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Key Points

Kill chains are a process to find, fix, track, target, and engage targets, then determine strike results. Completing precision strike kill chains at scale is the foundation to prevailing in armed conflict. Kill chains are systems of systems that consist of sensors, strike platforms, the weapons they deliver, and the networks they use to share information.

The development of increasingly effective kill chains and countermeasures to defeat them can be described as a long-term competition. China's PLA has developed kinetic and non-kinetic countermeasures to degrade or defeat every step in the U.S. military's kill chains at scale.

The U.S. Air Force must continuously evolve its kill chains to optimize their scale, scope, speed, and survivability to win the kill chain competition against the PLA in a major Pacific conflict.

To maintain its kill chain superiority in the near-to-mid-term, the Air Force must increase its capacity of F-35 and B-21 aircraft that are capable of independently closing kill chains in communications degraded or denied environments.

The Air Force should incorporate kill chains that consist of disaggregated families of systems that are more resilient and difficult to defeat into its force design in the long-term. To outpace PLA countermeasures, Air Force air battle managers must have the tools and authority to define and construct kill chains using these disaggregated systems in real-time.

Scale, Scope, Speed & Survivability: Winning the Kill Chain Competition

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Abstract

"Kill chain" describes the process militaries use to attack targets in the battlespace. The kill chain can be broken down into specific steps—find, fix, track, target, engage, and assess—that enable planners to build and task forces for combat operations. The U.S. military has long relied upon its superior ability to rapidly close kill chains against adversaries. This advantage is now at risk. China has developed countermeasures to obstruct or collapse U.S. kill chains, which could lead to combat failures that have devastating, long-term consequences for the security of the United States and its allies and partners.

To overcome these challenges, the Air Force must increase the scale, scope, speed, and survivability of its kill chains. In practice, the service must determine specific kill chain capability objectives for each of these attributes:

- Scale: The number of simultaneous kill chains a military can close.
- Scope: The distance, area, and duration over which a military can prosecute targets.
- Speed: The ability of a military to outpace adversary countermeasures to deny, disrupt, or break its kill chains.
- Survivability: How well a military maintains the integrity and effectiveness of its kill chains, even under attack.

In the near-to-mid-term, 5th and 6th generation combat aircraft will be crucial to assure kill chain dominance because they are consolidated "sensor-shooter" nodes that can *independently* close kill chains and facilitate the completion of other missions in localized areas of contested battlespaces. These aircraft will continue to provide air battle managers the necessary tools to rapidly compose resilient kill chains well into the future as the U.S. Air Force migrates toward a family-of-systems approach. Over the long term, the Air Force's advanced battle management system (ABMS) system of systems must support kill chains that are highly resilient, interoperable, and have large numbers of distributed nodes that are more difficult for a peer aggressor to defeat.

Introduction

"Kill Chain" is a colloquial term that describes the process militaries use to attack targets in the battlespace, or, as a combat pilot might say, "deliver bombs on target on time." Success in warfare comes down to a military's ability to create decisive combat effects in the battlespace. These effects may be kinetic, such as destroying an enemy missile launcher using a laser-guided bomb, or non-kinetic, like electronically jamming an adversary's radars. To create these effects, military forces must find targets, fix their position or track them if targets are moving, target and engage them with precision, and finally determine if their attacks have succeeded. Completing this process is called "closing" kill chains. It does not matter how many weapons, aircraft, tanks, ships, and satellites a military might have or how exquisite its sensors and processors might be if it cannot close kill chains at the scale, scope, speed, and with the degree of survivability needed to win.

The U.S. military's decisive advantage in combat has long relied upon its superior ability to close kill chains against adversaries. This advantage is now at risk. China has observed how kill chain dominance has enabled U.S. forces to swiftly prosecute targets with near impunity, and it has subsequently developed strategies and capabilities to obstruct or collapse the ability of the United States to close kill chains. One such warfighting strategy, called "system destruction," is designed to obstruct kill chains by jamming U.S. datalinks and communications, degrading or destroying U.S. sensors and shooters across all domains, and forcing U.S. and coalition forces to operate outside the ranges they need to independently locate and employ weapons against targets in the first place. The capabilities China has designed as part of this strategy are, indeed, eroding the U.S. military's ability to close its kill chains at the scale and speed required for decisive operations during a peer conflict. If the United States is unable to maintain kill chain dominance in the face of these challenges, it greatly increases the risk of losing a conflict with China.

The Air Force must evolve its kill chains if it is to maintain a decisive advantage in a peer conflict. In the future, air battle managers at the forward edge of engagements with enemy forces will be the key to identifying, composing, and managing disaggregated kill chains at the speed and scale required for peer conflict.

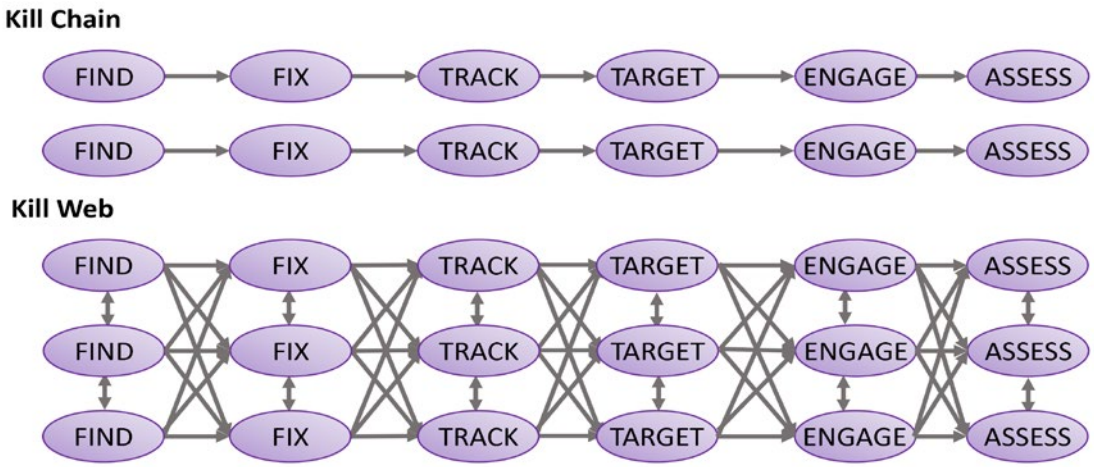

Figure 1: Comparison of Linear Kill Chain and Kill Web. Linear kill chains are difficult to scale and easy to target. Kill webs offer redundant and multiple paths through compatible and functional nodes, thus increasing the quantity and resiliency of potential kill chains.

Credit: Mitchell Institute

In the near-to-mid-term, 5th and 6th generation combat aircraft will be crucial to assure kill chain dominance because they have the advanced sensors, processing power, and other capabilities needed to initiate and complete every step of the kill chain process. In other words, they are consolidated "sensor-shooter" nodes that can *independently* close kill chains and facilitate the completion of other missions in localized areas of contested battlespaces.

Since the mid-2000s, the Air Force has operated an inventory of combat aircraft that is the smallest and oldest it's operated since it became a separate service in 1947.[1] To make the most of this diminished force, the Air Force must rapidly field new capabilities and develop new operational concepts that create more flexible, resilient, and lethal kill chain options. Identifying, building, and executing these kill chains in real-time is a primary objective of the Air Force's Advanced Battle Management System (ABMS) program. ABMS will increase the number of possible kill chain pathways across different operating domains by connecting and rapidly sharing information across a large network of sensors and platforms. This is intended to increase the U.S. military's kill chain resiliency against Chinese countermeasures. For instance, instead of separate and linear kill chains, ABMS could help create "kill webs" that operate much like self-healing mesh networks. The loss of one node or datalink in a linear kill chain could prevent mission success, while the multiple nodes, datalinks, and other capabilities available in kill webs create other options to complete the find, fix, track, target, and engage process. Moreover, disaggregating kill chains in this way will create additional opportunities for warfighters to use sensors, platforms, and weapons from multiple services and across domains to create effects in the battlespace. This further reduces the predictability of the overall operational system, frustrating Chinese countermeasures and thus increasing the effectiveness of U.S. kill chain operations.

The Air Force will need capabilities like stealthy 5th and 6th generation aircraft that can independently close kill chains in highly contested environments to achieve its broader vision of more disaggregated, diversified kill chain operations.

As aggressively as the Air Force is working to develop the technologies, operational concepts, architecture, and other enablers for ABMS, they are still not mature. Moreover, even when disaggregated ABMS-enabled kill chains are mature, they will be operationally complex, require specialized processing, and be difficult to manage at the speed and scale required in a peer conflict. Their networks will also remain vulnerable to attack. A future force consisting predominately of 5th and 6th generation combat aircraft will reduce risk and increase mission flexibility for U.S. forces operating in localized contested areas when long-range networks, command and control, or other external supporting kill chain capabilities are degraded or denied. This means the Air Force will still need capabilities like stealthy 5th and 6th generation aircraft that can *independently close kill chains in highly contested environments* to achieve its broader vision of more disaggregated, diversified kill chain operations.

Why Kill Chains Matter

The kill chain competition is one of the foundational struggles that underpin military conflicts. Many strategic competitions to secure and assert an advantage in capabilities, capacity, geography, and industrial and financial resources can shift the balance of a conflict to one side or the other. Indeed, advantages in these areas can make a significant difference in conflict outcomes, which is why they are major defense priorities for many states in both peace and war. Yet any advantages in these areas will not matter if