html; Li Yiguo (李贻国), "Remembering the Great Victory of the War of Resistance Against Japan and Forging a Heroic People's Army: Upholding the Integrated Development of Combat, Construction, and Preparedness to Promote High Quality Development (铭记抗战伟大胜利、锻造英雄人民军队：坚持战建备一体 推进高质量发展)," China Military Online-PLA Daily (中国军网-解放军报), Aug. 25, 2025, accessed Mar. 4, 2026, http://www.81.cn/yw_208727/16404665.html; Zhang Wenjie (张文杰), "Speaker's Manuscript: From Gutian to Yunrang, How National Defense Modernization Supports National Rejuvenation (宣讲家文稿：从古田到云壤 看国防现代化如何托举民族复兴)," Sohu, Jun. 25, 2025, accessed Mar. 4, 2026, https://www.sohu.com/a/907381289_114882; Wang Shijie (王世杰), "Strengthen the Building of Party Organizations in the Military and Win the Decisive Battle to Achieve the Centenary Goal of the People's Liberation Army（切实加强军队党组织建设 打好实现建军一百年奋斗目标攻坚战）," *Party Building* (党建), Apr. 1, 2025, accessed Mar. 4, 2026, http://www.dangjian.cn/djzz/2025/04/01/detail_202503317814727.html.

In addition, when PRC researchers write about kill processes, they emphasize the importance and centrality of kill processes in modern operations and strategy and in preparing for the changes in future warfare in ways that imply a connection to this evolution. For example, in an article published in a journal sponsored by the China Ship Research and Design Center (中国舰船研究设计中心, a national defense research institution engaged in ship research and design in the PRC), the author claims that kill processes have become key elements in modern military strategy because they enable an efficient, precise, and rapid operational approach in an international security environment beset with unprecedented challenges due to complex and unpredictable environments as well as evolutions in technologies used in war (e.g., uncrewed systems).[23]

Similarly, PRC authors associated with military or national defense research institutions (e.g., NUDT, the Information Engineering University) have described kill processes as important indicators of the operational capability,[24] the core of the joint operations system,[25] and the core means of generating operational effectiveness and achieving the capability to conduct time-sensitive strikes on high-value targets.[26]

3.0 PRC Analysts Articulate a Vision for Future Kill Processes

When PRC researchers articulate a vision for future kill processes, they focus on describing the evolution of kill processes and identifying the characteristics and technologies that they hope future PLA kill processes will possess. To date, much of this writing reflects U.S. descriptions of the evolution of kill processes, but PRC writers are beginning to adjust and define kill processes for the PRC problem set.

3.1 PRC writers track the evolution of terms associated with kill processes

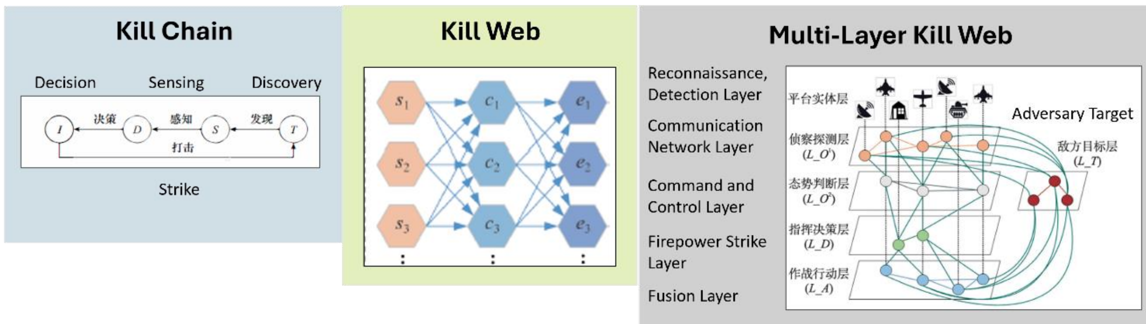
PRC researchers depict kill processes as having evolved through several stages of complexity that mostly mirror U.S. concepts. PRC writers have used very similar terminology to that used by U.S. researchers for "kill chains" (杀伤链) and "kill webs" (杀伤网), but more variation has appeared in how they have translated terms akin to "kill mesh," which was described in approximately 20 different articles using terms such as "multi-layer kill web" (多层杀伤网), "cross-domain kill web" (跨域杀伤网), "hypernetwork kill web" (超网络杀伤网), "cloud kill chain" (云杀伤链), and "cloud-edge collaborate kill web" (云边协同杀伤网).[27] The body of PRC research on kill mesh–like concepts is exploratory and evolving.[28]

At the time of writing, we have not observed a formal definition of these terms for PRC researchers. Rather, the descriptions PRC writers have used draw on U.S. descriptions of kill chains, webs, and cross-domain kill webs.

Figure 3 is a compilation of several examples of PRC researchers' illustrations showing the progression from kill chain to kill web to multi-layer kill web. Placing these depictions side by side helps illustrate that future kill processes are differentiated from kill chains by the following characteristics:

- Increased number and heterogeneity of nodes
- Increased number and types of connections between nodes
- Ability to leverage platforms and sensors in multiple domains
- Ability to target an adversary node via multiple paths
- Differentiation between types of nodes performing different functions

Figure 3. PRC depictions of a kill chain, a kill web, and a multilayer kill web



Sources: CNA; Wang Yaozu (王耀祖), Shang Bolin (尚柏林), Song Bifeng (宋笔锋), Li Pengfei (李鹏飞), Ke Erqin (科尔沁). "Identification Method of Key Nodes in Operational System-of-Systems Network Based Kill Chains (基于杀伤链的作战体系网络关键节点识别方法)." *Systems Engineering and Electronics* (系统工程与电子技术) 45, no. 3 (Mar. 2023): 736-744; Ruan Kaizhi (阮开智), Sun Xue'an (孙学安), Tong Yun (仝云), Liang Shuo (梁硕), Xu Tianyang (徐天洋). "Concept for Future Intelligent Kill Webs (未来智能杀伤网构想)." *Air & Space Defense* (空天防御) 7, no. 3 (2024): 27-33; Qin Changjiang (秦长江), Wu Keyu (吴克宇), Cheng Qing (成清), Huang Jincai (黄金才). "Node Importance Evaluation in Dynamic System Based on Kill-Web Contribution Rate (基于杀伤网贡献率的动态体系节点重要度评估)." *Systems Engineering and Electronics* (系统工程与电子技术) 45, no. 6 (Jun. 2023): 1732-1742.

Notes: In the kill chain illustration, the sequence begins on the right-hand side with the target and then proceeds through stages and nodes associated with discovery, sensing, decision, and finally strike, which is depicted as a line underneath the nodes going from left to right back to the target to close the loop. In the kill web illustration, the sequence goes left to right, but the graphic does not portray the target; it only includes the PRC nodes for detection, command, and strike.

3.2 PRC writers describe the characteristics that they envision future kill processes will possess

According to PRC writers, future kill processes will also be differentiated from kill chains by unique capabilities. To anyone familiar with U.S. thinking, the terms PRC writers use to describe characteristics of future kill processes will look familiar. In many cases, these terms appear to have been associated initially with U.S. concepts but are being used in writing about the development of PRC kill webs as well. For the most part, these desired characteristics include the following:

> *Future PRC kill processes need to have the following traits:*
>
> - Aggregated capabilities
> - Accurate (precise)
> - Adaptable
> - Complex
> - Cross-domain capable
> - Distributed
> - Dynamic
> - Effective (capable, reliable)
> - Rapid (fast, quick, efficient)
> - Resilient (self-healing, anti-destructive, anti-damage)
> - Redundant (robust)
> - Self-organized

- **Capable of aggregating capabilities:** Accommodates a large-scale increase in the number of key nodes (e.g., uncrewed platforms that rely on clustering or swarming), improves interoperability across the kill chain, improves scalability of the kill chain, and connects kill chains across services[29]
- **Accurate:** Includes reconnaissance, command and control (C2), and strike accuracy[30]
- **Adaptable:** Employs flexible decision-making when faced with the task of building a kill chain rather than being rigid and inflexible; produces kill sequences for several targets that are not unique and fixed[31]
- **Complex:** Involves many potential kill links from sensors (e.g., detection and perception nodes) to shooters (i.e., firepower strike nodes) in the system; enables the network information system to build kill loops for various strike targets but also makes the entire system complex and difficult to control[32]
- **Cross-domain capable:** Through cross-domain collaboration, flexibly organizes multidomain heterogeneous resources, dynamically generates operational capabilities with confrontation advantages, and achieves operational objectives[33]
- **Distributed:** Involves forces, capabilities, and systems distributed over a wide area (e.g., shore-base, undersea, far sea, near the enemy's bases, surface, air, space) to enable short-range and long-range activities[34]

- **Dynamic:** Can reconfigure and reconstruct according to the battlefield situation[35]
- **Effective (capable, reliable):** Is as reliable, capable, and survivable as possible[36]
- **Rapid (fast, quick, efficient):** Needs to be faster than the opponent's kill processes because the kill chain construction time and kill closure time are important[37]
- **Resilient (self-healing, anti-destructive, anti-damage):** Operates normally after being attacked and has "self-healing" ability[38]
- **Redundant (robust):** Has multiple kill chains that can complete the task[39]
- **Self-organized:** Optimally allocates, organizes, and coordinates resources[40]

The two characteristics most frequently emphasized by PLA researchers are that a kill web must be capable (i.e., destructive and lethal) and fast (in particular, faster than the opponent's).

3.3 PRC WRITERS DESCRIBE TECHNOLOGICAL ENABLERS FOR FUTURE KILL WEBS

According to PRC researchers, new technologies are required to accelerate, improve, and optimize the capabilities and performance of the kill process. PRC writers draw inspiration for these new technologies from developments in U.S. technologies that focus on what needs to be done. PRC writings on this topic treat the U.S. as an implied pacing threat and U.S. technologies as a reference point; PRC analysts describe what the PRC needs to develop in relation to U.S. capabilities, and they argue that the PRC must be able to close its kill chain faster than the U.S. can close its own.

The U.S. technologies highlighted in PRC technical journals demonstrate that AI technologies and technologies that enable information collection, processing, analysis, decision-making, and control attract PRC attention. Analysts also show interest in the use of commercial order management technologies and uncrewed platforms.

Future kill webs are part of a systems-focused approach to warfare, and although these technologies require improvements to individual sensors, platforms, and equipment, from PRC researchers' perspective, moving toward an integrated system-of-systems approach requires the following network improvements:

- The ability to enable diverse connections across sensors, platforms, humans, and systems
- The ability to fuse disparate and multisource data
- The ability to accommodate the scope and scale of the collection and transmission of data
- The ability to process and analyze data in a way that supports decision-making and C2
- The ability to intelligently generate future kill web systems that have desired characteristics in terms of accuracy, capability, resiliency, and speed

PRC researchers describe five big categories of technologies as integral to the realization of future kill webs: (1) AI, (2) big data and cloud computing, (3) communication and networking, (4) commercial order management and digital engineering technologies, and (5) uncrewed platforms.

PRC researchers agree that the PLA needs to use AI to process and analyze data to support decision-making and C2 for kill processes, and they suggest that AI will be used in several ways, including the following:

- To process and analyze multisource data and produce high-quality output in a fraction of the time that it takes conventional algorithms, and with huge gains in accuracy (aiming for a level of accuracy for each pixel rather than the entire image)[41]
- To train machines with logical analysis capabilities, give full play to the speed and rational advantages of machines, and provide situation assessments, suggestions, and even decision-making services[42]
- To leverage human experience and machine learning (including a deep operational knowledge base, deep reinforcement learning technology, and massive amounts of data obtained through operational exercises and sample generation, to give one example) that will be key to generating future intelligent kill webs[43]

PRC researchers identify the need for big data and cloud computing technologies to fuse multisource data in the context of executing kill processes. Specifically, they suggest that these technologies are needed for the following reasons:

- To aggregate, integrate, and process multisource data, as well as distributed data, to command information systems and kill nets[44]
- To provide the communication, computing, storage, and other infrastructure required to support the construction of the kill web[45]
- To help manage the heterogeneity of data resources generated by multidomain operational equipment and the differences in data scale and quality, and to help with cleaning, classification, storage and maintenance of various types of data to provide data support for decision-making at different levels[46]
- To integrate and optimize the kill chain systems, projects, and portfolios[47]

PRC researchers agree that communication and networking technologies that enable diverse connections across sensors, platforms, humans, and systems are crucial for kill processes. They mention the following needs:

- A secure and reliable communication network that connects all kinds of operational resources to build a cross-domain kill web[48]
- A way to unify sensor networks to form a three-dimensional reconnaissance network[49]
- Advanced data links to transmit information in real time across sensor platforms, weapon platforms and C2 systems[50]

- A distributed information processing system to conduct multisensor intelligence fusion[51]
- A way to share information across the network[52]
- A way to use blockchain to adopt a point-to-point message sending mechanism to propagate messages to authenticated nodes within seconds[53]

PRC researchers are interested in applying mission engineering, resource scheduling technologies, and commercial order management models to assign tasks and match resources. Examples include the following:

- Digital mission engineering (DME) and a software control system to match situations to tasks, tasks to capabilities, and capabilities to equipment functions[54]
- Optimized and dynamically scheduled crewed and uncrewed operational resources[55]
- Cloud resource query services to instantly determine the status and locations of various reconnaissance, strike, command, support and other platforms that meet the task requirements and automatically match them to optimize resource use[56]

PRC researchers emphasize the role that uncrewed platforms will play in kill processes. They describe uncrewed platforms as a cost-effective way to deploy large numbers of sensors or strike platforms that can cover wide areas, respond quickly, increase autonomy, and reduce casualties and damage to larger, more expensive platforms.[57]

4.0 PRC Writers Describe How Kill Process Research Will Help the PLA

PRC and PLA researchers are using kill process–related research to help the PLA identify the challenges, problems, and weaknesses it faces in joint and multidomain operations. The researchers are also investigating whether PRC kill web research can help mitigate these challenges (Table 2).

Table 2. Ways research on kill processes can help the PLA

Challenge that justifies kill process research	How kill process research will mitigate weaknesses and challenges
Shortening kill process timelines	• Improving advance planning and preparation • Informing procurement
Identifying key nodes	• Improving targeting (including time-sensitive targets and multiple targets)
Optimizing C2	• Adjusting force deployment • Better allocating resources • Improving C2 (e.g., providing ideas for process design, supporting operational planning, helping commanders incorporate intelligent decision-making solutions)
Coordinating operations across platforms	• Experimenting with how to integrate new platforms and new forces into operations • Improving interoperability and coordinated operations

Source: CNA.

When put together, the kinds of challenges and weaknesses that PRC researchers seek to address in their work suggest that they perceive difficulties across a broad range of issues. Together, these two lists—one of challenges and one of potential improvements—provide insight into how PRC and PLA researchers envision their research improving PLA capabilities. As we discuss in the following subsections, PRC researchers appear to think that using kill processes can mitigate these challenges.

4.1 Shortening kill process timelines

Several articles highlighted problems associated with kill process timelines, including shortening the time it took to construct a kill chain,[58] shortening the time to close a kill chain from discovery to engagement,[59] and shortening the time needed to conduct time-sensitive strikes.[60] Researchers associated with the Academy of Military Sciences (AMS) cite the need to be able to construct a kill chain for time-sensitive targets (e.g., drones, crewed and uncrewed missile boats, mobile missile launchers, mobile long-range rocket launchers, and mobile radars) that may arrive in large numbers, appear in a distributed fashion on modern battlefields, and leave little reaction time for positioning, planning, decision-making, and firepower.[61]

4.2 Improve advance planning and preparation

According to PRC researchers, kill chain and kill web analysis can help in planning maneuvers and operations. This analysis can include generating plans, creating target lists, or informing pre-positioning and pre-deployment of forces—such as undersea forces, uncrewed early warning aircraft,[62] or uncrewed interceptors—that might ultimately reduce the time it takes to close a kill chain, particularly in time-sensitive situations.[63]

4.3 Inform procurement

PRC research on kill webs provides ideas about the kinds of platforms, weapons, technologies, and systems that might be procured or adjusted in advance. Sometimes researchers state that their analysis can guide decisions about which equipment is selected or designated for research.[64] It may also inform determinations about the procurement of an additional platforms (e.g., the right balance between the numbers of uncrewed early warning drones versus uncrewed strike drones) or different payloads for platforms (e.g., whether the payload of uncrewed interceptors should be explosive, electronic, or high-energy microwaves to deliver soft or hard lethal jamming).[65] In addition, the research can shape debates on whether to have a larger number of less-expensive, less-capable uncrewed nodes or a smaller number of uncrewed nodes with better performance.[66]

Researchers associated with the Shanghai Academy of Spaceflight Technology (上海航天技术研究院) and the Shanghai Electro-Mechanical Engineering Institute (上海机电工程研究所) argue that the PLA's ability to conduct beyond visual range air operations would benefit from a list of potential improvements, many involving procurement modifications. The list includes the following options:

- Increasing the number of platforms and sensors (specifically low-orbit constellations) and establishing an inter-machine datalink to improve interoperability across services
- Expanding space-based sensors (e.g., satellites) and networks and deploying long-range weapons in large numbers (on satellite carrier platforms)
- Increasing the use of stealth penetration fighters that operate closer to a target to conduct ISR and enable long-range weapons to be launched from non-stealth ground- or air-based platforms that are outside the target zone
- Using air datalinks, laser communications, and low Earth orbit (LEO) satellites to improve the speed of information transmission[67]

4.4 Identifying key nodes

In multiple articles, researchers pointed to shortcomings in the ability to identify and evaluate key equipment or nodes in the adversary's operational system (which may be important targets to strike), the PRC's own system (which may need enhanced defense), or both.[68] Therefore, some PRC researchers use kill process research as a means of understanding key nodes (e.g., reconnaissance, C2, communication, firepower) in adversaries' systems or kill chains to inform PRC targeting.[69]

The researchers' primary goal was to improve the selection and prioritization of targets. Often, researchers state that the results can be used for targeting but are vague about the specific potential targets, as in the following examples:

- According to authors affiliated with the NUDT College of Systems Engineering, their research helps select which adversary nodes to attack to enable the PRC to (a) reduce the operational effectiveness of the enemy's kill web in joint operations, and (b) implement an anti-access/area denial strategy.[70]

- AMS researchers argue that their work could help the PLA select which precision strike kill chain platforms are best positioned to conduct strikes against an adversary's time-sensitive targets.[71]
- Analysts from the Nanjing University of Science and Technology School of Automation argue that their research, which involves 20 adversary drones, contributes to planning for how to intercept groups of drones in air defense operations.[72]
- Researchers from the NUDT College of Systems Engineering assess that strikes on the adversary's important communications nodes will have more significant effect on the adversary's operational system than attacks on other types of nodes because these nodes are integral to command and logistics.[73]

PRC analysts also emphasize the importance of targeting early warning aircraft first and surface ships second. This construct was used in two articles that discuss the importance of proper target sequencing.

The first article, by authors associated with the PLA National Defense University, identifies three possible types of Blue nodes to target (note that PRC authors often refer to China's forces as "Red" and adversary forces as "Blue"):

- **Early warning aircraft:** targeted because they provide battlefield intelligence information on incoming aircraft, missiles, and more.
- **Surface ships:** targeted because they provide air defense and antimissile defense with the support of early warning aircraft, attacking incoming missiles and aircraft.
- **Fighter formations:** targeted because they use support from Airborne Warning and Control Systems aircraft to attack incoming missiles and aircraft, collaboratively protecting friendly targets.[74]

In the second article, authors associated with the Naval Aviation University (海军航空大学) analyze a maritime kill chain based on the U.S. Navy's Naval Integrated Fire Control-Counter Air to find the most critical node. The researchers discuss a scenario-based analysis focused on targeting a range of U.S. naval platforms, including the Aegis destroyer, the MQ-4C drone, the F-35C fighter, the E-2D early warning aircraft, the E/A-18G electronic warfare aircraft, and the "Standard"-6 missiles (SM-6). Ultimately, the authors conclude that the E-2D, the Aegis destroyer, and the F-35C are the most important nodes to target because they are important means of information acquisition and perception that affect Blue's decision-making and C2 and because they are the weakest links in the kill chain. [75]

4.5 Optimizing command and control

In numerous articles, PRC researchers discuss how the concept of kill chains may help the PLA with scheduling, matching, and allocating resources; coordinating capabilities, tasks, and equipment;[76] providing ideas for incorporating process design into C2; supporting operational planning; and helping commanders with decision-making in various ways.

4.5.1 Better allocate tasks and resources

A consensus among PRC researchers is that the PLA needs a better, faster, more automated way to allocate tasks, equipment, and resources. Because these are system-wide challenges, combining the logic of kill process research with AI, mission engineering, and order management processes equips PLA researchers to rapidly improve their ability to understand how the nodes involved in operations function together, both holistically and across domains; they can consequently improve their ability to conduct intelligent warfare, joint operations, and system-on-system confrontation.

Three examples of research on resource and task allocation follow:

1. **Resource allocation.** In one article, researchers argued that insufficient attention has been paid to resource allocation and dynamic coordination between multiple nodes and multiple platforms, especially in the complex and dynamic maritime battlefield environment; the researchers also claimed research on how to efficiently deploy and allocate perception and strike nodes in that complex and dynamic environment is lacking.[77]
2. **Task allocation.** In another article, researchers claimed that problems exist in current command information systems associated with links in operational command. The researchers also highlighted problems in task allocation in coordinated operations leveraging crewed and uncrewed platforms, arguing that these problems result in low use of these platforms.[78]
3. **Resource scheduling.** In a third article, researchers stated that traditional C2 systems rely mainly on centralized cloud computing to process tasks and that these systems can no longer meet the requirements of low latency and high reliability. This inability results in dynamic resource scheduling problems for C2 organizations against time-critical targets.[79]

To mitigate these challenges, some PRC researchers examined how using kill process research might enable more rational allocation of resources. For example, researchers associated with the Beijing Institute of Technology’s School of Mechanical Engineering (北京理工大学机械与车辆学院) argued that the ability to allocate resources intelligently can have several positive effects. Those effects include reducing the burden on system designers, making kill web design an intelligent AI-enabled process, and enabling quick decisions in a rapidly changing battlefield environment.[80]

Researchers associated with the NUDT College of Systems Engineering describe resource scheduling for time-sensitive strikes as a multi-objective optimization problem. They developed an algorithm to improve resource optimization and proposed a dynamic resource scheduling method that can reduce the window of time it takes to conduct a time-sensitive strike on a target and enhance time-sensitive strike capability.[81]

Several sets of PRC analysts have conducted research geared toward providing ideas for how to improve task, equipment, and resource allocation by experimenting with models relevant to commercial order management (for example, flexible consumption business models used in on-demand food delivery services or ride-hailing services) or internet services, whereas others were inspired by observations in the Russia-Ukraine war. Some examples include the following:

- In two articles—one article written by researchers from the Northwestern Polytechnical University's School of Aeronautics (西北工业大学航空学院) and the other written by researchers associated with the Air Force Engineering University (空军工程大学)—the authors describe efforts to model kill processes in a way that treats them like customer orders in a sequence. The first article's model includes dispatching, dropping, and receiving orders.[82] The second focuses on "order grabbing" and "dispatching orders" strategies.[83]
- In another example, researchers affiliated with the Key Laboratory of Science and Technology on Complex Aircraft System Simulation (复杂飞行器系统仿真重点实验室) describe the military application of a commercial internet service system to identify targets, determine attack vectors, and design and evaluate kill nets for efficient and reliable time-sensitive targets.[84]
- In a final example, researchers affiliated with the PLA Information Engineering University describe the use of spatial crowdsourcing to match massive amounts of heterogeneous resources with fragmented tasks through a distributed network. The authors attempt to show how this process can be applied in the context of air defense and antimissile kill chains when responding to highly dynamic saturation attacks.[85]

4.5.2 Support operational planning

In some cases, PRC researchers identified challenges with command and planning for operations. For example, in discussing maritime operations, the authors of an article in the *Chinese Journal of Ship Research* argue that operational processes and command systems can no longer adapt to the needs of precision strikes in modern maritime operations, in which (a) the battlefield is vast in scale, is structurally complex, involves diverse combat platforms, and is highly interactive across domains, and (b) operations are more information centric and networked. The authors see a need to integrate multiple operational nodes and quickly generate operational plans for large, complex, interactive battlefields that involve multiple domains.[86] Researchers associated with the Air Force Engineering University describe air defense operations as highly uncertain, arguing that they are sometimes required in situations where there is little warning or the operations are subject to resource or timing conflicts. In other scenarios, according to the researchers, air defense operations may require the ability to adapt in real time on the battlefield.[87]

4.5.3 Modify the organizational structure for command and control

In a 2022 paper published in the *Journal of Command and Control*, several PRC researchers associated with NUDT argue that shortcomings exist in traditional C2 organizational structure analysis and evaluation methods and that it is therefore necessary to use new analysis and evaluation methods to ensure a rational and efficient C2 organizational structure.[88] The researchers use kill chain–based research to analyze the performance of a "traditional" versus "adjusted" C2 organizational structure in the context of a complex, changeable battlefield environment.[89] In the paper's scenario, neither the deployment locations of the platforms nor the number of adversary targets change, but the C2 organization does:

- The traditional structure involves a notional "First Army" comprising 7 brigades, 18 battalions, 7 reconnaissance platforms, 9 support platforms, and 14 strike platforms. In this structure, each battalion is responsible for 1 or 2 platforms.
- The adjusted structure involves just 10 battalions (which are responsible for 1 to 3 platforms each), and 8 platforms are directly under brigade leadership. This structure changes both the overall number of command nodes as well as which nodes are responsible for which platforms.

The researchers find that the different C2 organization structures can significantly affect the overall capability of the system. They find that most kill chains—even enemy units that could feasibly be targeted—changed under adjusted C2 organizational structures, resulting in changes in how the decision-making load was spread across nodes. They argue that this capability-based way of evaluating C2 supports kill chain construction and enables more optimized kill chains for enemy targets.[90]

Evaluating the C2 processes through the lens of a kill web could also point to areas in which software, AI, or large language models (LLMs) could perform portions of the process, reducing the burden on human operators and improving accuracy. Research by additional NUDT analysts on the use of LLMs in C2 and their application in kill chains notes the potential of LLMs to empower and support commanders by enabling faster management and scheduling of data about the situation, tasks, constraints, and paths, allowing decision-makers to focus on other tasks.[91]

4.5.4 Incorporating intelligent decision-making capabilities to support commanders

Another consensus among PRC researchers is that incorporating intelligent decision-making solutions is key to future performance and efficiency in closing kill chains. For example, the PRC authors of a 2022 paper in the journal *Mathematics* describe decision-making as the core of kill webs. They claim that decision-making methods for kill webs are still in their early stages and that the military needs to apply new methods that incorporate AI in the kill web decision-making process in a way that accounts for kill webs being, in essence, large-scale complex systems.[92]

PRC writers explore how to make kill web decision-making capabilities more intelligent by applying a variety of decision-making tools. The types of tools they use in their research include reasoning methods and AI agent–based approaches. PRC writers explore the use of multiple types of reasoning methods to help enhance the decision-making speed and performance of kill web designs. Papers in our dataset focused on evidence-based reasoning, knowledge-based reasoning, and LLMs. Researchers focused on several types of AI agent–based approaches: single agents, a deep neural network agent, a Deep-Q Network agent, and multiple agents.

PRC research on how to make kill processes more intelligent emphasizes efforts to combine intelligent decision-making systems to complement human efforts in human-machine teaming and crewed-uncrewed collaboration. We offer two examples:

- In a journal sponsored by the China Aerospace Science and Industry Corporation (CASIC) Flight Technology Research Institute (中国航天科工飞航技术研究院), PRC writers who have expertise on radar, detection, and perception technologies and discuss how intelligent decision-making systems can optimize the closure of a kill chain. In the article, researchers address future counter-drone kill chains, noting that intelligent decision-making systems can help with detection and perception, battlefield decision-making, and interception.[93]
- Another set of analysts—several affiliated with the Chinese Academy of Sciences (CAS) Institute of Automation (中国科学院自动化研究所) or the CAS University School of Artificial Intelligence (中国科学院大学人工智能学院)—derived a system in which experts used their knowledge and experience to help an aircraft group (composed of one crewed leader platform and four uncrewed platforms) make decisions in complex operational situations, enabling members of the aircraft group to adjust their operational style and preparing them to confront multiple opponents at once.[94]

How Else Might Kill Process Research Help Commanders?

PRC patents describe inventions that claim to help commanders and decision-makers in the following ways:

- Generate early warning and interception strategies to support planning for real-time operations
- Rapidly generate kill chains and provide options and recommendations about the courses of action (COAs)
- Enable precise selection of optimal attack and defense strategies
- Identify threats, countermeasures, and potential adversary COAs
- Predict future trends

4.6 Coordinating operations across platforms

PRC researchers hope that their research using kill chains and webs can resolve operational problems ranging from difficulties with integrating weapon and equipment information from different domains,[95] providing high-precision intelligence support to operations,[96] improving naval and maritime operations, coordinating air-ground coordinated operations, and conducting air defense operations (which was the focus of the most research). Examples of this research include the following:

- **Naval and maritime operations.** Problems with naval long-range precision strikes in distant sea areas include poor real-time performance, low accuracy, single means of target identification and strike effect evaluation, and relatively fixed early warning, C2, and firepower strike nodes. Researchers argue that all these contribute to fragile kill chains that are broken if a single key node is destroyed.[97]
- **Air-ground coordinated operations.** Two members of a PLA unit and two researchers at an institute that specializes in fire control, C2, and military computer technology for conventional weapons[98] wrote an article in which they discuss kill web technologies needed to address problems associated with air-ground coordination in operations. The authors list many needs (e.g., break down barriers across military services in terms of messages, data, and services) and challenges (e.g., equipment systems are developed for particular platforms and struggle with compatibility and recognition with other systems) that require new technologies to address and enable coordination in these types of operations.[99]

Numerous PRC writers have emphasized the urgency and potential for kill process–related research to help solve air defense operational problems. To do so, they cited a number of needs, including the following:

- A need to improve the active air defense system's current target classification and identification process, which is almost entirely manual and performed by command center operators (if many drones attack, the operators' ability and limitations will hinder decision-making efficiency and operational effectiveness)[100]
- A need to integrate long-range early warning systems into the kill web to help with issues such as intelligence accuracy, intelligence transmission, and intelligence dissemination[101]
- A need to address an urgent problem in current air defense operational planning—how to generate reasonable air defense plans based on the existing capabilities of one's own platform for large-scale air strike targets[102]
- An increasingly urgent demand for counter-drone operations, for which traditional air defense systems are not well suited (uncrewed interception can be a better alternative)[103]

- A need to examine existing air operational decision-making methods, which fail to address the dynamic changes and diverse strategies that opponents use in air operations today[104]
- A need to address equipment system integration difficulties, tasking, and other factors to defend against enemy high-value platforms and targets (e.g., bombers, early warning aircraft, electronic jammers, tankers) given currently higher requirements for air defense operations (due to speed, maneuverability, detection capabilities, and increased security threats)[105]

PRC research on kill processes helps address these issues in two ways: 1) by allowing researchers to explore how to integrate new types of enablers, platforms, and forces into operations, and 2) by allowing them to explore possible adjustments to force deployment.

4.6.1 Explore how best to integrate new types of enablers, platforms, and forces into operations

Individual articles discuss PRC thinking on integrating airborne early warning aircraft, long-range early warning systems (including reconnaissance satellites, early warning aircraft, and long-range early warning radars), and electromagnetic capabilities into kill webs.[106]

Multiple researchers examined the need to develop and use newer aerial platforms and uncrewed platforms in operations. For example, in an article in a journal sponsored by CASIC's Flight Technology Research Institute, researchers looked at using uncrewed early warning aircraft and uncrewed interceptors to respond to a scenario in which they need to respond and defend against a swarm raid. CASIC's research uses kill processes to explore the roles uncrewed early warning aircraft and uncrewed interceptors should fill, where they should be deployed, how they should maneuver and be linked to other platforms, to what degree AI should be involved in decision-making, and how they might ultimately intercept an adversary target.[107]

Researchers from the Dalian Naval Academy have published two articles looking at kill processes and integration of C4ISR resources into maritime operations. The researchers' writing suggests a lack of confidence in the PRC's ability to operationalize kill processes in maritime areas far from China. For example, in one article, the researchers describe naval long-range precision strikes in distant sea areas as a main style of operations in the future, but they lament problems including poor real-time performance, low accuracy, single means of target identification and strike effect evaluation, relatively fixed early warning, C2, and firepower strike nodes. They argue that these problems contribute to fragile kill chains that break if a single key node is destroyed. The authors recommend a combination of leveraging space-based reconnaissance and early warning systems, far sea pre-positioning, and using uncrewed platforms, advanced communication networks, AI, and other technologies to enable a more dynamic kill network. Ultimately, the authors envisioned their work as a reference for improving the development of the kill chain system.[108]

PRC Patents That Claim to Offer Operational Benefits

In addition to published research, several PRC patents related to kill webs are geared toward providing support to operations. PRC authors describe their inventions as making the following types of contributions:

- Generating killing chains rapidly (e.g., how to strike a satellite system)
- Improving operational effectiveness and efficiency
- Improving detection and strike capabilities
- Reducing consumption of resources required for strikes
- Evaluating the reliability of equipment
- Improving communication, collaboration, and information sharing across domains, platforms, and formations

4.6.2 Adjust force deployment

Several sets of PRC researchers suggest that their research can be used to inform adjustments in how forces are deployed. For one article, PRC researchers affiliated with NUDT and a coauthor affiliated with a PLA unit conducted research that shows how deploying platforms to certain locations would improve the ability of the platforms to both detect and strike targets, enabling kill chain closure.[109] Similarly, publishing in the *Journal of the Information Engineering University* (信息工程大学学报), researchers presented a method that uses the least possible number of uncrewed nodes to collect data from cloud-based terminal resources and provide services such as communication and computing for distributed battlefield resources.[110] In addition, researchers from the Shenzhen branch of the Harbin Institute of Technology hold a patent for a method that uses a kill chain model to generate weapon deployment locations faster than was possible using prior methods.

4.7 Conclusion

Whether PRC research on kill processes has or will directly affect PLA operations is an open question. Emerging evidence suggests that PRC researchers are moving toward more direct applications of their work.[111] However, the bulk of the data published to date fits into the LOEs described in section 6.0: build kill processes, model the nodes and systems involved in kill webs, evaluate the capability of kill processes, simulate how kill processes perform, and develop technologies to enable kill processes.[112]

5.0 PRC Researchers Prioritize Kill Process Research

Although we lack direct evidence of a formal directive or requirement for PRC and PLA analysts to pursue kill process research, multiple indicators show that this research is a priority in the PRC and PLA. These indicators include the following:

- The quantity and recent nature of PRC articles published on kill process research
- The institutional diversity of the authors publishing kill process research
- The provision of national, local, and military funding for kill process research

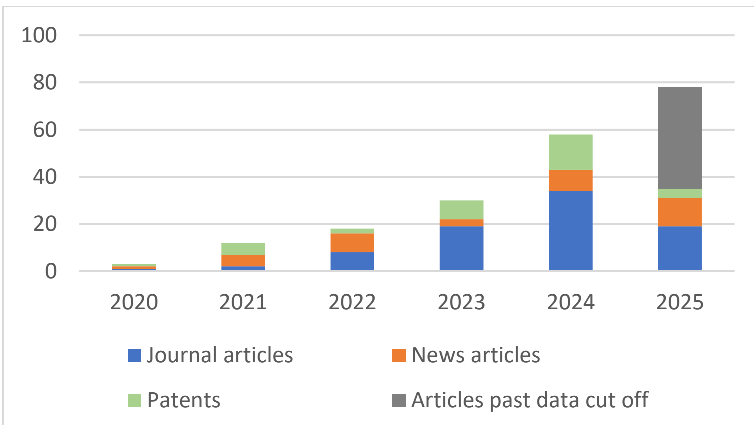
The following sections discuss each of these indicators in further detail.

5.1 Large body of recent publications

During our research, we found a large and relatively recent dataset of PRC writing on kill processes and related concepts. This dataset includes 85 articles authored by analysts affiliated with China's military and national defense apparatus published between January 2020 and May 2025. We also found 25-plus news articles and 35 patents, which provided complementary types of data to the journal articles.

Note also that publication dates in our data are weighted to the latter end (i.e., 2023–2025) of our data collection window (2020 to 2025).[113] Figure 4 shows the total number of articles published in PRC journals or newspapers and the number of patents filed per year in CNA's kill process dataset.

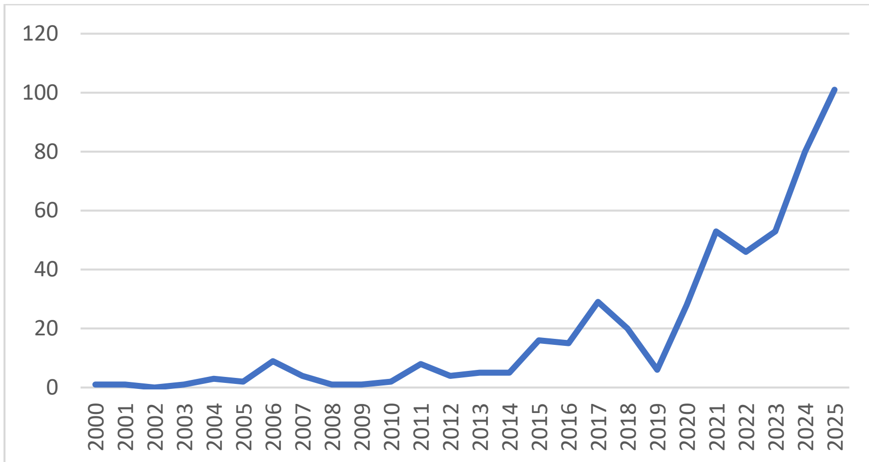
Figure 4. PRC articles published and patents filed in 2020–2025 kill process dataset



Source: CNA.
Note: The articles and patents represented here are those included in our dataset; others may also exist. The cutoff for our journal and news article dataset was May 2025. To get a sense of the number of journal and newspaper articles published between June and December 2025, we ran a search in February 2026 and counted an additional 42 journal articles and one newspaper article that were published after our cutoff date. Those articles are represented in gray for 2025 to show the publication trend over time, but they were not part of the dataset for this study because of their dates of publication.

The recent increase in publications examining kill processes is even more stark in the longer view. Figure 5 shows the number of published PRC journal articles that mention kill processes in the title, abstract, or keyword between 2000 and 2025.

Figure 5. Published PRC journal articles that mention "kill chain" or "kill web" in title, abstract, or keyword, 2000-2025



Source: CNA.

5.2 Diversity in the affiliations of researchers

A mix of military and civilian analysts are conducting research on kill processes in the PRC. Table 3 summarizes several general kinds of PRC institutions that have published articles about kill processes in PRC-produced journals.

Most of these PRC researchers have direct ties to the PLA, Chinese military universities, or entities that serve PRC aerospace and national defense industries. The types of scholars and institutions publishing about kill processes reflect the focus on aerospace and outer space domains, systems engineering and integration, civil-military command information systems, AI, algorithmic learning, and deep learning.

In addition, the institutions whose researchers are publishing about kill processes include some who contribute to research theory and concept development as well as others who engage in technology development and production and may be qualified to produce technologies that would enable kill webs.

Table 3. Key types of PRC institutions publishing about kill webs

Type and Description of PRC Institution	Number of Articles
Military academic institutions: Universities, colleges, and academies that are under the PLA or a PLA service branch	33
Specialized institutes, centers: Institutes, academies, and centers that have a particular professional focus, such as electronic systems, aerospace engineering, ship research and design, and uncrewed systems (many of these are state sponsored or supported)	19
Laboratories: National-level laboratories or key laboratories that address a particular research need and are state sponsored or supported (they may be under a university or a ministry and focus on subjects such as information systems engineering and national strategic technological needs)	16
Companies: Private, semiprivate, or state-owned enterprises	14
PLA units: Distinct numbered PLA units located around the PRC	14
Civilian universities: Civilian universities that have colleges or schools that have pursued research related to kill webs	13

Source: CNA.

Note: Because journal articles may have authors associated with more than one type of institution, the total does not add up to 85.

5.3 Evidence of national, local, and military funding for kill process research

Another way to gauge national and military support for ongoing research is to look at whether researchers indicate receiving funding for their work. In past research efforts on comparable topics, CNA has found that about a quarter of PRC journal articles specify that the research was supported by one or more civilian or military funds. In our dataset, about half of the journal articles specified that the researchers received support from one or more civilian or military funds.

6.0 Multiple Lines of Effort Exist in PRC Kill Process Research

PRC analysts who conduct kill process–related analysis delve into many subtopics of research. We grouped these subtopics into LOEs, which include the following:

- **Building kill processes.** PRC researchers describe the fundamental building blocks and logic of kill webs, including the types of nodes involved, the types of connections between them, the types of kill sequences, and the rules that must be followed. After laying out these building blocks and assumptions, researchers generate kill webs.
- **Modeling the nodes and systems involved in kill webs.** PRC analysts' mathematical modeling (e.g., Petri nets, game theory, graph theory) or network modeling (e.g., network models, network topologies, evaluation of node importance) helps improve the performance of kill webs.

- **Evaluating the capability of kill processes.** PRC researchers establish metrics to measure progress and thresholds that indicate the validity, applicability, effectiveness, and performance of kill chains.
- **Simulating how kill processes perform.** PRC researchers use simulation techniques extensively in their research on kill processes to verify effectiveness, generate data, calibrate models, and illustrate scenarios.
- **Developing technologies to enable kill processes.** PRC researchers describe the actual development of some technologies that would enable or facilitate requisite connections across sensors, command units, weapons, and platforms to improve the PLA's kill processes.

Improving Kill Process Design and Research

PRC researchers pointed to weaknesses in current kill process–related research, including the following:

- Kill web design is highly dependent on human experience, and it is subjective, slow, and inefficient for real-time battlefield environments and specific missions.[114]
- PRC research on kill web design has focused more on back-end design (e.g., evaluation) than front-end design (e.g., generating a kill web, connecting equipment and nodes into a chain, and clustering kill chains into a web).[115]
- Most existing kill process research uses methods that work well for one specific battlefield environment but not necessarily for others.[116]
- There is a dearth of mathematical modeling in kill process design; instead, the focus is on the network model representation and network architecture.[117]
- Kill chains must be able to dynamically reconstruct or adapt when damaged, manage both the destruction of existing targets and the emergence of new ones, and involve more equipment types and operational constraints.[118]
- There are shortcomings in identifying dependencies within the operational system in terms of which equipment and platforms depend on one another.[119]
- Existing research focuses on either the PRC's or the adversary's kill processes, not the interaction between the two. In addition, research focuses on the capabilities of individual kill chains and rather than the overall capability of the system.[120]

6.1 Build kill processes

Most PRC research on kill webs includes efforts to explain or lay out the fundamental components of kill webs, to convey the logic and assumptions in researchers' work, and to generate kill processes. Researchers identify all the pieces involved and discuss how, why, when, and where they connect:

- PRC researchers lay out the architecture of the systems, equipment, and layers involved in kill webs. Such descriptions often involve diagrams depicting various weapons, equipment, reconnaissance sensors, C2 layers, or elements such as perception, communication, decision-making, and attack.[121]
- PRC researchers identify specific types of nodes, "edges," and common kill chain sequences that are an inherent part of how different parts of the PRC system connect and how kill processes function.
    - Researchers use the term "node" (节点) to refer to different sensors, equipment, and platforms in PRC and adversary systems. Researchers categorize nodes by function—sensor or reconnaissance, communication support, assessment, decision, and strike or influence.
    - Researchers use the term "edge" (边) to refer to the possible connections between nodes (for example, a sensor node could provide information to a decision-making node, but it would not task a strike node to engage or with a target).
    - Nodes in the system connect in common sequences to carry out a strike. For example, a standard kill chain sequence might involve a sensor providing information to a decision-maker and a decision-maker tasking a platform to strike a target. However, the sequence varies depending on the number and types of nodes involved.[122]
- PRC researchers identify rules that must be followed and tasks, resources, or sequences that must be considered. This stage often uses the logic of observe, orient, decide, act (OODA); find, fix, track, target, engage, and assess; or related cycles.[123] For example, to better automate the process of building kill webs, one report developed three lists of rules to better match tasks, capabilities, and equipment and coordinate the sequences and weapons involved in a kill web.

Once researchers have identified the fundamental building blocks and assumptions that are a part of constructing a kill process, they build, design, or generate kill processes as a part of ongoing research. For some papers, the design or generation of kill processes was the explicit focus; other times, it was just part of the researchers' work (e.g., if they were looking at optimization, they had to show their starting point). Typically, researchers illustrated the kill webs in figures without much detail.[124] In a few cases, researchers listed kill webs in sequence form.[125] The kill webs illustrated in our dataset do not look overly complex, but some researchers claim to be moving toward more complex and adaptable kill webs.

These demonstrations of kill web generation—in multiple publications and by different groups of authors—suggest that a range of researchers are producing kill webs tailored to different circumstances and scenarios and seeking ways to automatically generate kill web models or solutions.

6.2 Model kill processes

In part because of the PRC focus on system confrontation, network analysis and network theory features prominently in PRC kill web research. We found multiple articles that look at the construction, evaluation, or capability of the kill web through the lens of networks. These articles include efforts to model the network of kill webs, the topology of the networks involved, and conduct centrality analysis to better understand the level of importance that different nodes in the network carry.

The research typically begins with a discussion about identifying and classifying particular nodes and edges, accounting for the heterogeneity of nodes, understanding the relationships between nodes, and determining how important nodes are.[126]

6.3 Evaluate the capability of kill processes

In PRC efforts to improve kill processes, researchers frequently evaluate the capability or performance of kill processes. The researchers establish metrics by which to measure progress and thresholds that indicate validity and applicability.

In several articles, researchers developed tailored, narrow sets of indicators aligned with the direction of their research. For example, in a February 2025 article, researchers from the CAS Institute of Automation and the CAS University School of Artificial Intelligence assessed how well an intelligent agent could design a kill web for air operations that involve multiple aircraft (both crewed and uncrewed) by comparing how the intelligent agent these researchers designed performed relative to 6 of the top 12 teams in the first National Air Intelligent Game Competition (全国空中智能博弈大赛) that had also been used to design kill webs for the scenario. The authors conducted thousands of battle experiments and evaluated the performance of the intelligent agents based on the following indicator categories:

- **Defensive capability:** Probability of evading enemy missiles
- **Strike capability:** Probability of successfully destroying enemy aircraft
- **Formation looseness:** Average operational group distance
- **Attack range:** Average missile launch distance
- **Coordination capability:** Number of multi-aircraft coordinated operations[127]

According to the authors, the new agent that they developed performed better than did any of the six test agents in relation to the indicators listed previously. Their research is one of numerous PRC efforts to incorporate agent-based modeling in kill process research. Moreover, given the comparison of this agent to a select group of teams in a national competition, the significance of their research extends beyond the findings in their paper and likely contributes to intelligent agent development at the national level.

Several articles systematically developed and applied broader frameworks of indicators to assess the overall effectiveness of a kill chain. Typically, these are tiered indicator systems that researchers depict in hierarchical charts in attempts to show how many narrower, more discrete calculations can be combined to arrive at a larger indicator of the overall capability or effectiveness of a kill chain (in the hierarchical charts, this indicator is typically at the top).[128] The systems are not specific to a particular type of operation or service branch; instead, the intent seems to be to arrive at a method to measure kill process efficacy at a higher level.

For example, in a 2024 article in the *Journal of System Simulation* (系统仿真学报), researchers state that the kill chain is integral to understanding, orchestrating, and executing military operations in modern conflict scenarios, but they also argue that traditional methods of assessing kill chain efficacy overlook how different parts of kill chain affect one other. The researchers seek to understand and help visualize how different criteria interact as well as which ones are causes and which are effects to aid in decision-making. The researchers developed a three-level indicator system:

- **A single first-level indicator** that represents the kill chain's overall capability
- **Six second-level indicators** that are associated with the effectiveness of reconnaissance and detection, location and tracking, C2 and firepower strikes, cost versus destruction, and operational coordination
- **Twenty-five third-level indicators,** each of which is subordinate to a second-level indicator and includes a definition and description of how to quantify it (e.g., third-level indicators associated with reconnaissance and detection are reconnaissance sortie efficiency, reconnaissance speed, detection accuracy, and detection range)[129]

The depth and breadth of the indicator systems used to measure the effectiveness of kill chains provides insight into how PRC researchers may be assessing the effectiveness of individual kill chains or kill webs. In addition, this type of research reflects an effort to position the effectiveness of kill chains in a larger context that includes many other variables and factors. Given that some PRC researchers consider kill web capabilities to be an approximation of operational capabilities, these indicator systems may help PRC and PLA researchers arrive at a higher-level assessment about the overall operational capability of PLA kill processes.

These evaluation efforts are examples of how PRC researchers use kill process research to think holistically about how different nodes function together across domains and, in theory, across civilian and military systems, to improve the PLA's ability to conduct intelligent warfare, joint operations, and system-on-system confrontation.

6.4 Simulate kill processes

PRC researchers use simulation techniques extensively in their research on kill chains and kill webs to verify effectiveness, generate data, calibrate models, and illustrate scenarios.

Their use of simulation techniques is important because it shows efforts to move beyond the theoretical and conceptual stage of research to test these theories, models, systems, and methods. In addition, researchers may be able to apply the demonstrations evident in these simulations and scenarios to larger datasets that are made more complex or tailored to different scenarios. That said, PRC articles on kill webs provide different levels of detail in their discussions and demonstrations of how they use simulations in their work.

Some PRC researchers report using simulations in their work but provide few details. For example, an article in the journal *Air and Space Defense* (空天防御) states that the effectiveness of the researchers' kill web model was verified on a simulation software platform but does not elaborate.[130] Similarly, PRC writers affiliated with institutions that research radar, detection, and perception technologies (including the Nanjing Research Institute of Electronics Technology (南京电子技术研究所), the National Key Laboratory of Radar Detecting and Sensing (雷达探测感知全国重点实验室), and the Jiangsu Key Laboratory of Detection and Perception Technology (江苏省探测感知技术重点实验室)), report that their work included phased simulations of scenarios to defend against swarm attacks but provide no details about the phased simulations.[131]

Some PRC articles on kill web research include illustrations of what appear to be software-based simulations used during their research. For example, authors associated with the Beijing Institute of Technology's School of Mechanical Engineering explore a way to intelligently design a kill web for air defense and antimissile systems using knowledge reasoning. The researchers verify the effectiveness of their method with a "general system confrontation simulation platform."[132]

Likewise, an article in *Computer Simulation* evaluates the effectiveness of a method for kill chain design. The authors use results from simulation experiments that are generated using a system confrontation simulation deduction platform.[133] The authors do not name the platform, but they describe it as a "comprehensive confrontation simulation system," and they include a figure showing the simulation deduction situation.[134]

These examples provide evidence that PRC researchers are using confrontation simulation platforms to verify research on kill processes.

6.4.1 Use of scenarios

Although not all simulations in PRC research on kill webs involve a descriptive scenario surrounding the simulation or the entities involved, a significant number do (more than 20). These descriptive scenarios are important because they show researchers' experiments with moving beyond conceptualization to apply and test their approaches in specific domains and with particular platforms.

Most of the scenarios we reviewed focused on assessing the efficacy of PRC capabilities in air and maritime defense scenarios, including the following:

- Missile and antimissile scenarios
- Interception of uncrewed swarms

- Space-based surface strikes
- Air-to-air, air interception, and air defense scenarios
- Island combat
- Island reef disputes
- Long-range raid operations

All of the scenarios are Red (PRC) versus Blue (adversary) except one, which includes a Green participant who is in an alliance with Blue. The researchers' descriptions of the scenario backgrounds sometimes imply that Blue is the US, including featuring assumptions of large-scale attacks, strikes, and operations in battlefield environments described as dynamic, complex, uncertain, and harsh or damaged with electromagnetic confrontation.

The scenarios vary widely in complexity and in how they are described:

- **Scenario.** In a couple of cases, the researchers allude to scenario circumstances but do not elaborate on them; in others, they provide more detail.
- **Nodes.** In a couple of cases, the researchers provide virtually no information about the nodes. In other cases, researchers identify the exact numbers of nodes involved and the types of platforms, sometimes including specific platform names. The numbers of nodes involved tended to be small, often 30 or fewer; the greatest range we found is 50 to 70.
- **Purpose.** The researchers are generally attempting to vet or improve PRC efforts to design and optimize kill webs; occasionally, they evaluate a method being applied to chain research.
- **Results and outcome.** Typically, the researchers' work is intended to support their hypotheses; in some cases, it suggests avenues for future research.

In the following two subsections, we summarize two selected scenarios that show how the researchers frame their research and the use of the scenario.

6.4.1.1 An air defense and antimissile operational scenario

Researchers from the Beijing Institute of Technology's School of Mechanical Engineering used ontology to design a kill web and test their method in the context of a scenario. Key parts of the scenario context or description include the following elements:[135]

- **Purpose.** The researchers sought to design a reasonable kill web to intercept the Blue side's invading targets with Red side's existing resources in air defense and antimissile systems.
- **Scenario.** In a certain sea area, the Red side's existing air defense and antimissile system includes three main elements: 1) an early warning aircraft that takes off from a western airport and conducts early warning and reconnaissance missions to the center of a bay, 2) an air defense system deployed on the western coast, and 3) two multifunction fighter jets that take off from an airport on the east side for patrol

missions and are responsible for air defense on the east side. One day, a formation of two Blue multifunction fighter jets intrudes into Red's airspace. Using satellite reconnaissance, Blue locates Red's air defense and antimissile system and launches an attack with four air-to-ground missiles. Red prepares to retaliate. In the scenario, Blue's incoming flight targets include two aircraft and four launched missiles. Red has six operational missions: intercept four Blue missiles and destroy the two Blue aircraft.

- **Process.** The researchers construct a multilevel kill web. It includes three types of kill web design rules to realize dynamic knowledge modeling of kill web design; it also proposes an intelligent design process framework for kill webs based on knowledge reasoning. Finally, the web identifies three kill chain evaluation indicators to ensure that it can realize rapid intelligent design of kill webs in a dynamic battlefield.
- **Results.** The kill web effectively destroys enemy aircraft and intercepts all missiles, successfully completing the operational mission. The methodology the researchers use provides an option for a knowledge-based method to design kill webs intelligently and rapidly for specific tasks in real-time battlefield environments.[136]

6.4.1.2 An uncrewed swarm scenario

Aerospace researchers associated with the Northwestern Polytechnical University's School of Aeronautics and the National Key Laboratory of Aircraft Configuration Design (飞行器基础布局全国重点实验室) used a cloud-edge collaborative kill web architecture to generate a kill web and demonstrate its efficiency in a maritime scenario in which an uncrewed swarm must be intercepted. In the scenario, Party B is the friendly side, and Party A is the adversary. Key parts of the scenario include the following elements:[137]

- **Purpose.** The researchers sought to analyze and verify whether using a business process design method to design a cloud-edge collaborative kill web architecture to analyze kill webs would be effective.
- **Scenario background.** Party A dispatches an uncrewed swarm to penetrate Party B's maritime defense system and destroy Party B's maritime defense force. If the penetration and destruction are successful, Party A plans to commit a larger force to support its distant allies; if the penetration is unsuccessful, Party A will abandon attempts to support its allies or conduct a larger-scale confrontation because of the disparity in strength. To stop the war, Party B's maritime defense system must defend against the attack and deter the enemy.
- **Battlefield environment and space.** In this scenario, the environment is dynamic and uncertain with a strong electromagnetic confrontation element; the operational space includes air, space, sea, electromagnetic, and other domains.

- **Platforms.** Party B has carrier-based early warning aircraft, fighters, and destroyers, among others. Party A has enemy drones, missiles, and surface and underwater vehicles, among others.
- **Operations.** Party A's uncrewed equipment strikes in multiple directions and waves. Party B has long-range, medium-range, and short-range protection networks in three directions, forming an architecture of one central cloud and two edge clouds. Nine task agents have been dispatched to process the real-time situation information obtained from early warning detection and to generate and close combat links in real time for discovered targets.
- **Results.** Multiple business processes (e.g., one for time-sensitive targets, one for non-time-sensitive targets), different information transmission requirements for cloud connections, different aggregation methods, and different collaborative relationships must be considered to meet operational requirements. [138]

6.5 Develop technologies to enable kill processes

In PRC journal articles, researchers allude to nascent research or progress in developing the technologies that would enable the connections across sensors, command units, weapons, and platforms that are necessary to enable kill processes.

In addition to searching for relevant journal articles, we conducted a preliminary examination of patents issued by PRC authors and institutions related to kill chains and kill webs. We gathered data on a sample of 36 patents for innovations related to kill chains and kill webs that have been filed, granted, or are pending for PRC authors and institutions, most of which emerged between 2020 and 2025. Twenty-four different PRC or PLA institutions had applied for or been granted one or more patents on research related to kill chains and webs, including PLA-affiliated universities, a PLA unit, civilian universities, and multiple companies.

Most of these patents pertain to analytic methods rather than specific technologies, hardware, or software, but some patents resulted in devices, mediums, apparatuses, equipment, systems, and products related to kill chain generation, intelligentization, and optimization.

PRC journal and patent descriptions of these technologies can be vague, but they do appear to describe concrete, specific technologies that represent an effort to transition past conceptualization and thus should be considered when assessing PRC progress on conceptualization, development, and deployment. In particular, some cases of PRC R&D and innovations in the broad areas of hardware and software merit attention; we discuss these in the following two subsections.

6.5.1 Hardware

Patent data provide evidence that PRC entities are developing hardware to advance the PLA's ability to construct kill chains and kill webs. Table 4 lists a few examples of the PRC patents that claim to provide not only an analytic method but also some type of device, system, or equipment to realize kill web capabilities. We list the inventions in order of the name of the institution that filed them.

Table 4. Examples of PRC patents related to kill process inventions

Institution	Title of Patent	Summary of Components
Antiy Technology Group Co Ltd	Method and Device for Constructing Attack Killing Chain, Electronic Equipment, and Storage Medium	Provides a construction method, a device, electronic equipment, and a storage medium for a kill chain that can be generated rapidly and can strike satellite systems
Beijing Institute of Technology	Method, System, Equipment, Medium, and Product for Generating Killing Network Strategy Based on Game Theory	Discloses a method, a system, equipment, a medium, and a product for generating a killing network strategy based on game theory
China Electronics Technology Group Corporation (CETC) 15th Research Institute	Method and Apparatus for Constructing an Elastic Kill Web Based on Cross-Platform Resource Scheduling of Formation	Discloses a method and apparatus (a device) for constructing an intelligent elastic kill web based on cross-platform resource scheduling of formation within a naval fleet
NUDT	Method, Apparatus, and Device for Constructing Cross-Domain Kill Chains Based on Meta-Paths	Provides a method, apparatus, and device for rapidly constructing cross-domain kill chains based on meta-paths
NUDT	Synergistic Strategy-Based Kill Chain Construction Method, Device, Equipment, and Medium	Provides a method, a device, equipment, and a medium for constructing a killing chain based on a collaborative strategy
PLA Unit 95844	System and Method to Assist in Rapid Construction of a Kill Chain	Discloses a system and method for assisting the rapid construction of a kill chain

Sources: CNA
Note: The status of those shaded in green is "in force"; those in white are "pending."

One PRC journal article stands out because it addresses the technical and practical implementation aspects of this research; it includes a design for a "crewed-uncrewed collaborative kill chain engine." In another article, authors associated with the CETC 28th Research Institute (中国电子科技集团第 28 研究所) explore the construction of a closed-loop kill chain engine for crewed-uncrewed teaming (有无人协同杀伤链引擎) that would create a collaborative kill chain. The kill chain would seamlessly integrate ISR, C2, and information-based firepower strikes to meet the needs of highly dynamic operations with time-sensitive targets in situations that require systems to integrate crewed and uncrewed forces across multiple domains. The researchers describe a distributed and service-oriented "closed" kill chain operation engine, a set of hardware and software modules supporting closed kill chain agents, a series of closed kill chain C2 application software, and a series of closed kill chain combat intelligent terminals.[139] The authors suggest that the results of their research can be embedded into existing command information systems, effectively supporting the rapid response and precision combat needs of the Chinese military and improving operational effectiveness in multiple ways.[140]

6.5.2 Software

Multiple PRC articles referred to the development of specific software to construct or support the construction of kill processes. In some cases, researchers seemed to be exploring applying different types of software to enable the connections required to construct a kill chain. For example, in a 2024 article in *Air and Space Defense*, researchers who focus on advanced technology, intelligent design, and simulation software discuss the merits of applying digital mission engineering software to the construction of kill chains. They also describe the different types of software (kill cloud software control system, kill web software control system, strike chain software control and weapon system) needed to build a cloud-based, software-controlled modular intelligent system that can construct kill chains.[141]

Another example of the development of software intended to enable kill process capabilities is a “land-air collaborative soft bus.” Authors affiliated with a PLA unit and the North Automatic Control Technology Institute (北方自动控制技术研究所, also known as the China Ordnance Industry Group’s 207th Research Institute (中国兵器工业集团第二〇七研究所))[142] propose a distributed collaborative soft bus for land and air to integrate information transmission, distribution, management, and scheduling for tasks associated with the operational requirements of land-air coordinated operations involving multiple service branches. The authors also report that their research results can guide the development of many kinds of equipment (e.g., network-chain integrated communication equipment, air-ground collaborative service scheduling software), provide diversified interactive means (e.g., cross-domain voice, data, reports, and messages for land-air coordinated operations), and enhance integrated combat capabilities (e.g., joint situational awareness, collaborative sensing, synchronization in time and space, and coordination of strikes).[143]

6.6 Conclusion

PRC researchers are undertaking kill process–related research from many distinct angles at the same time. They use a wide range of analytic tools from varied fields (e.g., mathematics, network analysis, systems engineering, business, software development) to do so. Our intent in this section has been to summarize and describe these LOEs.

The depth and scope of this research suggests that researchers have either been given the go-ahead or are taking the initiative to make some assumptions and see what works and what might be worth pursuing. In other words, they are not pursuing this research sequentially (i.e., they are not waiting to perfect the design of kill processes before they seek to model, evaluate, and simulate them); instead, they seek iterative and cumulative progress on multiple LOEs at the same time.

7.0 DETERMINING THE STATUS OF PRC RESEARCH ON KILL PROCESSES IN TERMS OF CONCEPTUALIZATION, DEVELOPMENT, AND DEPLOYMENT

When examining this research, it is useful to think of the PRC adoption of kill processes as part of a three-phase process:

- **Conceptualization.** During this phase, analysts think about the concept kill processes and how to incorporate them.
- **Development.** During this phase, the defense R&D complex develops concrete technologies and capabilities to enable kill processes.
- **Deployment.** During this phase, kill processes would be used in military operations.

Using this construct as a lens to view our data, we make the following observations: The bulk of our data captures PRC analysts' efforts to work through the conceptualization of kill processes. This finding is unsurprising for two reasons: 1) conceptualization efforts are most easily captured in academic journals, and most are the type of content that these journals tend to publish; and 2) conceptualization efforts represent thoughts under consideration rather than policy decisions. Therefore, the content is less sensitive and more likely to be publicly accessible. There is ample evidence that PRC and PLA researchers tie the development of kill processes to future warfare and are conceptualizing both how to counter adversary kill processes and how to incorporate kill processes into PLA operations.

Some evidence suggests that the PRC needed to pursue, develop, and patent technologies to actualize these capabilities within the PRC defense R&D complex. In some cases, researchers are exploring how to apply commercial business capabilities in pursuit of kill process development. We also found efforts to develop hardware and software to design and support kill processes.

Right now, our dataset of PRC-published kill process–related research does not contain PRC and PLA writings that suggest kill webs have been operationalized by China's military. Other than a brief Ministry of National Defense statement about optimizing kill chains in recent PLA exercises, the closest evidence of operationalization in PRC-published research we have found is discussions of simulations or brief references in PLA news articles.[144] This finding is also unsurprising. Any detailed discussion of how kill processes are operationalized is likely highly sensitive and would be less likely to appear in PRC-produced publications. Indeed, U.S. government statements suggest that PRC publications do not fully represent China's progress in operationalizing kill processes (see section 1.1.).

Some possible indicators of a more formal adoption of the construct include the following:

- Companies in the PRC defense industry marketing products geared to support kill chain, kill web, or kill mesh design and optimization

- References to or discussions of kill chains, kill webs, and kill meshes in news coverage about PLA exercises
- Discussion of changes in operations due to incorporation of kill chains or kill webs (e.g., improvements in targeting or time-sensitive, precise strikes)
- References to kill processes in such outlets as military guidance, concepts, and doctrinal writings.

A disconnect persists between the capabilities the PLA shows in modern-day exercises and how PRC researchers discuss their kill chain capabilities. On the one hand, the PLA is demonstrating incipient capabilities to carry out multidomain operations.[145] On the other hand, PRC kill web research suggests that their aspirations are much greater than their current demonstrations of capabilities display. The researchers' assessments suggest that they want to be able to carry out multidomain precision operations at a speed and a scale that they do not currently have. In many ways, the PRC is engaged in conceptualization, development, and deployment at the same time. Nonetheless, PRC and PLA research on kill chains and kill webs may lead to changes and improvements in the short term and the long term.

In the short term, how the PLA uses the results of its research to inform planning, processes, and decisions may allow them to adjust procurement, deployment of forces, allocation of resources, and C2. Simulations and exercises may allow the PLA to assess improvements that may stem from adjustments based on this body of research. However, lessons learned in simulations and exercises are not a substitute for lessons learned from engaging in real-life operations. Short of actual conflict, the PLA could seek to refine certain lessons learned through military operations other than war, such as involvement in disaster response and continued examination of other countries' lessons learned in actual combat (e.g., from information about US, Russian, and Ukrainian operations).

In the long term, if we consider additional factors, such as the latent sensor and communication networks that the PRC is constructing for a variety of purposes (e.g., civilian emergency response in times of peace, national defense mobilization in a time of war) as well as the PRC's intent to build a system that fuses civilian and military resources and capabilities in support of national security (which the PRC calls the Integrated National Strategic System and Capabilities), the PRC may be well positioned to navigate the processes of kill web development and deployment, positioning itself to counter current expectations of future wars.

US analysts may find the current moment a valuable one to monitor PRC and PLA writing about kill processes to see how the discussion evolves, to watch for the types of data that emerge about it, and to be prepared to identify improvements in the PLA's operations as a result of adopting and innovating this construct for PLA use.

APPENDIX: PRC RESEARCHERS CLOSELY FOLLOW U.S. DISCUSSIONS OF KILL PROCESSES

The prospect of confronting the U.S. as an adversary features prominently in PRC-produced writing about kill processes in both explicit and implicit ways. When PRC and PLA experts think about kill processes, the U.S. military plays the role of the pacing threat in future warfare.[146] As a result, PRC researchers closely follow U.S. discussions of kill processes and use them as both a justification for their work (i.e., the U.S. is using this process and we need to be prepared to counter it) and a basis for their research (e.g., providing processes and definitions that they then incorporate into their models and research). There is a sense that establishing a baseline understanding of where the U.S. is vis-à-vis research and technologies for kill processes can help PRC researchers catch up and reduce or eliminate a perceived generation gap between the U.S. and China when it comes to the development, concepts, capabilities, technologies, and employment that enable kill webs.[147]

PRC research about kill processes relies on more than just definitions from U.S. writing—it draws on the logic that underpins the constructs as well. In writings about kill webs, researchers react to and incorporate multiple categories of U.S. kill web writing:

- **US writing about command and control loops and targeting cycles.** PRC writers emphasize the centrality of the OODA loop; the planning, readiness, execution, assessment loop; and the find, fix, track, target, engage, and assess cycle in the logic and cycle of kill chains, kill webs, and kill meshes. In many cases, PRC writers adopt these constructs entirely for their research.
- **Changes in U.S. operating concepts.** PRC writers document the evolution of U.S. thinking about kill processes, tracking changes in U.S. operating concepts including the Navy's Naval Integrated Fire Control-Counter Air, the Joint All-Domain Command and Control, and the Mosaic Warfare concept from the Defense Advanced Research Projects Agency (DARPA). They highlight adjustments in the complexity of U.S. operations as well as shifts from multidomain to all-domain to cross-domain operations. They reference DARPA's Adapting Cross-Domain Kill-Webs concept, algorithmic warfare, and the need for decision-making advantage.
- **US military doctrine.** PRC writers use U.S. military doctrine (e.g., joint publications) as references. For example, one article refers to JP3-60, "Joint Targeting," to define terms and understand how the U.S. distinguishes between time-sensitive and high-value targets.[148]
- **US military demonstrations of capabilities.** PRC writers highlight capabilities demonstrated in U.S. military exercises.[149] Such exercises appear to serve as touch points for PRC writers to see where the U.S. military is in its process of achieving the modernizations envisioned in operating concepts and in operationalizing new technologies. PRC researchers are also monitoring how long it takes for the U.S. military to close kill chains in certain circumstances.

In the context of PRC writing about kill processes, these U.S. operating concepts serve as reference points for how kill processes are evolving and the direction of future war.

GLOSSARY

Artificial intelligence (AI) agents: According to Microsoft, AI agents can be thought of as "intelligent virtual teammates that help businesses work faster by learning, adapting, and making decisions in real time."[150] Different types of agents exist, and they are reshaping how businesses and industries work by streamlining tasks, improving services, and increasing the speed and efficiency with which simple tasks and complex decisions are made. In addition, new innovations (e.g., smarter reasoning) are expanding what AI agents can do.[151] (CNA note: Agents are a rapidly evolving topic. Some of our data specified the way the agent was built or formed (e.g., deep neural network, Deep Q-Network) but not all).

AI reasoning: According to IBM, "Reasoning in artificial intelligence (AI) refers to the mechanism of using available information to generate predictions, make inferences, and draw conclusions. It involves representing data in a form that a machine can process and understand, then applying logic to arrive at a decision."[152] (CNA note: AI reasoning is a rapidly evolving topic. Some of our data specified the type of reasoning the researchers were using (e.g., evidence-based reasoning, knowledge-based reasoning, large language models) but not all).

Digital engineering: According to Ansys, this term can be defined as the use of "computational tools, digital models, and connected data to support the design, test, monitoring, and maintenance of modern-day cyber-physical systems. A digital engineering system consists of a holistic set of engineering practices developed to deal with complex systems, evolving technologies, and pressures to get products to market faster."[153]

Digital mission engineering (DME): This term refers to the use of digital engineering tools in the mission engineering process.[154] According to the Department of War (DoW), advantages of DME include the following characteristics:

- Provides a technical means to communicate across a diverse set of stakeholders
- Allows for traceability from mission tasks to solutions
- Enables the reuse of products to facilitate updates and changes as needed
- Enables common understanding, sharing, and reuse of products across the enterprise[155]

Flexible consumption business models: According to analysts at Deloitte Insights: "Flexible consumption business models (FCMs), also known as 'as-a-Service' or XaaS models, offer customers product delivery and payment options that allow them to purchase access to products as a service."[156] Deloitte Insights notes that this system offers advantages to the customer (e.g., only pay for what you consume) and the provider (e.g., enabling them to serve customers at scale through a common platform, lower operational costs, and create renewable revenue streams).[157]

Mission engineering: According to DoW, this term can be defined as "the deliberate planning, analyzing, organizing, and integrating of current and emerging operational and system capabilities to achieve desired warfighting mission effects."[158] It is an analytic and data-driven approach to decompose and analyze the constituent parts of a mission to identify measurable trade-offs and draw conclusions.[159] DoW offers its own definition: "Mission engineering is an interdisciplinary process encompassing the entire technical effort to analyze, design, and integrate current and emerging operational needs and capabilities to achieve desired mission outcomes."[160]

Ontology: According to the Systems Engineering Research Center, ontology is a type of semantic model that (at its simplest) defines categories of things that are taken to exist and describes the relations between them. This model can be used as an approach for formalizing linked data about and relationships between things (e.g., unmanned aerial vehicles, tanks) in a domain (e.g., military vehicle, projectile launcher). Ontology's methods and tools allow stakeholders with different expertise to leverage the linked data. Basic components include types (hierarchical taxonomies, defined as classes and subclasses), relations (object property relations and data property relations), instances (individuals or objects), and axioms (assertions, including rules).[161]

Order management: According to Oracle, this term can be defined as "the process of order capturing, tracking, and fulfilling customer orders. The order management process begins when an order is placed and ends when the customer receives their package."[162]

ENDNOTES

[1] Heather R. Penney, Mitchell Institute for Aerospace Studies, https://www.mitchellaerospacepower.org/app/uploads/2023/05/Scale_Scope_Speed_Survivability_-KillChain_-Policy_Paper_40-New.pdf. Adam J. Hebert, "Compressing the Kill Chain," *Air & Space Forces Magazine*, Mar. 1, 2003, accessed Oct. 27, 2025, https://www.airandspaceforces.com/article/0303killchain/; John T. Correll, "From Sensor to Shooter," *Air & Space Forces Magazine*, Feb. 1, 2002, accessed Oct. 27, 2025, https://www.airandspaceforces.com/article/0202edit/.

[2] Note: Typically, when discussing kill webs or nets, PRC writers use the characters "杀伤网" and translate them as "kill web." Occasionally, PRC writers translate the characters as "kill net."

[3] U.S. Department of War, "U.S. Department of War Annual Report to Congress: Military and Security Developments Involving the People's Republic of China, 2025," see page 26.

[4] Josh Luckenbaugh, "JUST IN: Space Force Studying How to Break China's Kill Chains," *National Defense Magazine*, Oct. 22., 2024, accessed Jan. 9, 2026, https://www.nationaldefensemagazine.org/articles/2024/10/22/space-force-studying-how-to-break-chinas-long-range-strike-kill-chains.

[5] Josh Dinner, "China Now Has a 'Kill Mesh' In Orbit, Space Force Vice Chief Says," Space.com, Mar. 21, 2025, accessed Jan. 9, 2026, https://www.space.com/space-exploration/space-force-general-warns-of-adversaries-surpassing-us-abilities-in-orbit-we-are-at-an-inflection-point.

[6] Chris Panella, "A More Complicated Kind of Kill Chain is Making China's Missiles a Deadlier Problem for U.S. Forces, a Top General Says," *Business Insider*, July 2, 2025, accessed Jan. 7, 2026, https://www.businessinsider.com/kill-web-makes-chinas-missiles-deadlier-more-accurate-us-general-2025-7.

[7] For example, see Tye Graham and Peter W. Singer, "China's Burgeoning Undersea Sensor Net Aims to Turn the Ocean Transparent: The PLA is Building a Self-Healing 'Kill Web' to Surpass Today's Brittle Kill Chains," Defense One, Oct. 15, 2025, accessed Dec. 4, 2025, https://www.defenseone.com/threats/2025/10/chinas-burgeoning-undersea-sensor-net-aims-turn-ocean-transparent/408815/.

[8] U.S. Department of War, *Joint Publication 1-02: Department of Defense Dictionary of Military and Associated Terms*, Apr. 12, 2001 (as amended through Sept. 2010), accessed 9 Jan. 2026, https://apps.dtic.mil/sti/pdfs/ADA542006.pdf

[9] The author would like to acknowledge CNA analyst David Broyles for his work defining these terms. Dr. Broyles specializes in cyber operations, artificial intelligence and autonomy, special operations, and information warfighting.

[10] Xinhua News Agency (新华社), "Xi Jinping Proposed to Achieve the Centenary Goal of the Founding of the Army and Create a New Situation in the Modernization of National Defense and the Army (习近平提出，实现建军一百年奋斗目标，开创国防和军队现代化新局面)," Oct. 16, 2022, https://www.gov.cn/xinwen/2022-10/16/content_5718831.htm; "Questions and Answers on Xi Jinping's Thought on Strengthening the Military ⑤｜Striding Towards World-Class—On Realizing the Party's Goal of Strengthening the Military in the New Era (习近平强军思想学习问答⑤｜向着世界一流迈进—关于实现党在新时代的强军目标)," China Military Online-PLA Daily (中国军网-解放军报), Jun. 8, 2023, https://ztjy-people-cn.translate.goog/n1/2023/0608/c457389-40009346.html?_x_tr_sch=http&_x_tr_sl=zh-CN&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=sc.

[11] For example, China's 2015 defense white paper hints at "intelligentization," while the 2019 defense white paper lays these stages out more clearly, stating: "There is a prevailing trend to develop long-range precision, intelligent, stealthy or unmanned weaponry and equipment. War is evolving in form toward informationized warfare, and intelligent warfare is on the horizon." The State Council Information Office of the People's Republic of China (国务院新闻办公室), "China's Military Strategy (中国的军事战略)," Ministry of National Defense (国防部), May 26, 2015, http://eng.mod.gov.cn/DefenseNews/2015-05/26/content_4586748.htm; The State Council Information Office of the People's Republic of China (国务院新闻办公室), "China's National Defense in the New Era (新时代的中国国防)," The State Council Information Office of the People's Republic of China (国务院新闻办公室), Jul. 24, 2019, http://www.scio.gov.cn/zfbps/32832/Document/1660314/1660314.htm.

[12] For example, see Tang Zheng (唐政) Chen Chilian (陈赤联), Hu Junfeng (胡军锋), Wang Yu (王瑜), Jiang Xi (姜希), "Data Link 2.0: The Victory Maker of Intelligent War (数据链 2.0：智能化战争的制胜利器)," *Journal of Command and Control (指挥与控制学报)* 6, no. 1 (Mar. 2020).

[13] Sun Xue'an (孙学安) Ruan Kaizhi (阮开智), Tong Yun (仝云), Liang Shuo (梁硕), Xu Tianyang (徐天洋), "Concept for Future Intelligent Kill Webs (未来智能杀伤网构想)," *Air & Space Defense (空天防御)* 7, no. 3 (2024). Zhao Guohong (赵国宏), "SoS-Centric Warfare: Capstone Operational Concept for Future War (体系中心战：未来战争的顶层作战概念)," *Journal of Command and Control (指挥与控制学报)* 7, no. 3 (Sept. 2021). Zhou Xiaoli (周小利), "Intelligent Warfare Perspective—the Unmanned Intelligent Operational System Comprehensively Empowers the Kill Chain (智能化战争面面观——无人智能作战体系全方位赋能杀伤链)," *PLA Daily (解放军报)*, May 27, 2025, accessed Jun. 11, 2025, http://www.xinhuanet.com/milpro/20250527/a29f2a2c7d8d46049f63f62189d697f4/c.html., Hou Kaiyu (侯凯宇) et al., "Research on the Construction of Kill Chains in Beyond-Visual-Range Air Combat Confrontation (超视距空战对抗下的杀伤链构建研究)," *Air & Space Defense (空天防御)* 7, no. 4 (Aug. 2024).

[14] For example, one article notes that modern operations are a confrontation between systems, and militaries need an efficient operational system to win a war. Lyu Hongqing (吕红庆) et al., "Precision Mapping Method of Supernetwork Kill Web Based on Global Sensitivity (基于全局敏感性的超网络杀伤网精度映射方法)," *Journal of Command and Control (指挥与控制学报)* 10, no. 4 (Aug. 2024). A second article emphasizes that future wars will be complex system confrontations that involve a multi-dimensional and full-domain environment, and are characterized by high degrees of intensity, time sensitivity, and uncertainty. Ruan Kaizhi (阮开智), "Concept for Future Intelligent Kill Webs (未来智能杀伤网构想)."

[15] Zhao Guohong (赵国宏), "SoS-Centric Warfare: Capstone Operational Concept for Future War (体系中心战：未来战争的顶层作战概念)." The author is affiliated with the Complex Aircraft Systems Simulation Key Laboratory (复杂飞行器系统仿真重点实验室).

[16] Chen Wenhao (陈文豪) Lu Tongliang (鲁统亮), Ge Bingfeng (葛冰峰), Deng Qiling (邓祁零), "Multi-Layer Network Modeling of Operational Systems Under Information Support (信息支援下的作战体系多层网络建模)," *Systems Engineering and Electronics (系统工程与电子技术)* 44, no. 2 (Feb. 2022).

[17] "Ministry of National Defense: Military Training Across the Armed Forces in 2025 Focused on Combat Readiness, Joint Capabilities, and New Breakthroughs (国防部：2025 年全军军事训练向战聚焦向联聚力向新突破)," Ministry of National Defense, Dec. 25, 2025, accessed Mar. 4, 2026, https://www.news.cn/politics/20251225/7565177b60bb4962bc18ecd1d7374587/c.html.

[18] "With the Approval of the Chairman of the Central Military Commission Xi Jinping, the Central Military Commission issued the 'Chinese People's Liberation Army Joint Operations Outline (Trial)' (经中央军委主席习近平批准中央军委印发《中国人民解放军联合作战纲要 (试行)》)," Xinhua (新华社), Nov. 13, 2020, http://www. xinhuanet.com/2020-11/13/c_1126735392.htm; "Chinese Military Releases Outline to Improve Joint Combat Capabilities," Xinhua, Nov. 13, 2020, http://www.xinhuanet.com/english/2020-11/13/c_139513202.htm.

[19] "Regular Press Conference of the Ministry of National Defense on November 26," China Military Online, Nov. 29, 2020, http://eng.mod.gov.cn/news/2020-11/29/content_4874839.htm.

[20] See David M. Finkelstein, *The PLA's New Joint Doctrine: The Capstone of the New Era Operations Regulations System*, CNA, DOP-2021-U-0306430-Final, Sept. 2021, https://www.cna.org/reports/2021/09/the-plas-new-joint-doctrine.

[21] U.S. Department of War, *U.S. Department of Defense Annual Report to Congress: Military and Security Developments Involving the People's Republic of China, 2025*, 2025, accessed Jan. 15, 2026, https://media.defense.gov/2025/Dec/23/2003849070/-1/-1/1/ANNUAL-REPORT-TO-CONGRESS-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2025.PDF. See p. 19.

[22] U.S. Department of War, *U.S. Department of Defense Annual Report to Congress: Military and Security Developments Involving the People's Republic of China, 2025*. See pp. 16–18. According to CNA Distinguished Research Fellow Dave Finkelstein, "In the world of Chinese military planning and programming, the directives and decisions contained in the Military Strategic Guidelines are the highest-level planning guidance given to the armed forces by the Party. They emanate from the CCP's Central Military Commission under the imprimatur of the Central Military Commission Chairman — who is also usually the General Secretary of the Party, as is Xi Jinping today." David M. Finkelstein, ed., *Comments on China's Military Strategy*, *CNA,* Alexandria, VA, July 10, 2015, 2015.

[23] Li Jingjing (李晶晶) Li Bowen (李博文), Zhang Longjian (张龙剑), Zhao Wei (赵为), Zhan Zihao (占子豪), Xu Weiyang (徐纬阳), Yu Minghui (余明晖), "Research on the Optimization Strategy for Air-to-Air Missile Defense Kill Chains at Sea Based on Evolutionary Meta-Game of Hybrid Clusters (基于混合集群演化元博弈的海上对空反导杀伤链优选策略研究)," *Chinese Journal of Ship Research (中国舰船研究)* (Oct. 11, 2024).

[24] Chen Yonglu (陈永禄) Sun Lina (孙利娜), Chen Zhiwei (陈志伟), "Invulnerability Analysis of Dynamically Reconfigurable Operational Networks Based on Kill Chains (基于杀伤链的动态重构作战网络抗毁性分析)," *Fire Control & Command Control (火力与指挥控制)* 48, no. 2 (Feb. 2023).

[25] Liu Jingxu (刘靖旭), Yu Ru (于茹), and Jiang Bingchuan (蒋秉川), "Comprehensive Evaluation of Battlefield Environmental Effects Based on Evidence Reasoning (基于证据推理的战场环境效应综合评估)," *Military Operations Research and Assessments (军事运筹与评估)* 39, no. 4 (Aug. 2024).

[26] One article describes kill webs as one of many new operational concepts and the main mode for generating operational effectiveness in new combat operations that require multi objective optimization. See Xia Boyuan (夏博远), Yang Kewei (杨克巍), Yang Zhiwei (杨志伟), Zhang Xiaoke (张小可), Zhao Danling (赵丹玲), "Multi-Objective Optimization of Equipment Combination Based on Kill Web Evaluation (基于杀伤网评估的装备组合多目标优化)," *Systems Engineering and Electronics (系统工程与电子技术)* 43, no. 2 (Feb. 2021).

[27] A few examples are Pan Jiyuan (潘积远) et al., "Network and Information Aggregation Superiority Mathematical Problems in Distributed Kill Chains (分布式杀伤链中网络与信息聚优数学问题探析)," *Tactical Missile Technology (战术导弹技术)* 2 (Apr. 2024); Wang Kaisheng (王凯生) and Huang Yanyan (黄炎焱), "Multi-Layer Kill Net Operation Planning Technology for OODA Chain Optimization Closed Loop (面向 OODA 链优化闭环的多层杀伤网作战规划技术)," *Journal of Nanjing University of Science and Technology (南京理工大学学报)* 48, no. 05 (2024); Chen Hong (陈虹), Zhang Hongjiang (张洪江), Ye Xi (叶希), Pan Gang (潘埂), "A Method to Construct a 'Cloud Kill Chain' ('云杀伤链' 构建方法)," *Ordnance Industry Automation (兵工肩劲化)* 43, no. 4 (Apr. 2024); Guan Xingkai (关星凯) et al., "Service-Oriented Operational Chain Construction Process Design for the Cloud-Edge Collaborative Kill Web (云边协同杀伤网的作战链路服务化构建流程设计)," *Journal of Command and Control (指挥与控制学报)* (Nov. 2024); Han Guangsong (韩光松) Wang Zhong (王忠), "Constructing Cross Domain Kill Networks for Time Sensitive Targets (构建时敏目标跨域杀伤网)," *Ship Electronic Engineering (舰船电子工程)* 43, no. 9 (Sept. 2023).

[28] Xia Boyuan (夏博远), "Multi-Objective Optimization of Equipment Combination Based on Kill Web Evaluation (基于杀伤网评估的装备组合多目标优化);" Wan Silai (万斯来) et al., "A Knowledge Reasoning-Based Intelligent Design Method of Kill-Web (基于知识推理的杀伤网智能设计方法)," *Acta Armamentarii (兵工学报)* 45, no. 4 (Apr. 2024); Xia Boyuan (夏博远), "Multi-Objective Optimization of Equipment Combination Based on Kill Web Evaluation (基于杀伤网评估的装备组合多目标优化);" Wu Keyu (吴克宇) Qin Changjiang (秦长江), Cheng Qing (成清), Huang Jincai (黄金才), "Node Importance Evaluation in Dynamic System Based on Kill-Web Contribution Rate (基于杀伤网贡献率的动态体系节点重要度评估)," *Systems Engineering and Electronics (系统工程与电子技术)* 45, no. 6 (Jun. 2023). Lu Tongliang (鲁统亮), "Multi-Layer Network Modeling of Operational Systems Under Information Support (信息支援下的作战体系多层网络建模)."

[29] Hou Kaiyu (侯凯宇) et al., "Research on the Construction of Kill Chains in Beyond-Visual-Range Air Combat Confrontation (超视距空战对抗下的杀伤链构建研究)."

[30] Pan Jiyuan (潘积远) et al., "Network and Information Aggregation Superiority Mathematical Problems in Distributed Kill Chains (分布式杀伤链中网络与信息聚优数学问题探析)."

[31] Sun Xian (孙显) et al., "A Network Information System Modeling and Characteristic Measurement Method for Kill Chain Construction (面向杀伤链构建的网络信息体系建模及特性测度方法)," *Journal of Command and Control (指挥与控制学报)* 11, no. 1 (Feb. 2025).

[32] Sun Xian (孙显) et al., "A Network Information System Modeling and Characteristic Measurement Method for Kill Chain Construction (面向杀伤链构建的网络信息体系建模及特性测度方法)."

[33] Sun Xian (孙显) et al., "A Network Information System Modeling and Characteristic Measurement Method for Kill Chain Construction (面向杀伤链构建的网络信息体系建模及特性测度方法)."

[34] Hu Hai (胡海) Gao Baohui (高保慧), "Research on Operational Concept of Dynamic Kill 一 Webs in Integrated Space, Air, and Sea Maritime Strikes (舰船电子工程_高保慧_天空海一体对海打击动态杀伤网作战概念研究)," *Ship Electronic Engineering (舰船电子工程)* 43, no. 1 (Jan. 2023).

[35] Sun Lina (孙利娜), "Invulnerability Analysis of Dynamically Reconfigurable Operational Networks Based on Kill Chains (基于杀伤链的动态重构作战网络抗毁性分析)."

[36] Zhou Li (周黎) Sun Lijian (孙立健), Zhu Xianqiang (朱先强), Zhang Weiming (张维明), "Conceptual Analysis of Kill Chains (杀伤链概念解析)," *Journal of Information Engineering University (信息工程大学学报)* 24, no. 5 (Oct. 2023).

[37] Liu Xiangyu (刘祥雨) et al., "Kill Chain Design Method for Regional Air Defense Scenarios (面向区域防空场景的杀伤链设计方法)," *Systems Engineering and Electronics (系统工程与电子技术)* (Mar. 2024).

[38] Hou Kaiyu (侯凯宇) et al., "Research on the Construction of Kill Chains in Beyond-Visual-Range Air Combat Confrontation (超视距空战对抗下的杀伤链构建研究)."

[39] Yan Xiaohan (燕笑寒), Chai Hua (柴华), and Xu Qiangqiang (许强强), "Effectiveness Analysis of U.S. Missile Defense System Based on Kill Web Evaluation (基于杀伤网评估的美导弹防御体系效能分析)," *Systems Engineering and Electronics (系统工程与电子技术)* 47, no. 4 (Apr. 2025).

[40] Qian Feng (钱丰) and Zhao Hong (赵红), "Design and Implementation of an Unmanned and Manned Collaborative Kill Chain Engine (有无人协同杀伤链引擎设计与实现)," *Informatization Research (信息化研究)* 49, no. 2 (Apr. 2023).

[41] Liu Yiji (刘益吉) Fan Jinxiang (范晋祥), Li Ning (李宁), Chai Juanfeng (柴娟劳), "Development in the Intelligentization of Precision Strike System of Systems (精确打击体系智能化的发展)," *Air & Space Defense (空天防御)* 6, no. 4 (Dec. 2023).

[42] Wang Zhong (王忠), "Constructing Cross Domain Kill Networks for Time Sensitive Targets (构建时敏目标跨域杀伤网)."

[43] Ruan Kaizhi (阮开智), "Concept for Future Intelligent Kill Webs (未来智能杀伤网构想)."

[44] Wang Zhong (王忠), "Constructing Cross Domain Kill Networks for Time Sensitive Targets (构建时敏目标跨域杀伤网)."

[45] Cao Yajie (曹亚杰) Wang Yuqian (王玉茜), She Xiaoqiong (佘晓琼), Liao Yongyi (廖咏一), "Research on the U.S. Military's Kill Web Concept and Inspiration to Chinese Air Defense Operational Equipment System (美军杀伤网概念研究及对我防空作战装备体系的启示)," *Modern Defense Technology (现代防御技术)* 51, no. 6 (Dec. 2023).

[46] Wang Yuqian (王玉茜), "Research on the U.S. Military's Kill Web Concept and Inspiration to Chinese Air Defense Operational Equipment System (美军杀伤网概念研究及对我防空作战装备体系的启示)."

[47] Chen Lu (陈路) Wang Weiping (王维平), Wang Junmin (王军民), Li Xiaobo (李小波), Zhu Zhi (朱智), "Progress Review and Technical Conception on the Digital Mission Engineering Research for Kill-Chain System-of-Systems (杀伤链体系数字任务工程进展综述与技术构想研究)," *Air & Space Defense (空天防御)* 7, no. 5 (Oct. 2024).

[48] Wang Yuqian (王玉茜), "Research on the U.S. Military's Kill Web Concept and Inspiration to Chinese Air Defense Operational Equipment System (美军杀伤网概念研究及对我防空作战装备体系的启示)."

[49] Ma Jing (马晶) et al., "Analysis of the Winning Mechanism of Algorithmic Warfare from the Perspective of the Kill Chain (杀伤链视角下算法战制胜机理分析)," *Ship Electronic Engineering (舰船电子工程)* 44, no. 8 (Aug. 2024).

[50] Ma Jing (马晶) et al., "Analysis of the Winning Mechanism of Algorithmic Warfare from the Perspective of the Kill Chain (杀伤链视角下算法战制胜机理分析)."

[51] Ma Jing (马晶) et al., "Analysis of the Winning Mechanism of Algorithmic Warfare from the Perspective of the Kill Chain (杀伤链视角下算法战制胜机理分析)."

[52] Ma Jing (马晶) et al., "Analysis of the Winning Mechanism of Algorithmic Warfare from the Perspective of the Kill Chain (杀伤链视角下算法战制胜机理分析)."

[53] Zhao Guohong (赵国宏), "SoS-Centric Warfare: Capstone Operational Concept for Future War (体系中心战：未来战争的顶层作战概念)."

[54] Wang Weiping (王维平), "Progress Review and Technical Conception on the Digital Mission Engineering Research for Kill-Chain System-of-Systems (杀伤链体系数字任务工程进展综述与技术构想研究)."

[55] Qian Feng (钱丰) and Zhao Hong (赵红), "Design and Implementation of an Unmanned and Manned Collaborative Kill Chain Engine (有无人协同杀伤链引擎设计与实现)."

[56] Chen Hong (陈虹), "A Method to Construct a 'Cloud Kill Chain' ('云杀伤链' 构建方法)."

[57] Deng Dasong (邓大松) Zhang Hao (张昊), "Future Outlook and Analysis of 'Counter-Drone by Drone' Kill Chains (未来无人反无人杀伤链展望分析)," *Tactical Missile Technology (战术导弹技术)* 5 (Oct. 2024).

[58] Qian Feng (钱丰) and Zhao Hong (赵红), "Design and Implementation of an Unmanned and Manned Collaborative Kill Chain Engine (有无人协同杀伤链引擎设计与实现)."

[59] Cao Jiang (曹江) Zhao Jinming (赵锦明), Zhou Chifei (周赤非), "Systematic Analysis of the Kill Chain Time Optimization Problem (杀伤链时间优化问题系统分析)," *Journal of Information Engineering University (信息工程大学学报)* 24, no. 6 (Dec. 2023).

[60] Qian Feng (钱丰) and Zhao Hong (赵红), "Design and Implementation of an Unmanned and Manned Collaborative Kill Chain Engine (有无人协同杀伤链引擎设计与实现)."

[61] Liu Gang (刘刚) and Li Ming (季明), "Analysis of the Strike Window for Time-Sensitive Targets in Kill Chains (面向杀伤链的时敏目标打击窗口分析)," *Military Operations Research and Assessments (军事运筹与评估)* 39, no. 5 (Oct. 2024).

[62] Early warning aircraft (预警机) is the Chinese phrase used most frequently in our data, with no acronym or specific platform identified (i.e., most articles do not use the acronym AWACs or AEW&C), though on article distinguished between crewed and uncrewed early warning aircraft.

[63] Gao Baohui (高保慧), "Research on Operational Concept of Dynamic Kill 一 Webs in Integrated Space, Air, and Sea Maritime Strikes (舰船电子工程_高保慧_天空海一体对海打击动态杀伤网作战概念研究)"; Zhao Jinming (赵锦明), "Systematic Analysis of the Kill Chain Time Optimization Problem (杀伤链时间优化问题系统分析)"; also Zhang Hao (张昊), "Future Outlook and Analysis of 'Counter-Drone by Drone' Kill Chains (未来无人反无人杀伤链展望分析)."

[64] Lyu Hongqing (吕红庆) et al., "Precision Mapping Method of Supernetwork Kill Web Based on Global Sensitivity (基于全局敏感性的超网络杀伤网精度映射方法)."

[65] Zhang Hao (张昊), "Future Outlook and Analysis of 'Counter-Drone by Drone' Kill Chains (未来无人反无人杀伤链展望分析)."

[66] Zhao Jinming (赵锦明) et al., "Multiple Unmanned Nodes Edge Service Coverage Method for Constructing Kill Webs (面向杀伤网构建的多无人节点边缘服务覆盖方法)," *Journal of Information Engineering University (信息工程大学学报)* 26, no. 2 (Apr. 2025).

[67] Hou Kaiyu (侯凯宇) et al., "Research on the Construction of Kill Chains in Beyond-Visual-Range Air Combat Confrontation (超视距空战对抗下的杀伤链构建研究)."

[68] Wang Yaozu (王耀祖) et al., "Identification Method of Key Nodes in Operational System-of-Systems Network Based on Kill Chains (基于杀伤链的作战体系网络关键节点识别方法)," *Systems Engineering and Electronics (系统工程与电子技术)* 45, no. 3 (Mar. 2023); Qin Changjiang (秦长江), "Node Importance Evaluation in Dynamic System Based on Kill-Web Contribution Rate (基于杀伤网贡献率的动态体系节点重要度评估)"; Pan Changpeng (潘长鹏), Zhang Yuchen (张雨晨), and Li Chaobo (李超博), "Research on the Evaluation of the Importance of Typical Maritime Kill Chain Nodes Based on Complex Network Centrality Theory (基于复杂网络中心性理论的典型海上杀伤链节点重要度评估研究)," *Aero Weaponry (航空兵器)* 31, no. 5 (Oct. 2024); Wang Yaozu (王耀祖) et al., "Identification Method of Key Nodes in Operational System-of-Systems Network Based on Kill Chains (基于杀伤链的作战体系网络关键节点识别方法)."

[69] Qin Changjiang (秦长江), "Node Importance Evaluation in Dynamic System Based on Kill-Web Contribution Rate (基于杀伤网贡献率的动态体系节点重要度评估)"; Pan Changpeng (潘长鹏), Zhang Yuchen (张雨晨), and Li Chaobo (李超博), "Research on the Evaluation of the Importance of Typical Maritime Kill Chain Nodes Based on Complex Network Centrality Theory (基于复杂网络中心性理论的典型海上杀伤链节点重要度评估研究)."

[70] Chen Chuxiang (陈楚湘) Chen Deng (陈登), Zhou Chunhua (周春华), "Evaluation of the Importance of Kill Network Nodes Based on OODA Loop (基于 OODA 环的杀伤网节点重要性评估)," *Acta Armamentarii (兵工学报)* 45, no. 2 (Feb. 2024).

[71] The AMS researchers list the following strike platforms: a short-range howitzer kill, a long-range rocket launcher, a cruise missile, a short-range ballistic missile, and a shore-to-ship missile. The adversary targets could include drones, crewed or uncrewed missile boats, mobile missile launchers, mobile long-range rocket launchers, and mobile radars, but in one scenario included in the article, the authors use a mobile missile launcher and a transport ship. Liu Gang (刘刚) and Li Ming (季明), "Analysis of the Strike Window for Time-Sensitive Targets in Kill Chains (面向杀伤链的时敏目标打击窗口分析)."

[72] Wang Kaisheng (王凯生) and Huang Yanyan (黄炎焱), "Multi-Layer Kill Net Operation Planning Technology for OODA Chain Optimization Closed Loop (面向 OODA 链优化闭环的多层杀伤网作战规划技术)."

[73] Lu Tongliang (鲁统亮), Chen Wenhao (陈文豪), Ge Bingfeng (葛冰峰), Deng Qiling (邓祁零). "Multi-Layer Network Modeling of Operational Systems Under Information Support (信息支援下的作战体系多层网络建模)," *Systems Engineering and Electronics* (系统工程与电子技术) 44, no. 2 (Feb. 2022): 520-528.

[74] Wang Yushuai (王玉帅) and Si Guangya (司光亚), "Capability Dependency Analysis Based on Kill Chains and FDNA (基于杀伤链和 FDNA 的能力依赖关系分析)," *Journal of System Simulation (系统仿真学报)* 37, no. 4 (Apr. 2025).

[75] Pan Changpeng (潘长鹏), Zhang Yuchen (张雨晨), and Li Chaobo (李超博), "Research on the Evaluation of the Importance of Typical Maritime Kill Chain Nodes Based on Complex Network Centrality Theory (基于复杂网络中心性理论的典型海上杀伤链节点重要度评估研究)."

[76] For example: Huang Meigen (黄美根) et al., "A Dynamic Resource Scheduling Method for C2 Organization in Time-critical Target Strikes (面向时敏目标打击的 C2 组织资源动态调度方法)," *Journal of Command and Control (指挥与控制学报)* 11, no. 1 (Feb. 2025); Xia Boyuan (夏博远), "Multi-Objective Optimization of Equipment Combination Based on Kill Web Evaluation (基于杀伤网评估的装备组合多目标优化)."

[77] Zhang Longjian (张龙剑), Li Jingjing (李晶晶), Fan Huili (范慧丽), Zhang Jiantao (张建涛), Cai Zinuo (蔡子诺), Ma Ruhui (马汝辉), "Generation and Application of a Maritime Adaptive Kill Web Based on Graph Model (基于图模型的海上自适应杀伤网生成与应用)," *Chinese Journal of Ship Research (中国舰船研究),* (2025), doi: Online First Publishing Date: Jan. 6, 2025.

[78] Qian Feng (钱丰) and Zhao Hong (赵红), "Design and Implementation of an Unmanned and Manned Collaborative Kill Chain Engine (有无人协同杀伤链引擎设计与实现)."

[79] Huang Meigen (黄美根) et al., "A Dynamic Resource Scheduling Method for C2 Organization in Time-critical Target Strikes (面向时敏目标打击的 C2 组织资源动态调度方法)."

[80] The Beijing Institute of Technology's School of Mechanical Engineering is under the Ministry of Industry and Information Technology. Wan Silai (万斯来) et al., "A Knowledge Reasoning-Based Intelligent Design Method of Kill-Web (基于知识推理的杀伤网智能设计方法)."

[81] Huang Meigen (黄美根) et al., "A Dynamic Resource Scheduling Method for C2 Organization in Time-critical Target Strikes (面向时敏目标打击的 C2 组织资源动态调度方法)."

[82] Two of the authors are two of whom are also affiliated with National Key Laboratory of Aircraft Configuration Design (飞行器基础布局全国重点实验室). Guan Xingkai (关星凯) et al., "Service-Oriented Operational Chain Construction Process Design for the Cloud-Edge Collaborative Kill Web (云边协同杀伤网的作战链路服务化构建流程设计)."

[83] Liu Xiangyu (刘祥雨) et al., "Kill Chain Design Method for Regional Air Defense Scenarios (面向区域防空场景的杀伤链设计方法)."

[84] Zhao Guohong (赵国宏), “Operational Scenario-based Kill Web Design for Time Sensitive Targets (基于作战场景的时间敏感目标杀伤网设计),” *Journal of Command and Control (指挥与控制学报)* 8, no. 4 (2022).

[85] Liu Jingxu (刘靖旭), Yu Ru (于茹), and Jiang Bingchuan (蒋秉川), “Comprehensive Evaluation of Battlefield Environmental Effects Based on Evidence Reasoning (基于证据推理的战场环境效应综合评估).”

[86] Li Bowen (李博文), “Research on the Optimization Strategy for Air-to-Air Missile Defense Kill Chains at Sea Based on Evolutionary Meta-Game of Hybrid Clusters (基于混合集群演化元博弈的海上对空反导杀伤链优选策略研究).”

[87] Liu Xiangyu (刘祥雨) et al., “Kill Chain Design Method for Regional Air Defense Scenarios (面向区域防空场景的杀伤链设计方法).”

[88] Zhou Jing (周茎) Sun Lijian (孙立健), Zhang Xiaoke (张小可), Zhu Cheng (朱承), Zhang Weiming (张维明), “Analysis and Evaluation of C2 Organizational Structure Supported by a Kill Chain (杀伤链支撑的 C2 组织结构分析与评估),” *Journal of Command and Control (指挥与控制学报)* 8, no. 4 (Dec. 2022).

[89] Sun Lijian (孙立健), “Analysis and Evaluation of C2 Organizational Structure Supported by a Kill Chain (杀伤链支撑的 C2 组织结构分析与评估).”

[90] Sun Lijian (孙立健), “Analysis and Evaluation of C2 Organizational Structure Supported by a Kill Chain (杀伤链支撑的 C2 组织结构分析与评估).”

[91] Zhou Yun (周鋆) Sun Lijian (孙立健), Wei Dingjiang (韦定江), Zhu Cheng (朱承), Zhang Weiming (张维明), “Issues of Large Language Models for C2 Organization (大语言模型在 C2 组织领域的应用分析),” *Journal of Command and Control (指挥与控制学报)* 10, no. 6 (Dec. 2024).

[92] Chen Libin Wang Luyao, Yang Zhiwei, Li Minghao, Yang Kewei, Li Mengjun, “A Prospect-Theory-Based Operation Loop Decision-Making Method for Kill Web,” *Mathematics* 10, no. 3486, doi: Sept. 24, 2022.

[93] The researchers are affiliated with the Nanjing Research Institute of Electronics Technology (南京电子技术研究所; also called “CETC 14th Research Institute,” which is the birthplace of China's radar industry), the National Key Laboratory of Radar Detecting and Sensing (雷达探测感知全国重点实验室), and the Jiangsu Key Laboratory of Detection and Perception Technology (江苏省探测感知技术重点实验室). Zhang Hao (张昊), “Future Outlook and Analysis of ‘Counter-Drone by Drone’ Kill Chains (未来无人反无人杀伤链展望分析).”

[94] Chen Min (陈敏) Chen Jiale (陈加乐), Feng Jinyuan (冯锦元), Pu Zhiqiang (蒲志强), Chen Minjie (陈敏杰), “A Stylized Hierarchical Strategy for Multi-aircraft Collaborative Air Combat (面向多机协同空战的风格化分层策略设计方法),” *Journal of Command and Control (指挥与控制学报)* 11, no. 1 (Feb. 2025).

[95] Ruan Kaizhi (阮开智), “Concept for Future Intelligent Kill Webs (未来智能杀伤网构想).”

[96] Wang Huaijun (王怀军) Cao Chen (曹晨), “The New Characteristics of AEW Aircraft Pattern Evolution in Recent Years (预警机装备形态演变的新特征),” *Journal of China Academy of Electronics and Information Technology (中国电子科学研究院学报)* 19, no. 01 (2024).

[97] Gao Baohui (高保慧), “Research on Operational Concept of Dynamic Kill 一 Webs in Integrated Space, Air, and Sea Maritime Strikes (舰船电子工程_高保慧_天空海一体对海打击动态杀伤网作战概念研究).”

[98] The name of the institute is the Northern Institute of Automatic Control Technology (北方自动控制技术研究所), or the China Ordnance Industry Group’s 207th Research Institute (中国兵器工业集团第二〇七研究所).

[99] Zheng Huali (郑华利) et al., “A Construction Method for an Air-Ground Distributed Coordination Soft Bus (陆空分布式协同软总线构建方法),” *Journal of Command and Control* (指挥与控制学报) 9, no. 4 (Aug. 2023).

[100] Zhang Jin (张锦), Wang Xia (王虾), Guo Xiangke (郭相科), Zhao Minrui (赵敏睿), “Construction and Optimization of Air Defense and Anti-Missile Kill Chains Based on Spatial Crowdsourcing Mode (基于空间众包模式的防空反导杀伤链构建与优化),” *Military Operations Research and Assessments (军事运筹与评估)* 40, no. 1 (Feb. 2025).

[101] Zeng Zheng (曾政) Hu Bing (胡冰), “Application Analysis of Remote Early Warning Systems in Kill Webs (远程预警系统在杀伤网中的应用分析),” *Tactical Missile Technology (战术导弹技术)* 1 (Feb. 2025).

[102] Wang Kaisheng (王凯生) and Huang Yanyan (黄炎焱), "Multi-Layer Kill Net Operation Planning Technology for OODA Chain Optimization Closed Loop (面向 OODA 链优化闭环的多层杀伤网作战规划技术)."

[103] Zhang Hao (张昊), "Future Outlook and Analysis of 'Counter-Drone by Drone' Kill Chains (未来无人反无人杀伤链展望分析)."

[104] Chen Jiale (陈加乐), "A Stylized Hierarchical Strategy for Multi-aircraft Collaborative Air Combat (面向多机协同空战的风格化分层策略设计方法)."

[105] Lyu Hongqing (吕红庆) et al., "Precision Mapping Method of Supernetwork Kill Web Based on Global Sensitivity (基于全局敏感性的超网络杀伤网精度映射方法)."

[106] For example, see: "Insights into the Mechanism of Electromagnetically Empowered New Quality Killing Chain (透视电磁赋能新质杀伤链机理)," *Xinhua*, Nov. 19, 2024, accessed Jun. 11, 2025, http://www.xinhuanet.com/milpro/20241119/be758fb9bd2e4c3787b802fa05389b7e/c.html.

[107] Zhang Hao (张昊), "Future Outlook and Analysis of 'Counter-Drone by Drone' Kill Chains (未来无人反无人杀伤链展望分析)." A second article in a journal sponsored by the China Ship Research and Design Center (中国舰船研究设计中心, a national defense research institution engaged in ship research and design in the PRC) uses the kill chain to experiment with integrating uncrewed drones and uncrewed boats in maritime operations and to figure out how to most efficiently deploy and allocate perception and strike nodes in a particular scenario. Zhang Longjian (张龙剑), "Generation and Application of a Maritime Adaptive Kill Web Based on Graph Model (基于图模型的海上自适应杀伤网生成与应用)." Finally, in an article published in the *Journal of Command and Control* (指挥与控制学报) researchers present an experiment with crewed-uncrewed teaming intended to help multi-aircraft collaborative air operational decision-making, enable the uncrewed aircraft group to adjust its own operational style depending on its opponent, and prepare the uncrewed aircraft group to deal with multiple opponents. Chen Jiale (陈加乐), "A Stylized Hierarchical Strategy for Multi-aircraft Collaborative Air Combat (面向多机协同空战的风格化分层策略设计方法)."

[108] Gao Baohui (高保慧), "Research on Operational Concept of Dynamic Kill 一 Webs in Integrated Space, Air, and Sea Maritime Strikes (舰船电子工程_高保慧_天空海一体对海打击动态杀伤网作战概念研究)." The second article by these researchers is: Hu Hai (胡 海) Gao Baohui (高保慧), Zhong Zhitong (钟志通), Meng Hao (孟 浩), Sun Xinxuan (孙新轩), "Kill Chain Construction in Surface Strikes Under Space-based Guidance (天基引导对海打击杀伤链构建方法)," *Journal of Command and Control (指挥与控制学报)* 10, no. 2 (2024).

[109] Sun Lijian (孙立健), "Analysis and Evaluation of C2 Organizational Structure Supported by a Kill Chain (杀伤链支撑的 C2 组织结构分析与评估)."

[110] Zhao Jinming (赵锦明) et al., "Multiple Unmanned Nodes Edge Service Coverage Method for Constructing Kill Webs (面向杀伤网构建的多无人节点边缘服务覆盖方法)."

[111] Several of the most recently published articles that we identify in this report tie kill process research to specific military technologies or assessments of military exercises. For example, one article uses kill process research to analyze how large-sale LEO satellite constellations can enable faster precision strikes. A second article examines how text data from military exercises can be evaluated to assess operational effectiveness using kill process research. See Yang Ruochen (杨若辰), Cheng Su (成谡), Zhao Hainan (赵海楠), "Military Potential Analysis of Large-scale Low-Earth-Orbit Constellations and Their Application in the Kill Web of Precision Guidance (巨型低轨星座军事潜力分析及其在精确制导领域杀伤网中的应用)." *Journal of Projectiles, Rockets, Missiles and Guidance* (弹箭与制导学报), 45.05(2025):591-601; Gao Xin (高鑫), Chu Yang (初阳), "A Methodology for Extracting Kill Chain Information from Military Exercise Text Data (面向演训文本数据的杀伤链信息提取方法)." *Command Control & Simulation* (指挥控制与仿真), Oct. 31, 2025.

[112] A body of research examining kill processes and cyber operations exists; however, we did not examine it in the context of this research effort, during which we focused more narrowly on air and maritime defense operations.

[113] Our data include the following numbers of articles published in each year of this window: 2020: 1 article published; 2021: 2 articles published; 2022: 8 articles published; 2023: 19 articles published; 2024: 34 articles published; 2025: 19 (as of approximately May 2025).

[114] Wan Silai (万斯来) et al., "A Knowledge Reasoning-Based Intelligent Design Method of Kill-Web (基于知识推理的杀伤网智能设计方法)."

[115] Wan Silai (万斯来) et al., "A Knowledge Reasoning-Based Intelligent Design Method of Kill-Web (基于知识推理的杀伤网智能设计方法)."

[116] Ruan Kaizhi (阮开智), "Concept for Future Intelligent Kill Webs (未来智能杀伤网构想)."

[117] Wan Silai (万斯来) et al., "Modeling and Optimization Method of Kill Chains Based on AGE-MOEA (基于 AGE-MOEA 的杀伤链建模与优化方法)," *Acta Armamentarii (兵工学报)* 45, no. 8 (Aug. 2024).

[118] Wan Silai (万斯来) et al., "Modeling and Optimization Method of Kill Chains Based on AGE-MOEA (基于 AGE-MOEA 的杀伤链建模与优化方法)"; Lei Hongtao (雷洪涛) et al., "A Method of Analysis, Construction and Resilience Optimization for Kill Chains (杀伤链分析构建与韧性优化方法)," *Journal of Command and Control (指挥与控制学报)* 10, no. 6 (Dec. 2024).

[119] Wang Yushuai (王玉帅) and Si Guangya (司光亚), "Capability Dependency Analysis Based on Kill Chains and FDNA (基于杀伤链和 FDNA 的能力依赖关系分析)."

[120] Chen Wenyu (陈文钰) et al., "Calculating System Operational Capability Using an Interactive Network Approach (基于作战交互网络的体系作战能力计算)," *Acta Armamentarii (兵工学报)* 44, no. 10 (Oct. 2023).

[121] Zhao Guohong (赵国宏), "Operational Scenario-based Kill Web Design for Time Sensitive Targets (基于作战场景的时间敏感目标杀伤网设计)."

[122], Wu Xiaoying (邹潇莹) et al., "A Method for Assessing the Resilience of Operational Systems Based on Temporal Networks (基于时序网络的作战体系韧性评估方法)," *Journal of Air & Space Early Warning Research (空天预警研究学报)* 38, no. 6 (Dec. 2024).

[123] We saw two other variations in PRC research: a discover-launch-lock-complete-feedback method and a discover and identify, analyze and evaluate, operate and execute method. See Ma Jing (马晶) et al., "Analysis of the Winning Mechanism of Algorithmic Warfare from the Perspective of the Kill Chain (杀伤链视角下算法战制胜机理分析)."; Liu Jingxu (刘靖旭), Yu Ru (于茹), and Jiang Bingchuan (蒋秉川), "Comprehensive Evaluation of Battlefield Environmental Effects Based on Evidence Reasoning (基于证据推理的战场环境效应综合评估)."

[124] For example, see Wan Silai (万斯来) et al., "Modeling and Optimization Method of Kill Chains Based on AGE-MOEA (基于 AGE-MOEA 的杀伤链建模与优化方法)"; Liu Xiangyu (刘祥雨) et al., "Kill Chain Design Method for Regional Air Defense Scenarios (面向区域防空场景的杀伤链设计方法)."

[125] Gao Baohui (高保慧), "Kill Chain Construction in Surface Strikes Under Space-based Guidance (天基引导对海打击杀伤链构建方法)."

[126] Wu Xiaoying (邹潇莹) et al., "A Method for Assessing the Resilience of Operational Systems Based on Temporal Networks (基于时序网络的作战体系韧性评估方法)."

[127] Chen Jiale (陈加乐), "A Stylized Hierarchical Strategy for Multi-aircraft Collaborative Air Combat (面向多机协同空战的风格化分层策略设计方法)."

[128] Liu Jingxu (刘靖旭), Yu Ru (于茹), and Jiang Bingchuan (蒋秉川), "Comprehensive Evaluation of Battlefield Environmental Effects Based on Evidence Reasoning (基于证据推理的战场环境效应综合评估)."

[129] Zhao Zejing (赵泽靖), Shang Junliang (尚军亮), and Qin Yanpei (秦焰培), "Research on Kill Chain Effectiveness Evaluation Model Based on Gray DEMATEL-ANP (基于灰色 DEMATEL-ANP 的杀伤链效能评估模型研究)," *Journal of System Simulation (系统仿真学报)*, no. Online First (Apr. 2024).

[130] Ruan Kaizhi (阮开智), "Concept for Future Intelligent Kill Webs (未来智能杀伤网构想)."

[131] Zhang Hao (张昊), "Future Outlook and Analysis of 'Counter-Drone by Drone' Kill Chains (未来无人反无人杀伤链展望分析)."

[132] The vernacular is: 某通用体系对抗仿真推演平台. Wan Silai (万斯来) et al., "A Knowledge Reasoning-Based Intelligent Design Method of Kill-Web (基于知识推理的杀伤网智能设计方法)."

[133] Zhao Zejing (赵泽靖), Shang Junliang (尚军亮), and Qin Yanpei (秦焰培), "Research on Kill Chain Effectiveness Evaluation Model Based on Gray DEMATEL-ANP (基于灰色 DEMATEL-ANP 的杀伤链效能评估模型研究)."

[134] The vernacular is: 某综合性的对抗仿真系统实现. The figure depicts a scene in an island reef dispute in the Pacific Ocean where the Blue side controls the waters near the island reef and the Red side receives an order that Red forces must regain control of the waters near the island reef. In the simulation, the Blue side's forces are unknown. The Red side, meanwhile, has four destroyers (each equipped with one antisubmarine aircraft and one drone) and deploys sonar buoys to help it identify the location of the Blue side's submarines, fighter aircraft, and ships. According to the simulation, a Red destroyer is able to strike Blue targets. Han Minglei (韩明磊) et al., "Research on an Assessment System for Kill Chains on the Maritime Battlefield Based on Agent Modeling (基于 Agent 建模的海战场杀伤链评估系统研究)," *Computer Simulation (计算机仿真)* 39, no. 3 (Mar. 2022).

[135] Wan Silai (万斯来) et al., "A Knowledge Reasoning-Based Intelligent Design Method of Kill-Web (基于知识推理的杀伤网智能设计方法)."

[136] Wan Silai (万斯来) et al., "A Knowledge Reasoning-Based Intelligent Design Method of Kill-Web (基于知识推理的杀伤网智能设计方法)."

[137] Note that the National Key Laboratory of Aircraft Configuration Design (飞行器基础布局全国重点实验室) was jointly established by Northwestern Polytechnical University and the First Aircraft Design Institute of Aviation Industry Corporation of China, Ltd. (中航工业一飞院)). Guan Xingkai (关星凯) et al., "Service-Oriented Operational Chain Construction Process Design for the Cloud-Edge Collaborative Kill Web (云边协同杀伤网的作战链路服务化构建流程设计)."

[138] Guan Xingkai (关星凯) et al., "Service-Oriented Operational Chain Construction Process Design for the Cloud-Edge Collaborative Kill Web (云边协同杀伤网的作战链路服务化构建流程设计)."

[139] The vernacular used for "closed" in this series is 闭合. Although undefined, the term may relate to an emphasis on the closed loop needed for a kill chain.

[140] Qian Feng (钱丰) and Zhao Hong (赵红), "Design and Implementation of an Unmanned and Manned Collaborative Kill Chain Engine (有无人协同杀伤链引擎设计与实现)."

[141] Note that the researchers' affiliations include the Hunan Institute of Advanced Technology (湖南先进技术研究), the National Center of Technology Innovation for Intelligent Design and Numerical Control (国家智能设计与数控技术创新中心; the center is under the Ministry of Science and Technology and focuses on critical links in the innovation chain from science to technology transfer in intelligent design), Suzhou Tongyuan Soft Control Information Technology Co., Ltd. (苏州同元软控信息技术有限公司; the company focuses on next-generation cyber-physical system computing and simulation industrial software products), and NUDT's College of Systems of Engineering. Wang Weiping (王维平), "Progress Review and Technical Conception on the Digital Mission Engineering Research for Kill-Chain System-of-Systems (杀伤链体系数字任务工程进展综述与技术构想研究)."

[142] A recent description of this institution describes it as a specialized research institute that focuses on fire control, C2, military computer technology, computer software development and system integration, network communication, and information security product development. The description claims that the institute is the "overall institute for information technology development of the PLA Army equipment" (陆军装备信息化总体所) and that it shoulders the responsibility for overall design and development of an equipment information integration team.

[143] Zheng Huali (郑华利) et al., "A Construction Method for an Air-Ground Distributed Coordination Soft Bus (陆空分布式协同软总线构建方法)."

[144] "Ministry of National Defense: Military Training Across the Armed Forces in 2025 Focused on Combat Readiness, Joint Capabilities, and New Breakthroughs (国防部：2025 年全军军事训练向战聚焦向联聚力向新突破," Ministry of National Defense (国防部), Dec. 25, 2025, accessed Mar. 4, 2026, https://www.news.cn/politics/20251225/7565177b60bb4962bc18ecd1d7374587/c.html.

[145] The recent PLA exercise Justice Mission 2025 (正义使命—2025), which took place December 29-30, 2025, is one example of the PLA's ability to conduct multidomain operations. Per a report on Janes.com, this exercise featured joint operations by the PLA's air, land, naval, and rocket forces as well as the China Coast Guard. It also demonstrated the PLA's ability to compress warning times and initiate large-scale drills with minimal notice. Janes, "Special Report: Justice Mission 2025 Sheds Further Light on China's Maritime Playbook for a Taiwan Contingency," Jan. 19, 2026, accessed Feb. 20, 2026, https://www.janes.com/osint-insights/defence-and-national-security-analysis/justice-mission-2025-sheds-light-on-maritime-playbook-for-taiwan-contingency.

[146] For example, three researchers associated with a research institute that is a subsidiary of CASIC and one researcher associated with a PLA unit write that the U.S. military's kill web concept is an upgrade of its kill chain concept, is consistent with the concept of full-domain operations, and may profoundly change modern warfare and have a huge impact on China. They argue that China's future equipment system should be developed with these changes in mind. Wang Yuqian (王玉茜), "Research on the U.S. Military's Kill Web Concept and Inspiration to Chinese Air Defense Operational Equipment System (美军杀伤网概念研究及对我防空作战装备体系的启示)."

[147] For example, one article states this explicitly, saying that the results of the research provide a reference for eliminating the "generation gap" with the U.S. military vis a vis digital mission engineering, enabling the PRC to catch up, and "to strive to be on the same starting line with the U.S. military." Wang Weiping (王维平), "Progress Review and Technical Conception on the Digital Mission Engineering Research for Kill-Chain System-of-Systems (杀伤链体系数字任务工程进展综述与技术构想研究)."

[148] For example: Liu Gang (刘刚) and Li Ming (李明), "Analysis of the Strike Window for Time-Sensitive Targets in Kill Chains (面向杀伤链的时敏目标打击窗口分析)."

[149] For example, PRC authors point to the U.S. Army's 2020 and 2021 Project Convergence exercises. According to PRC writers, in the 2020 exercise, through the use of cloud computing, space-based satellite technology (Starlink satellites), and AI, the exercise shortened the complete kill chain from satellite and drone reconnaissance to artillery fire to within 20 seconds, significantly shortening the response time of the "reconnaissance-command-action" kill chain. See Sun Lijian (孙立健), "Conceptual Analysis of Kill Chains (杀伤链概念解析)"; (2) Wang Zhong (王忠), "Constructing Cross Domain Kill Networks for Time Sensitive Targets (构建时敏目标跨域杀伤网)"; (3) Yu Jun (俞俊) Yang Xin (杨歆), "The U.S. Military Pays Great Attention to the 'Starlink' Plan (美军高度关注"星链"计划)," *China Military Online*, Feb. 28, 2022, accessed Jun. 11, 2025, http://www.81.cn/gfbmap/content/2022-02/28/content_310316.htm. A second example discusses the 2021 exercise (which according to one PRC writer focused on the battlefield environment between the first and second island chains in the Western Pacific region), during which U.S. military services practiced a joint full-domain firepower strike operational kill chain and tested the effectiveness of various types of operational chains, such as reconnaissance chains, strike chains, and support chains in complex confrontation environments. See Wang Zhong (王忠), "Constructing Cross Domain Kill Networks for Time Sensitive Targets (构建时敏目标跨域杀伤网)." In a third example, a writer notes the verification of four AI systems ("Rainmaker," "Prometheus," "Firestorm" (FIRESTORM), and "Shooting" (SHOT)) and the opening up of killing links, including multisource reconnaissance data fusion, autonomous auxiliary command decision-making, intelligent operational mission planning, optimized selection of strike weapons, high-speed target indication and aiming, and comprehensive evaluation of strike effects. See He Yin (何银) Mou Di (牟迪), Yan Run (燕闰), Chen Jing (陈静), "Research on a Multi-Domain Joint Operational System Based on Near-Space (基于临近空间的多域联合作战体系研究)," *Aerospace China (中国航天)*, no. 11 (Nov. 2024).

[150] Microsoft, "AI Agent Types and Uses," accessed Feb. 19, 2026: https://www.microsoft.com/en-us/microsoft-copilot/copilot-101/ai-agents-types-and-uses

[151] Microsoft, "AI Agent Types and Uses," accessed Feb. 19, 2026: https://www.microsoft.com/en-us/microsoft-copilot/copilot-101/ai-agents-types-and-uses

[152] Rina Diane Caballar, Cole Stryker, "What is Reasoning in AI?," IBM, https://www.ibm.com/think/topics/ai-reasoning#:~:text=AI%20reasoning%20is%20the%20process%20of%20using,to%20analyze%20data%20from%20the%20knowledge%20base.

[153] Ansys, "What is Digital Engineering?", accessed Feb. 19, 2026: https://www.ansys.com/simulation-topics/what-is-digital-engineering.

[154] According to the DoW Office of the Under Secretary of Defense for Research and Engineering Mission Capabilities, "Examples of digital tools include physics-based, behavior-based, and effects-based simulations, as well as model-based or enterprise architecture software. These tools provide a quantitative, or computational and logical means, to trace, analyze, and evaluate a variety of factors that impact the end-to-end mission." U.S. Department of War Office of the Under Secretary of Defense for Research and Engineering Mission Capabilities, "Mission Engineering Guide, Version 2.0," Oct. 1, 2023, accessed Jan. 30, 2026: https://ac.cto.mil/wp-content/uploads/2023/11/MEG_2_Oct2023.pdf. See page 6.

[155] U.S. Department of War Office of the Under Secretary of Defense for Research and Engineering Mission Capabilities, "Mission Engineering Guide, Version 2.0," Oct. 1, 2023, accessed Jan. 30, 2026: https://ac.cto.mil/wp-content/uploads/2023/11/MEG_2_Oct2023.pdf. See page 6.

[156] Abhi Arora, Gopal Srinivasan, Isaac Khan, Deloitte Insights, "The Move Toward Flexible Consumption Models," Aug. 3, 2018, accessed Jan. 30, 2026: https://www.deloitte.com/us/en/insights/topics/business-strategy-growth/as-a-service-business-model-flexible-consumption.html

[157] Abhi Arora, Gopal Srinivasan, Isaac Khan, Deloitte Insights, "The Move Toward Flexible Consumption Models," Aug. 3, 2018, accessed Jan. 30, 2026: https://www.deloitte.com/us/en/insights/topics/business-strategy-growth/as-a-service-business-model-flexible-consumption.html

[158] U.S. Department of War Office of the Under Secretary of Defense for Research and Engineering Mission Capabilities, "Mission Engineering," accessed Feb. 19, 2026: https://ac.cto.mil/mission-engineering/.

[159] U.S. Department of War Office of the Under Secretary of Defense for Research and Engineering Mission Capabilities, "Mission Engineering," accessed Feb. 19, 2026: https://ac.cto.mil/mission-engineering/.

[160] U.S. Department of War Office of the Under Secretary of Defense for Research and Engineering Mission Capabilities, "Mission Engineering Guide, Version 2.0," Oct. 1, 2023, accessed Jan. 30, 2026: https://ac.cto.mil/wp-content/uploads/2023/11/MEG_2_Oct2023.pdf. See page 3.

[161] Systems Engineering Research Center, *Handbook on Digital Engineering with Ontologies*, Jun. 2025, accessed Jan. 30, 2026: https://www.cto.mil/wp-content/uploads/2025/06/SERC_Handbook-on-Digital-Engineering-with-Ontologies_2.0.pdf. Note: The Systems Engineering Research Center (SERC) is a U.S. federally funded University Affiliated Research Center managed by Stevens Institute of Technology. See pages 2, 47, 52,

[162] Oracle, "What is Order Management?" accessed Feb. 19, 2026: https://www.oracle.com/scm/order-management/what-is-order-management/.