

MITCHELL INSTITUTE
for Aerospace Studies



**Scale, Scope, Speed, and
Survivability:
Winning the Kill Chain Competition**

**Heather Penney
Senior Fellow**



Why this report now?

**Department of the Air Force
Operational Imperatives**

"The heart of our mission is to deter aggression. We don't want to fight wars – we want to prevent them – and the way you prevent conflicts is to convince the other side that you have the will to resist and the capability to defeat aggression." – Secretary Kendall

WHAT
The operational imperatives are the critical operational capabilities and functions the Department of the Air Force must possess to protect the United States, deny to our conflict and project power against pacing challenges.

• The success of our military depends upon the ability to control the air and space. Achieving these imperatives and enabling the Air Force and Space Force to maintain our competitive advantages. This is the change we must accelerate in order to win.

WHY
China is fielding capabilities designed to defeat the United States' ability to project power in the Western Pacific; Russia is attempting the same in Eastern Europe.

- While China and Russia have been building capabilities to defeat U.S. power projection and strengthen their grip in their respective regions, the U.S. announced a global call in 2021 to fight terrorism. Defeating a counterinsurgency threat represented a very different type of conflict against a very different type of opponent, using very different types of equipment than the pacing challenges we face today. The capabilities needed to conduct counterinsurgency are different than those needed to keep pace with modern peer nations.

SPACE ORDER OF BATTLE

SITUATION
The space environment on earth has only grown over time. Our potential adversaries have operationalized space to enable attacks on our terrestrial operations and to deny joint and combined forces the services from space that they depend on.

CHALLENGE
We need to protect our space capabilities, protect the services that we provide from space to our joint forces, and defend the other space capabilities, which try to do the same thing to their forces.

APPROACH
• The Department of the Air Force needs to focus its space-related operations on resilient space missions – meaning our space-based capabilities can be protected, access denied, degraded or denied, under attack, and be reconstituted as a result of the disruption.
• The other half of that equation has been recognizing that space-based military capabilities as they are attacked or new technology can be used. We must recognize and develop a robust adversary's space-based ability to attack our terrestrial assets, especially our high-value ground operations assets.

OPERATIONAL IMPERATIVE 1

OPERATIONALLY FOCUSED ABMS

SITUATION
The current ABMS is that using robust networking capabilities, communications capabilities, artificial intelligence, and data analytics for a number of systems, and providing a common integrity will support significantly improved intelligence, decision, and control and afford force employment.

CHALLENGE
We must identify and invest in the specific applications of ABMS that provide a measurable operational advantage to our warfighters.

APPROACH
The Department must move beyond conceptual demonstrations and experiments to focus investments on specific capabilities with their quantifiable mission value and operational impact.

MOVING TARGET ENGAGEMENT

SITUATION
The operations should being able to identify, track, and engage numerous targets simultaneously, which will take a mix of air and space-based capabilities.

OPERATIONAL IMPERATIVE 3



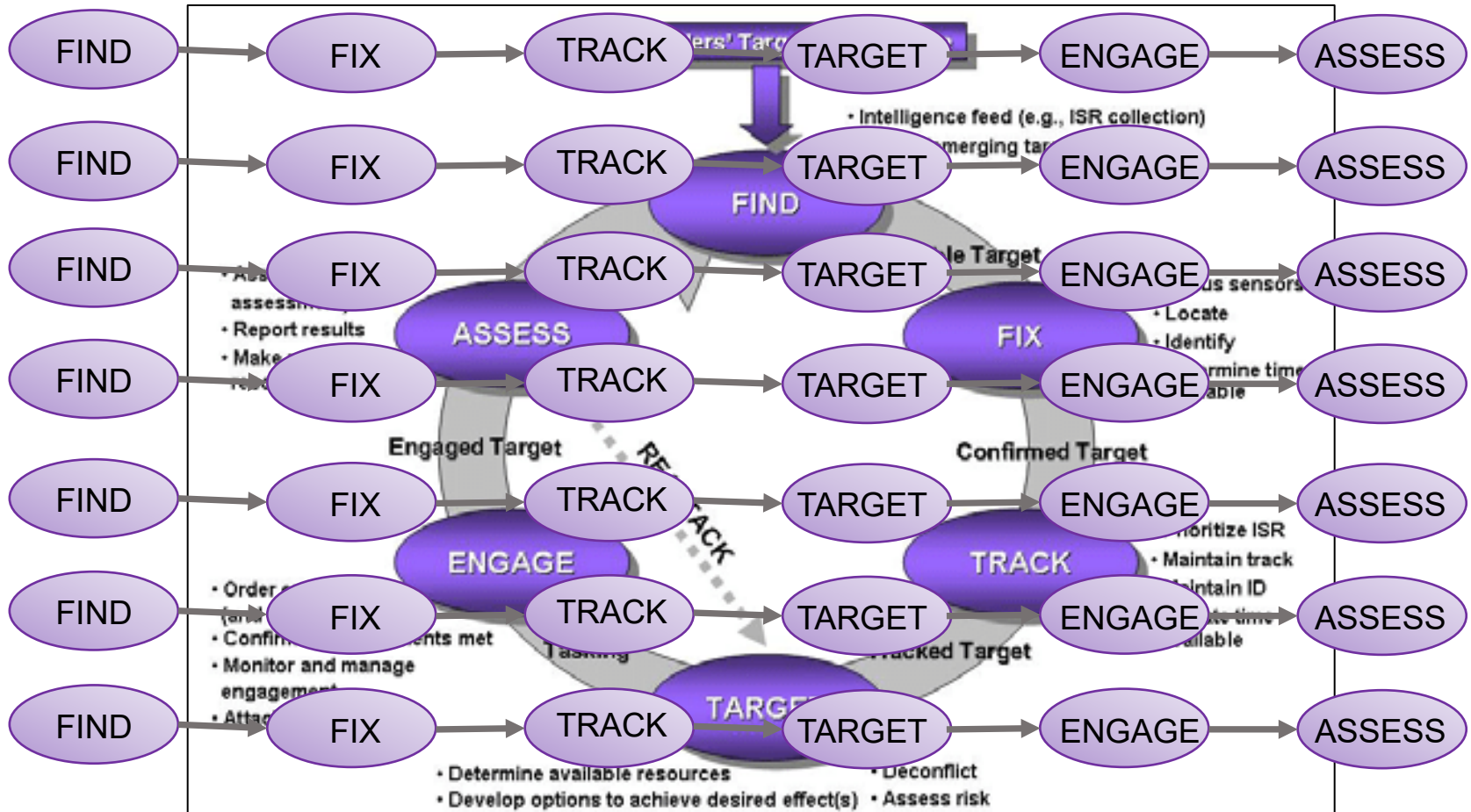
<https://www.monch.com/mpg.news/ew-c4i-channel/7334-saic-and-usaf-partner-for-jadc2.html>

RISK: Current methodologies of force planning and capability gap analysis focus on stove-piped problems and technologies – not on systems as a whole

Thinking in terms of a “kill chain competition” provides a framework by which to measure kill chain effectiveness as an operational system of systems



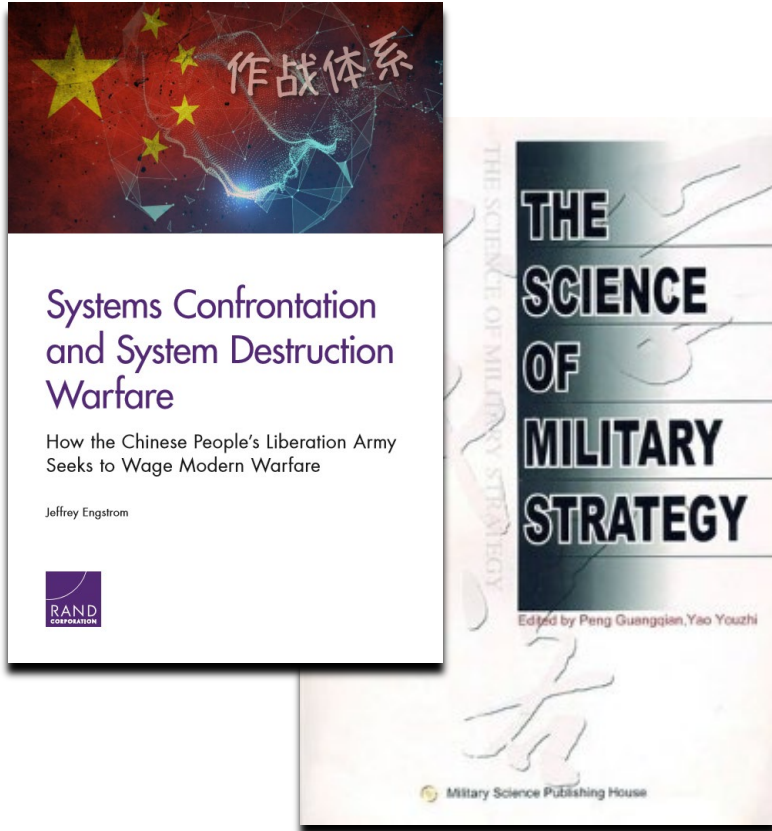
What is a kill chain?



To impose *any* effect on the adversary, military forces must close kill chains against targets



RISK: The PLA is prepared to contest every element, node, and process of the Air Force's kill chains



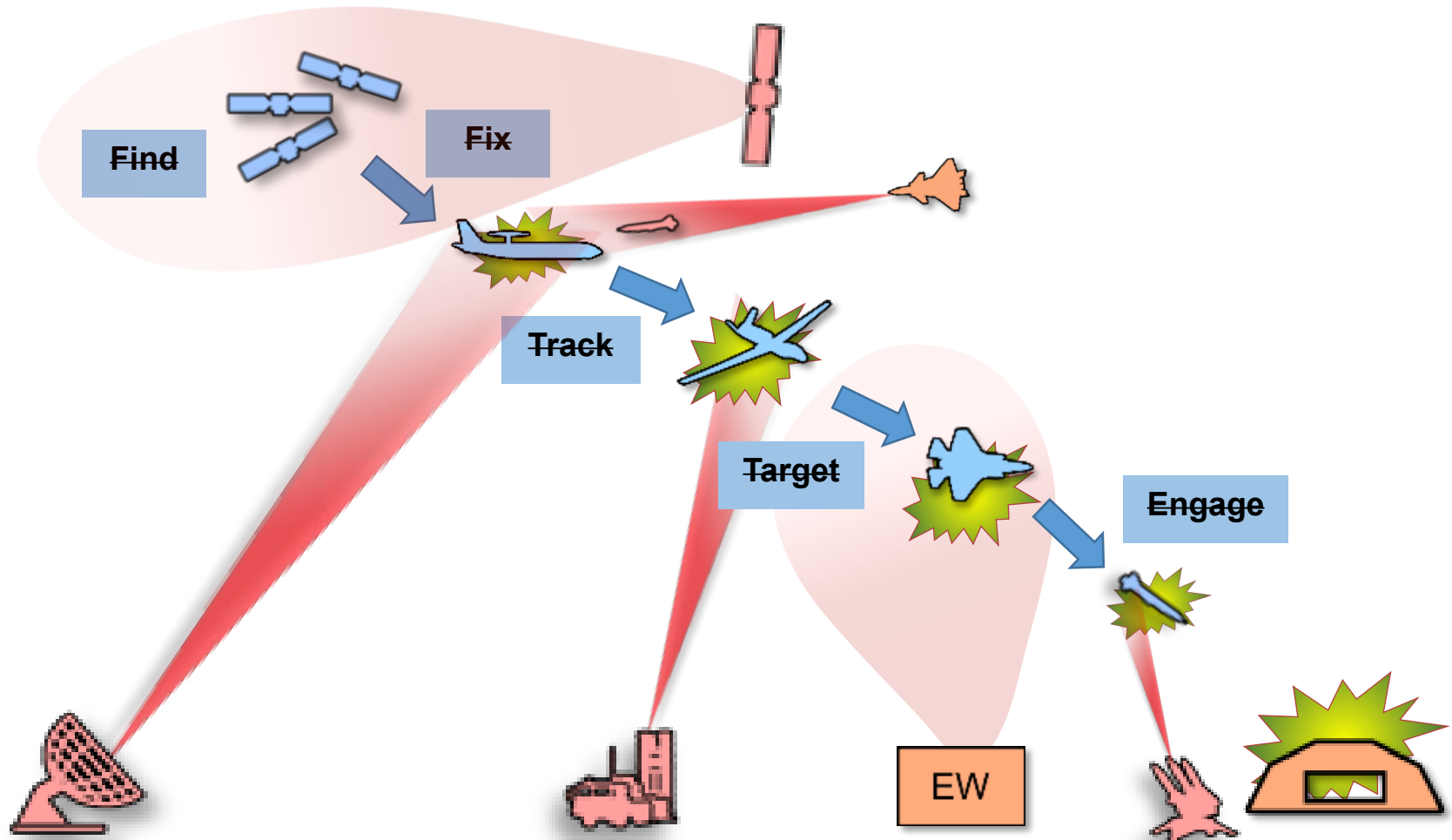
The PLA will target:

1. **Key system nodes.** Disable or destroy key physical nodes in U.S. systems that execute essential functions
2. **Information flows.** Isolate nodes by preventing them from sending or receiving information
3. **System relationships.** Disrupt and distort processes within and across multiple kill chains simultaneously
4. **Operational tempos.** Slow down or induce friction, confusion, and chaos into U.S. offensive & defensive operations

The PLA's strategy of "Systems Destruction" seeks to dismantle U.S. kill chains at every step and link



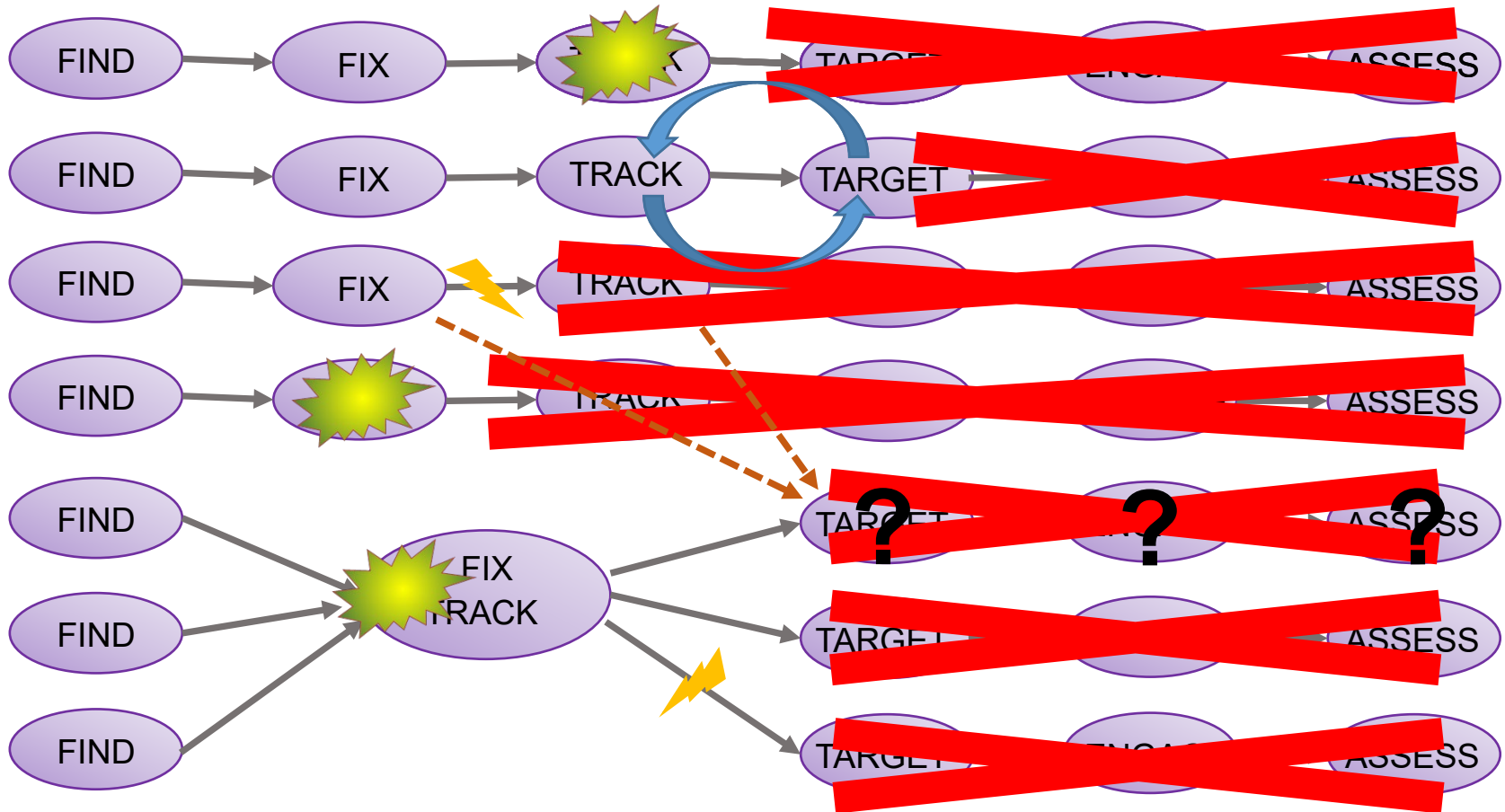
RISK: The PLA is prepared to contest every element, node, and process of the Air Force's kill chains



The PLA's strategy of "Systems Destruction" seeks to kinetically & non-kinetically dismantle U.S. kill chains at every step & link



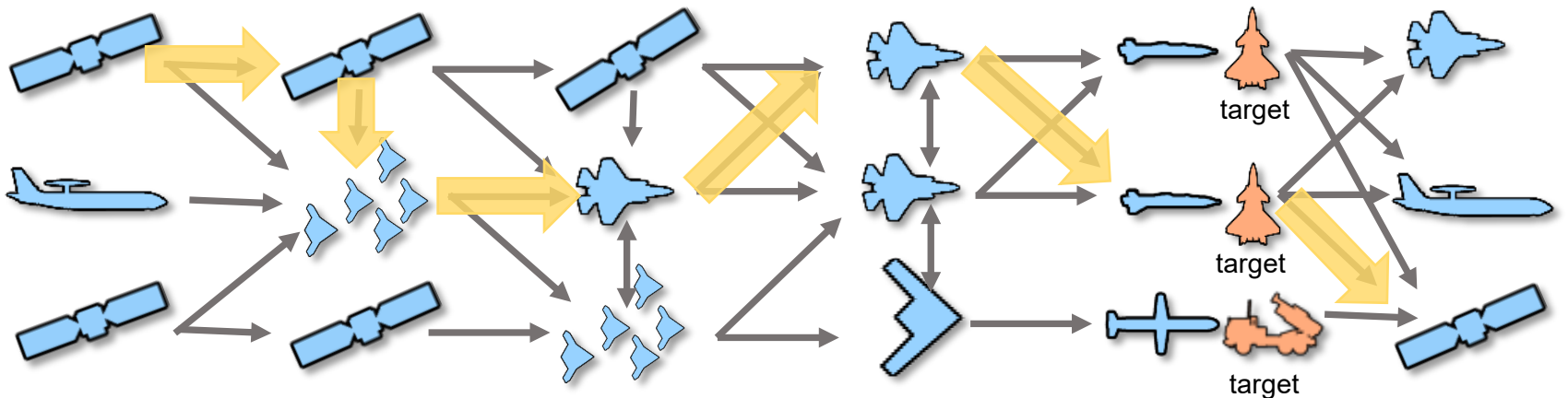
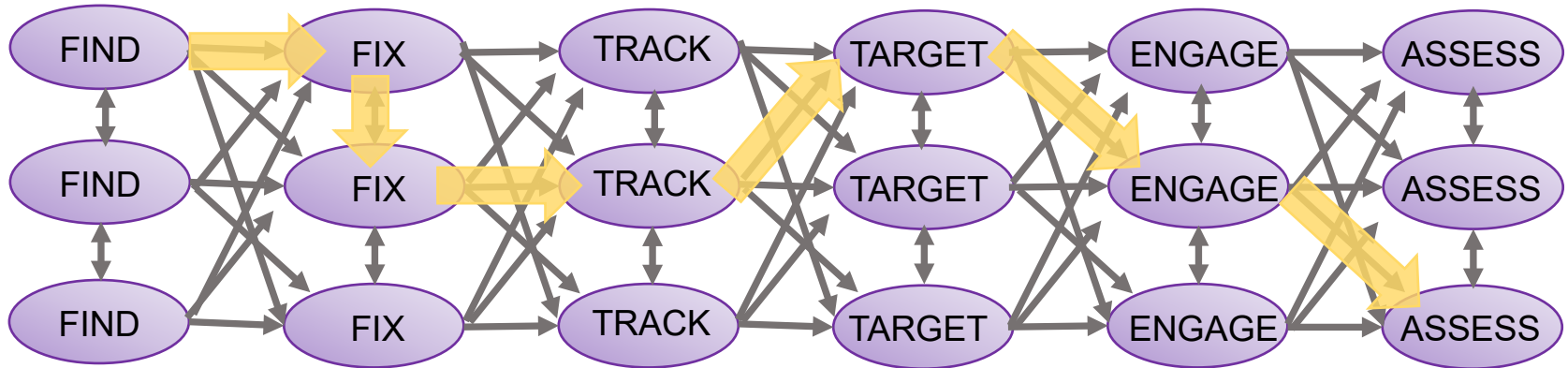
The PLA has developed the capacity to dismantle U.S. legacy kill chains *at scale*



To counter this strategy, the Air Force should take a different approach to understanding how to secure a kill chain advantage



Networked family of systems can increase kill chain superiority



Targets have unique informational requirements, and sensors and datalinks are not interchangeable



Mitchell Institute recommends optimizing four kill chain principles to ensure kill chain superiority

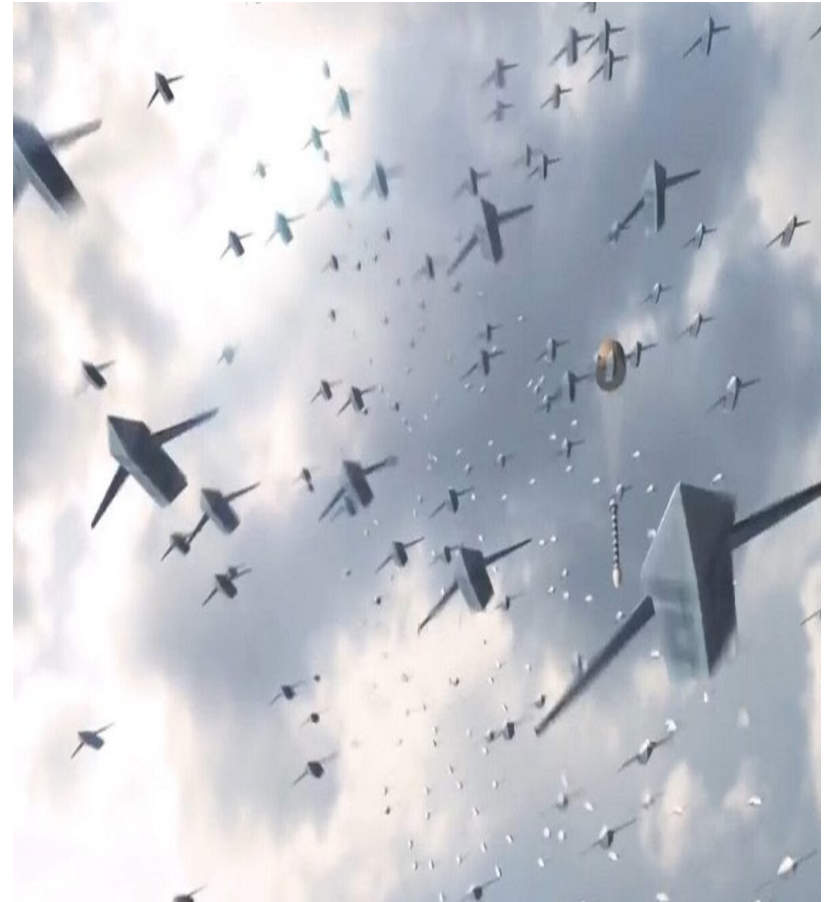
- 1. Right-size scale for the target sets.** Scale is the capacity to generate and close the necessary volume of simultaneous kills chains at any point in time.
- 2. Right-size scope for the theater.** Scope is the physical ability of a kill chain system to span both space and time. Kill chains must be effective over the necessary ranges and across the area of the battlespace, as well as for the required mission durations (persistence).
- 3. Speed must outpace adversary's countermeasures.** Speed refers to the time required to complete kill chains. U.S. kill chains must outpace adversary efforts to deny, disrupt, or break U.S. operational systems.
- 4. Ensure kill chain survivability.** Survivability is the ability of a kill chain to maintain its integrity and effectiveness even when under attack, withstanding an adversary's efforts to disrupt or break it and still close against the target.

This approach can provide the DAF the kill chain superiority it needs to prevail in a peer conflict against the PLA



Increasing kill chain SCALE will be essential to prevailing in future peer conflict

- 1. Increase node quantity.** Increasing the number and functions of nodes the Air Force can project and sustain in the battlespace creates the opportunity to increase the volume of simultaneous kill chains.
- 2. Improve interoperability across kill chains.** Understand what nodes are relevant to what missions, and what data must be shared across kill chain nodes to achieve the required scale of kill chain operations without excessive redundancy and wasted effort.

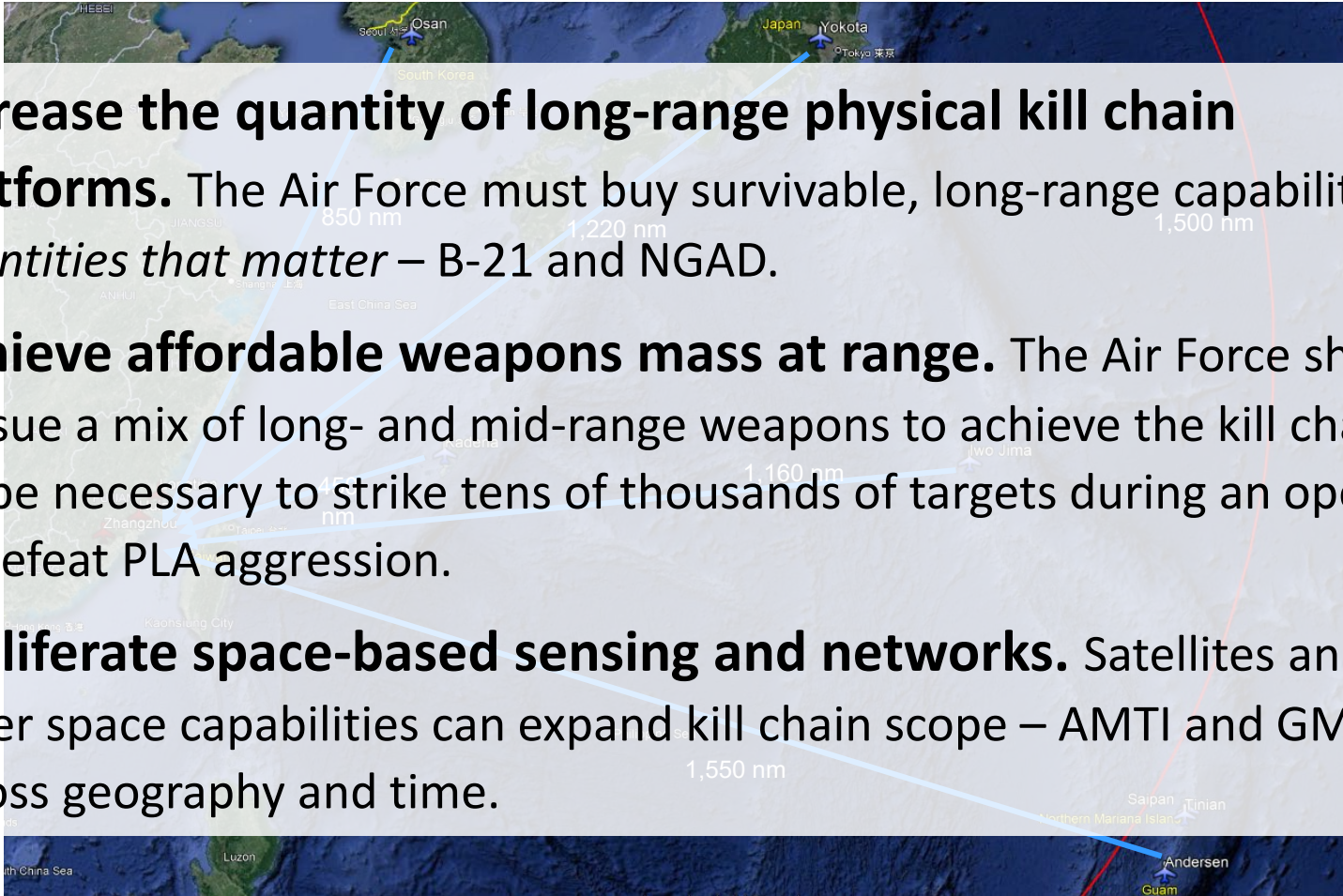


Increasing node quantity and connectivity will increase the number of kill chains the DAF can close simultaneously



The “tyranny of distance” and time of the Pacific theater demands increasing kill chain SCOPE

- 1. Increase the quantity of long-range physical kill chain platforms.** The Air Force must buy survivable, long-range capabilities *in quantities that matter* – B-21 and NGAD.
- 2. Achieve affordable weapons mass at range.** The Air Force should pursue a mix of long- and mid-range weapons to achieve the kill chain scope necessary to strike tens of thousands of targets during an operation to defeat PLA aggression.
- 3. Proliferate space-based sensing and networks.** Satellites and other space capabilities can expand kill chain scope – AMTI and GMTI – across geography and time.



Kill chains and their components must be able to go the distance for the duration – not just Day 1



Accelerating the **SPEED** of kill chains is key to countering the PLA's system destruction

- 1. Accelerate the speeds of physical kill chains.** Increase the speed of physical kill chain components where feasible and cost effective. This can be accomplished through increasing the airspeed of munitions, or by using stand-in, penetrating capabilities.
- 2. Increase kill chain network speeds.** Space-based communications can greatly increase the speed of kill chain operations, especially when kill chain nodes are located beyond-line-of-sight of each other.
- 3. Accelerate kill chain processing, pairing, and construction speeds.** Develop automated tools that can provide its air battle managers:
 - Fused, accurate, and timely common operating pictures
 - Optimized pairing of strike platforms, weapons, and targets
 - Real-time construction of kill chain networks

Improving kill chain speeds—even at the margins—can make the difference between the success or failure of an operation



Increase **SURVIVABILITY** of the overall kill chain system, not just the individual elements

1. Increase nodal and network survivability.

Traditional elements of force survivability contribute to kill chain survivability; if sensors, weapon platforms, munitions, and their networks survive, then their kill chains will, too.

2. Increase nodal and network attrition tolerance.

“Replacement” nodes must be of the right kind, interoperable with multiple diverse systems, in the right physical locations, and connected to other kill chain nodes and effectors. Self-healing networks must act as a “mesh” by having the ability to jump their data across alternate network paths to ensure kill chain nodes receive the data they need to close against targets.



Kill chains and their information must survive enemy attack, even if some of their nodes and networks do not



5th and 6th generation aircraft can provide kill chain superiority attributes today

Only 5th and 6th generation aircraft can **survive** to close kill chains at operationally relevant **speeds** and **scope** over global ranges and in contested environments – TODAY



BUT scale is also key

- The USAF must procure and ensure sufficient quantities of 5th and 6th generation aircraft are available
- The USAF should invest in next-generation weapons to further scale 5th and 6th generation kill chains

F-35A and soon, B-21, are the only proven capabilities that can ensure kill chain superiority in contested battlespaces



Near-to-Mid Term Recommendations

- 1. Maximize F-35 production rates, accelerate B-21 development and production.** To achieve kill chain scale and scope and mitigate risk in this decade, the Air Force should maximize the rate at which it procures its F-35As.
- 2. Aggressively invest in the modernization, range, and survivability of the F-35 and F-22 as a bridge to NGAD.** The Air Force needs advanced kill chain capability in the present that is capable of pioneering and maturing key concepts as the service develops NGAD.
- 3. Invest in the development and high-quantity production of advanced, survivable air-to-air and air-to-ground weapons suitable for 5th and 6th generation combat aircraft operations.** Enhancing the survivability of these weapons would address one of the most vulnerable parts of current kill chains.
- 4. Map out and connect the right sensors/platforms/weapons for high-potential kill chains in and across mission elements.** The Air Force should better understand and then connect its forces as an operational system.
- 5. Develop advanced networks and invest in connectivity across the force.** Enhancing the connectivity of 5th generation aircraft will empower them to be both consolidated and multifunction nodes that increase kill chain superiority.



Mid-to-Far Term Recommendations

- 1. Create automated tools that can support air battle managers to rapidly identify, validate, evaluate, and construct “in-zone” kill chains.** In a highly dynamic battlespace, battle managers need automated or intelligent tools to facilitate the real-time identification of kill chain options for target pairing.
- 2. Accelerate the development and fielding of collaborative combat aircraft as part of a family of systems for 5th and 6th gen aircraft.** By increasing the absolute quantity of platforms in the battlespace, CCAs have the potential to increase the number and reach of the Air Force’s 5th and 6th generation kill chains.
- 3. Develop and launch space-based sensing and data transport layer.** The unique attributes of the space domain, when populated with high-volume sensing and communication constellations, can dramatically boost the scale, scope, speed, and survivability of air-based kill chains.
- 4. Accelerate the development of NGAD as an advanced multifunction node in highly contested battlespace and procure in high rates and quantities.** The Air Force must develop and field the NGAD family of systems in robust quantities along with the F-35 and B-21 if it is to maintain its kill chain advantage over China.



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