

# The Future of Aircraft Maintenance and Sustainment

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Director

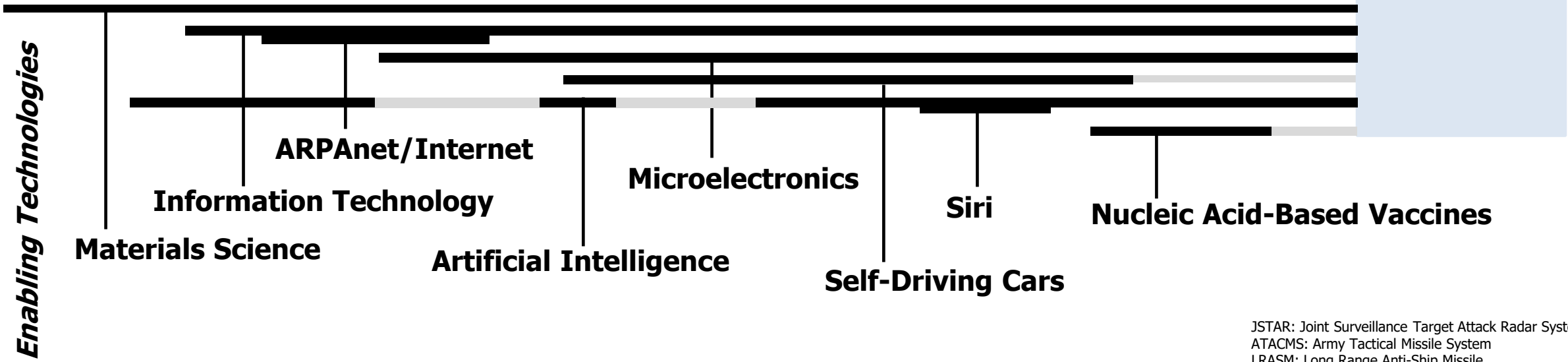
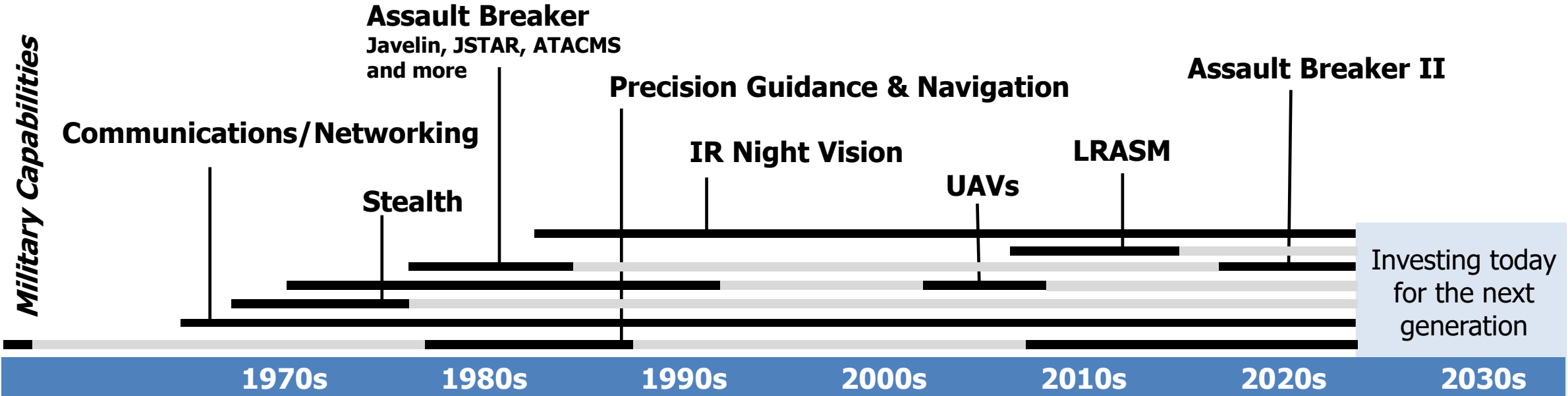
Military Aviation Logistics & Maintenance Symposium

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# Pivotal early investments that change what's possible



JSTAR: Joint Surveillance Target Attack Radar System  
 ATACMS: Army Tactical Missile System  
 LRASM: Long Range Anti-Ship Missile



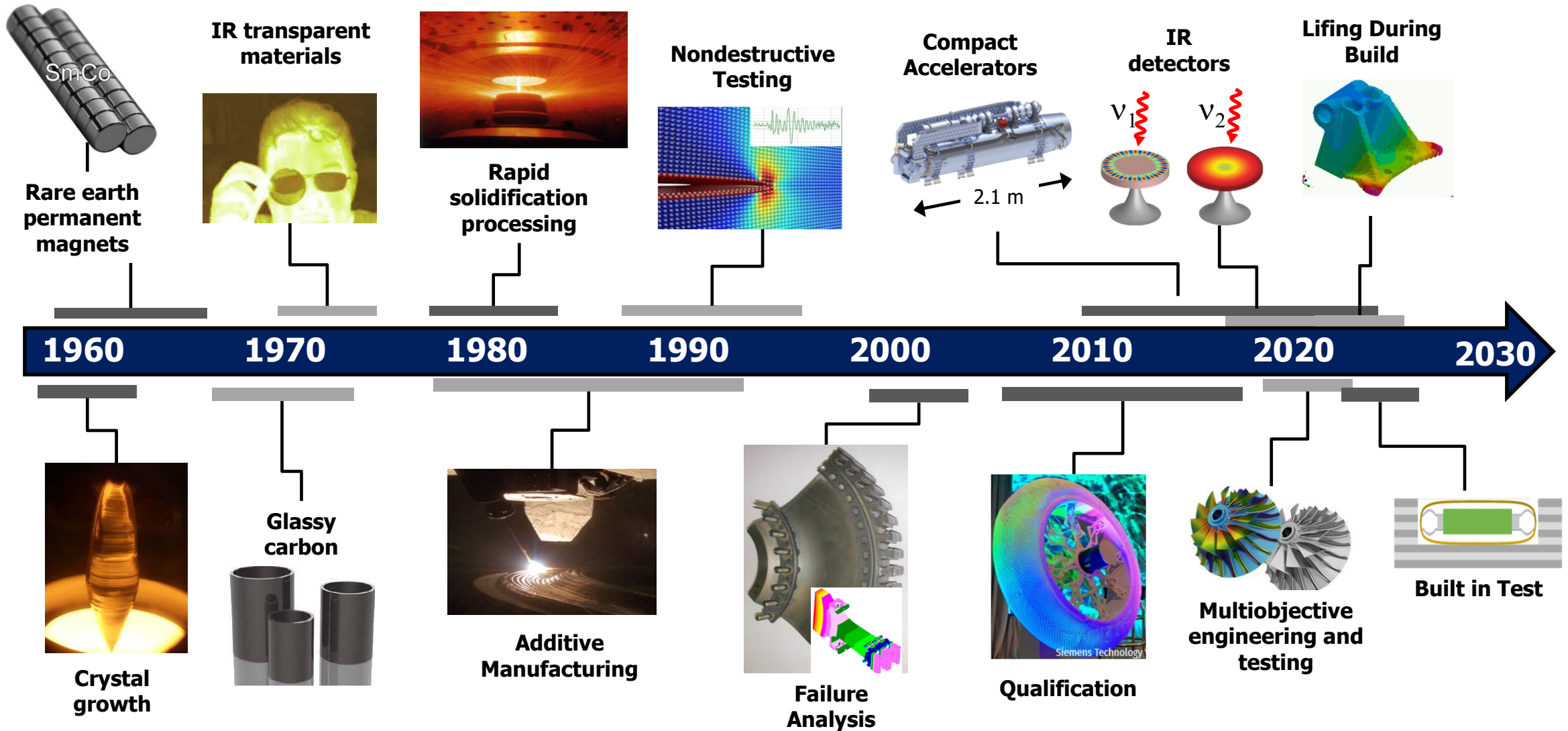
## Role in S&T ecosystem

- **Create breakthrough, paradigm-shifting solutions.**
- **Accept and manage significant technology risk.**
- **Disrupt or massively accelerate technology roadmaps.**



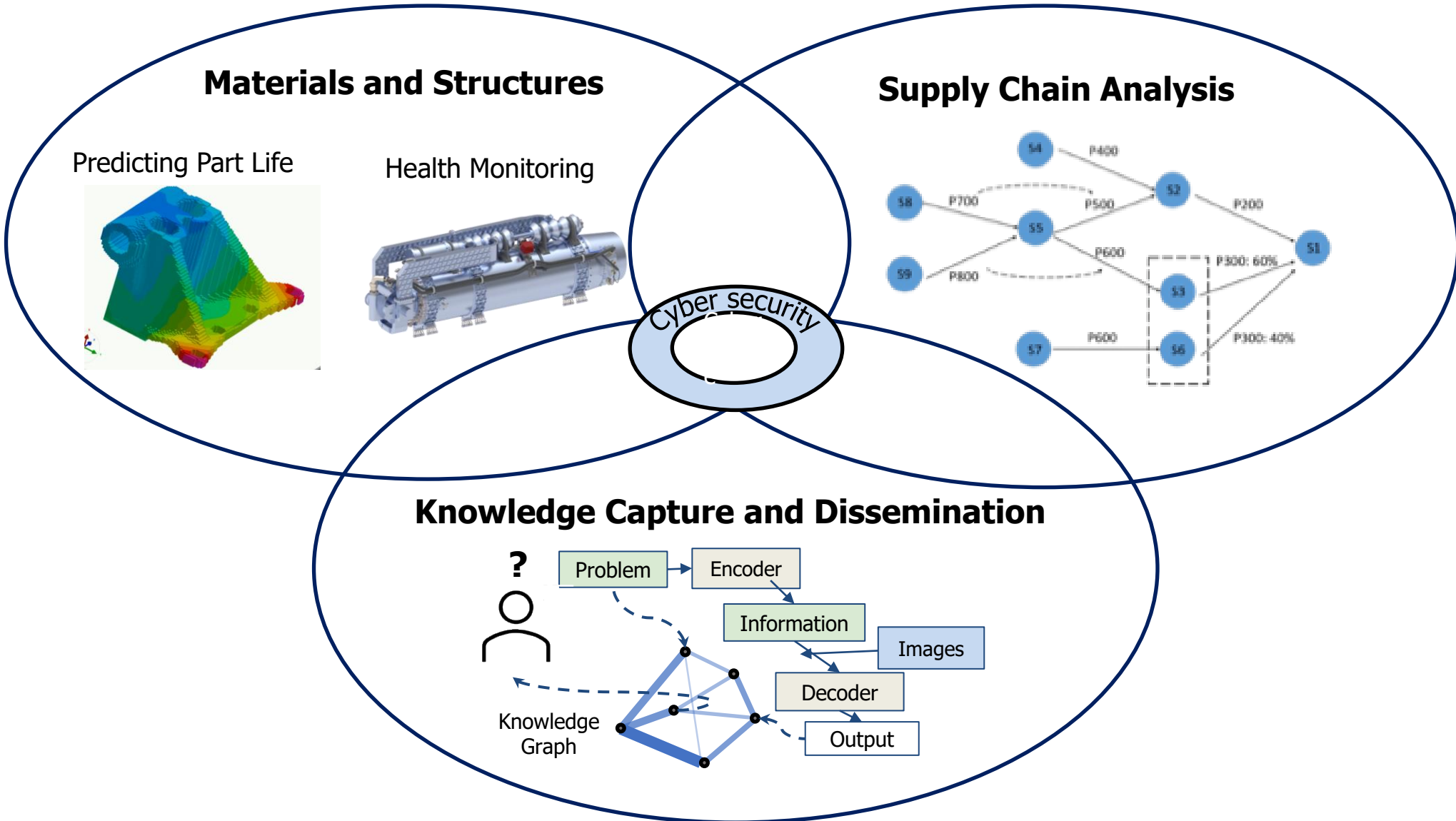


# DARPA's contribution to manufacturing and metrology



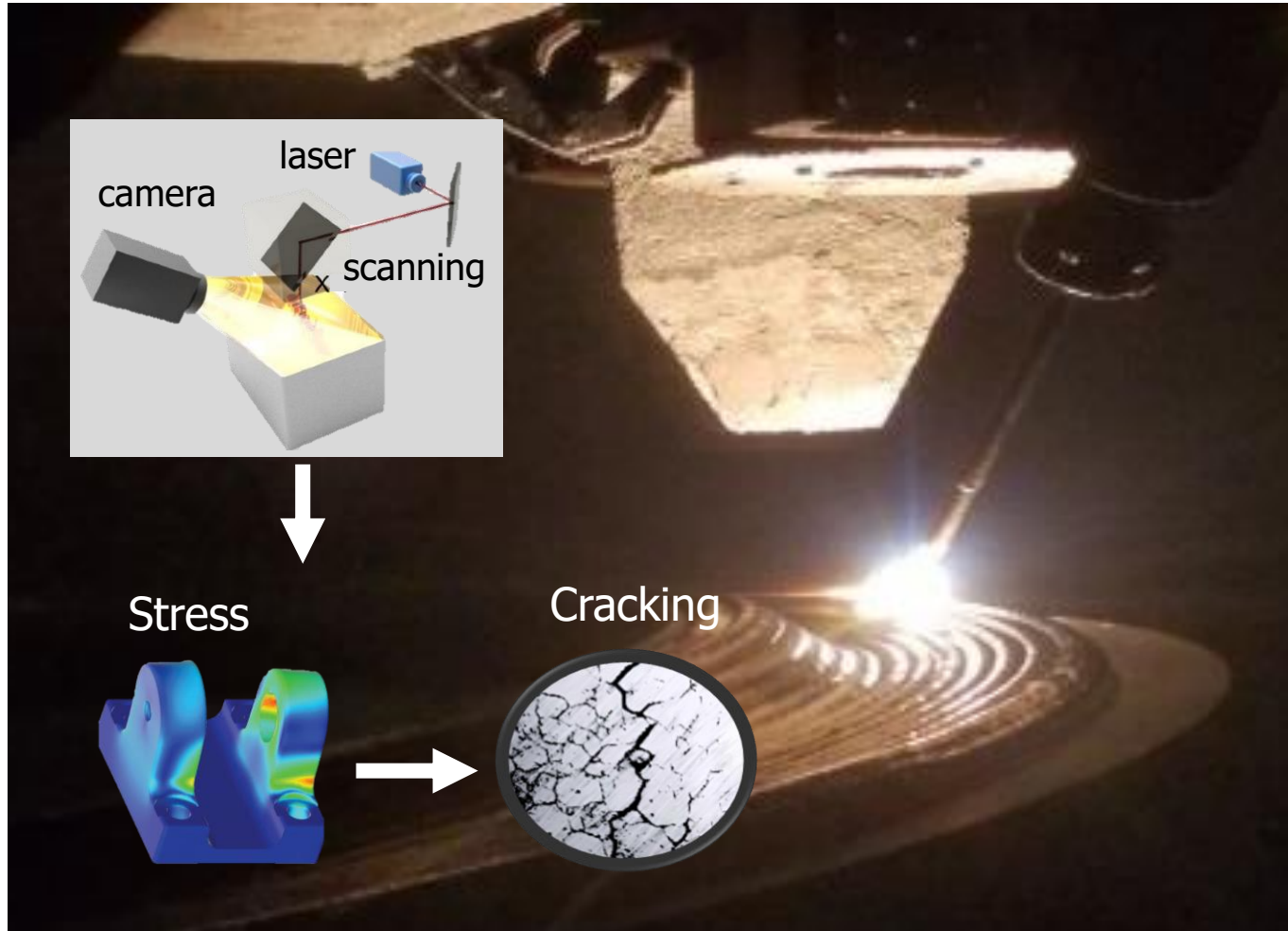


# DARPA programs that impact readiness





# Predicting part life directly from manufacturing data



## From making quality parts to understanding the quality of parts made by additive manufacturing

Capture critical manufacturing data during the build

- Measure microstructural defects
- Predict lifetime based on build data



# Built-in structural health monitoring

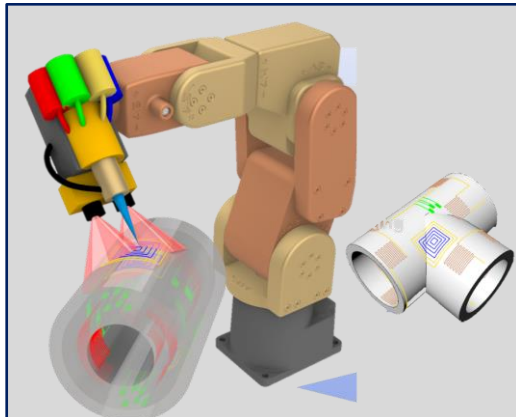
## Embedded sensors for real-time structural monitoring without impacting integrity

Embedded sensors measure:

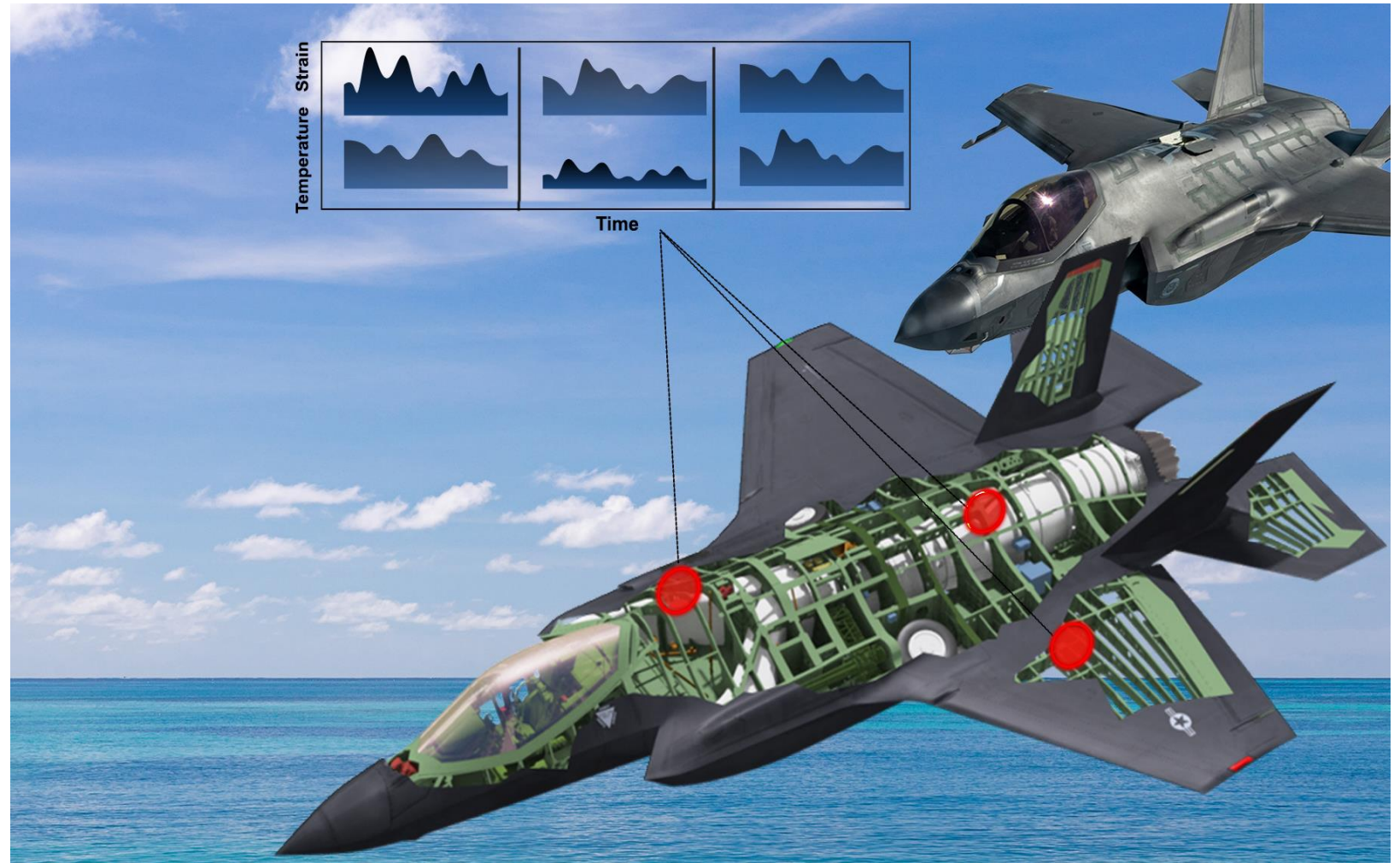
- Environmental conditions
- Dynamic loading

And determine:

- Crack initiation



Integrate structural health sensors into part





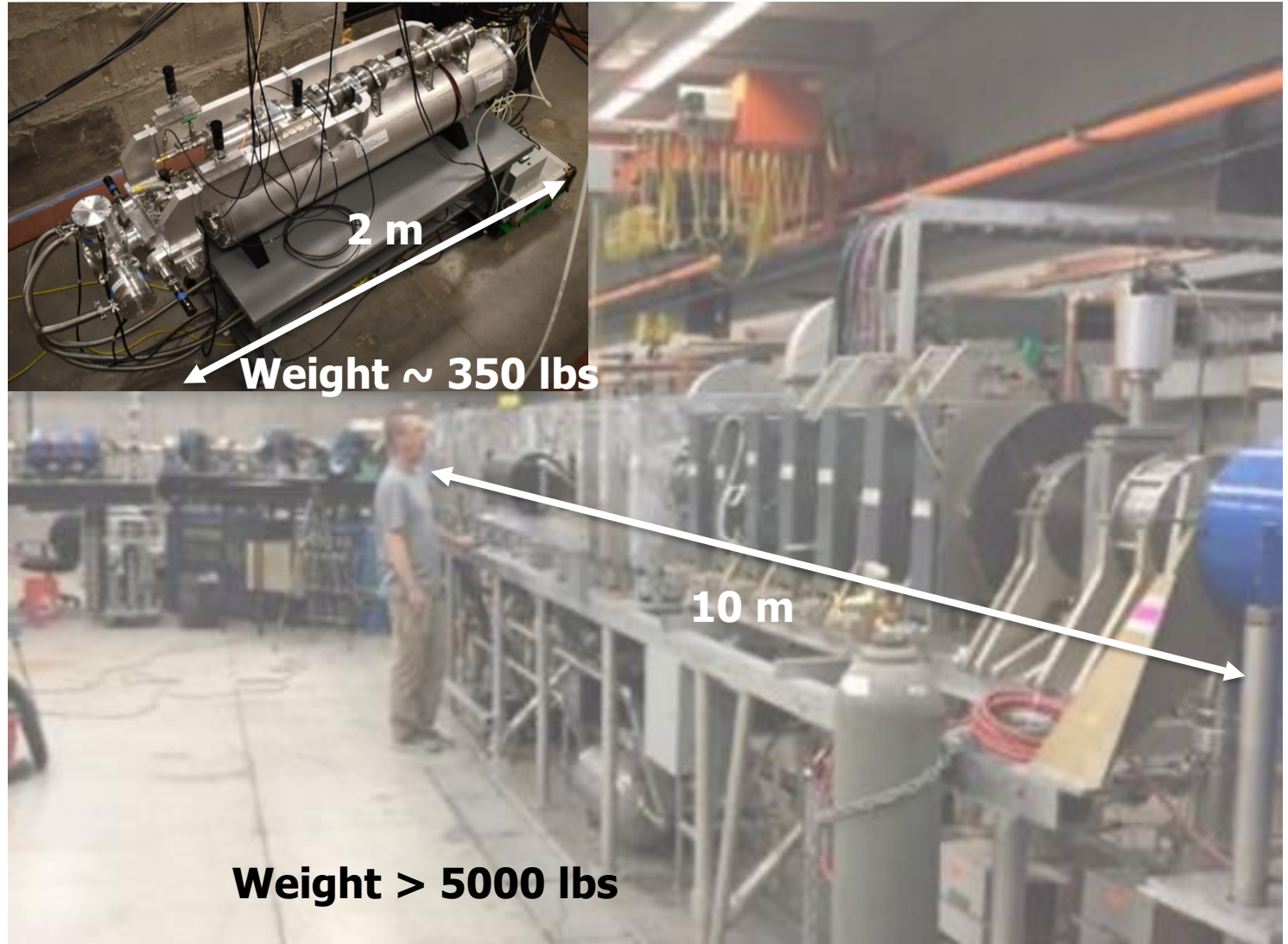
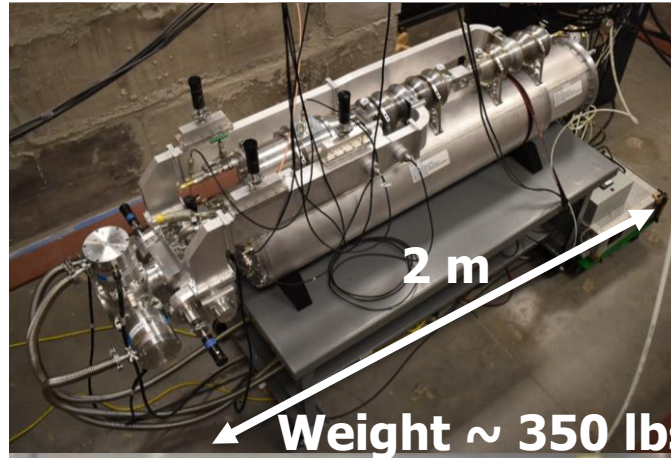
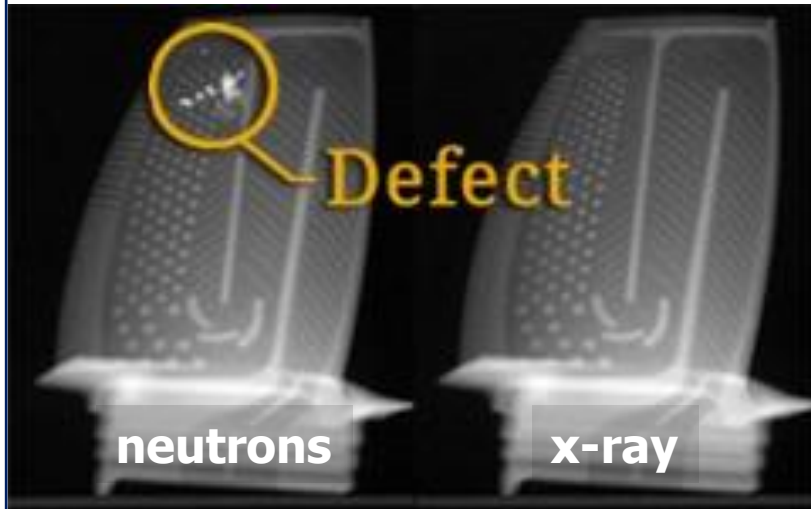
# Compact electron linear accelerators

## Portable particle generator for in field component inspection

Rapid Non-Destructive Inspection (NDI)

- High energy x-ray  $\sim 1\text{Mev}$
- High intensity neutrons  $\sim 10^{10}$  neutron/pulse/steradian

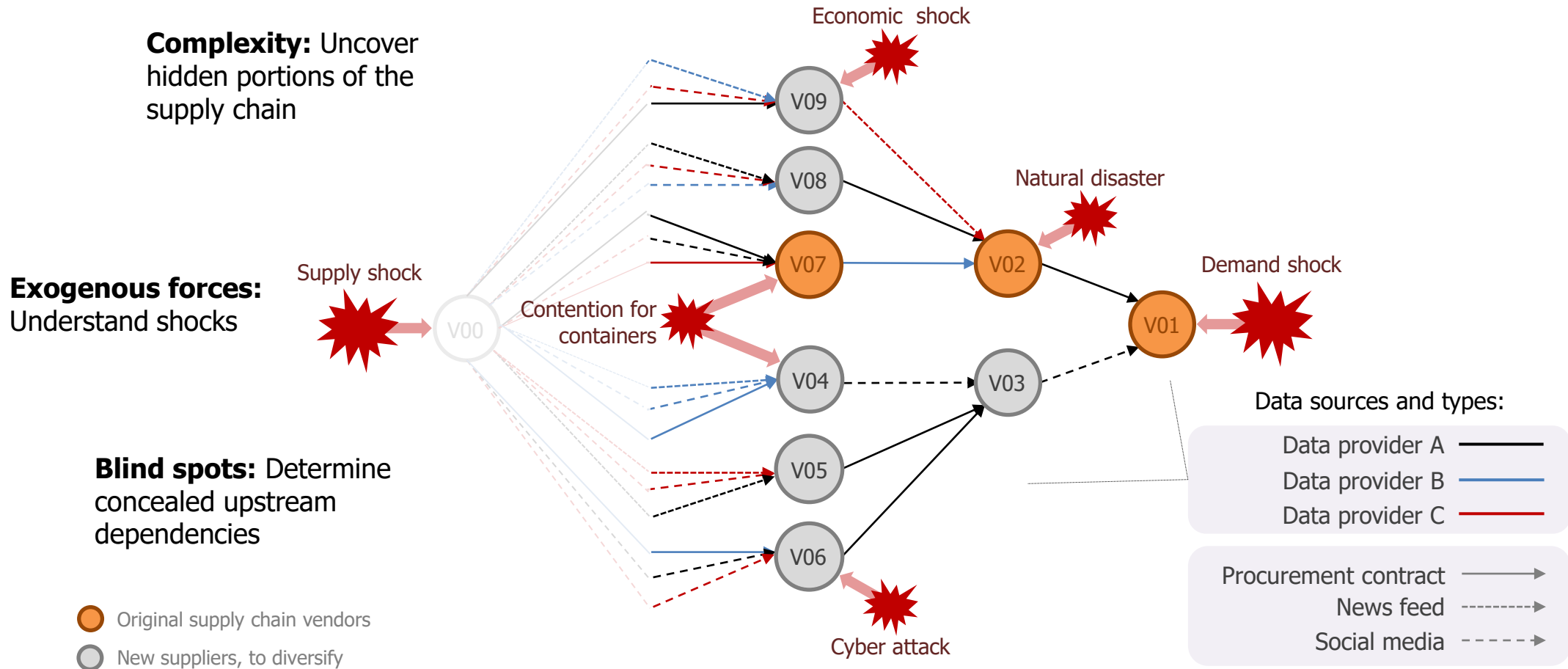
### Neutron Radiography





# Supply chain analysis: Risk and simulation

**Tools for supply chain analysis to understand natural and adversarial threats, to detect systemic vulnerabilities, and evaluate mitigations to improve resilience**

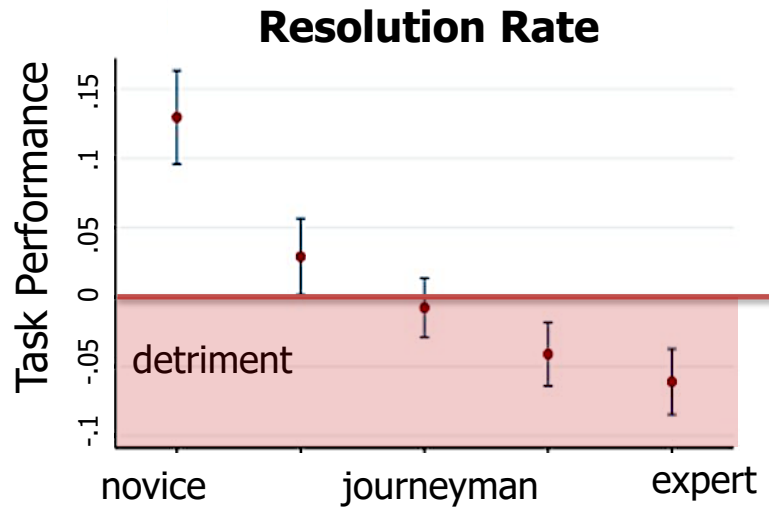




# Digital tools to capture knowledge for predictive maintenance

## Acquire and provide knowledge

- Before knowledge is lost to retirement, rotation, and replacement
- Push just in time, just enough, and just for me knowledge



Large Language Models (LLMs) do not provide nuanced knowledge





# Making software “unhackable”

TECH

## Chinese hackers outnumber FBI cyber staff 50 to 1, bureau director says

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**Formal methods** create mathematical proofs that software cannot be hacked.

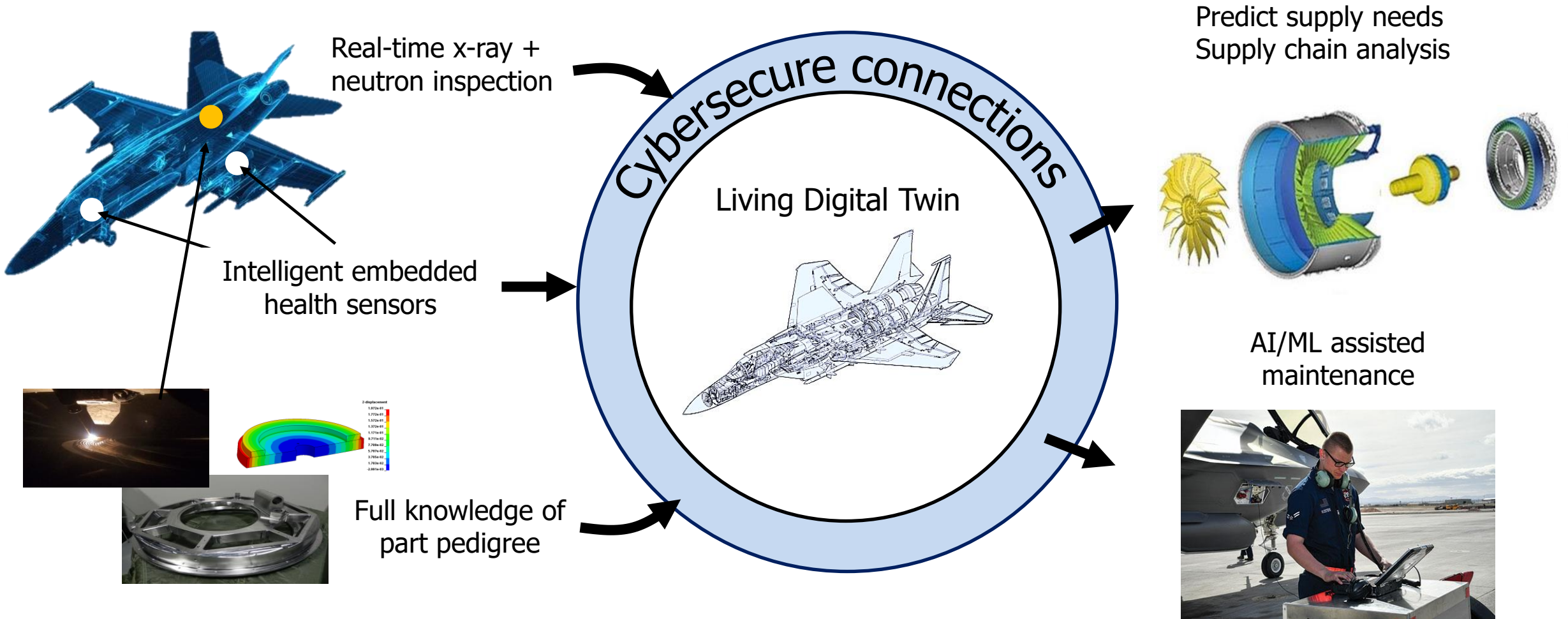
DARPA has demonstrated unhackable operational flight systems.

Follow-on programs apply formal methods to legacy code, software certification, and integrate them into standard software development tools.

***Eliminating Software Vulnerabilities Across DoD***

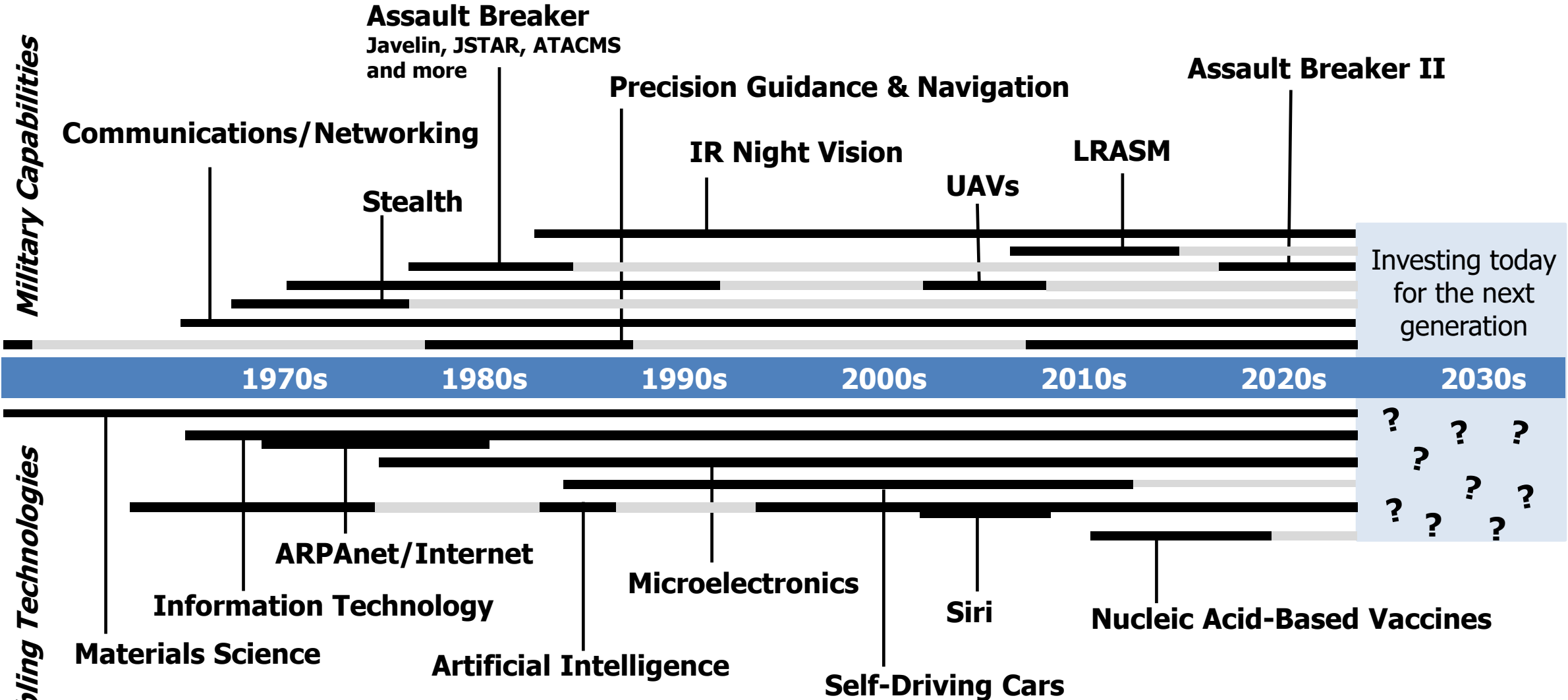


# Future: Condition-based maintenance 2.0





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