# Prototyping:  Accelerating the Adoption of Transformative Capabilities

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# Outline

- **The Need**

- **Prototyping as an Enabler**

- **Areas of Prototyping Employment**

- **What's Next?**

# The Need for Innovation

Secretary Carter
"Maintaining the Edge in
the Age of Everything"
*Defense One*
2 November 2015

*"Technology once long possessed by only the most formidable militaries have now gotten into the hands of previously less-capable forces, and even non-state actors. Nations like China and Russia are also rapidly modernizing their militaries. At the same time, our reliance on satellites and the Internet has led to real vulnerabilities our adversaries are eager to exploit.*

*So to stay ahead of those challenges and stay the best, we're investing aggressively in innovation. We're pushing the envelope with research into both new technologies and innovative ways to apply them. And whether it's robotics, data science, cyber defense, biotech, or hypersonic engines that can fly over five times the speed of sound, private sector innovation and partnerships will be critical to our future."*

# Strategic Initiatives

## Defense Innovation Initiative

- Decision Support
- Wargaming
- Novel Concepts
- Business Practices
- DIUx

## Better Buying Power 3.0

- Achieve affordable programs
- Incentivize productivity in industry and Government
- Incentivize innovation in industry and Government
- Promote effective competition

## 3rd Offset Strategy

- Effects at Range
- Quantity at Cost
- Autonomy

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# Why Greater Emphasis on Prototyping?

- **Constrained Budgets - we cannot afford to procure unique or exquisite systems for every potential threat**

- **Complex Threat Environment**

| Russia, China | North Korea, Iran | Trans-national Terrorists |
|---|---|---|

- **Advanced design and manufacturing tools enable faster and more affordable prototype development**

*Prototyping advances technology frontiers…*
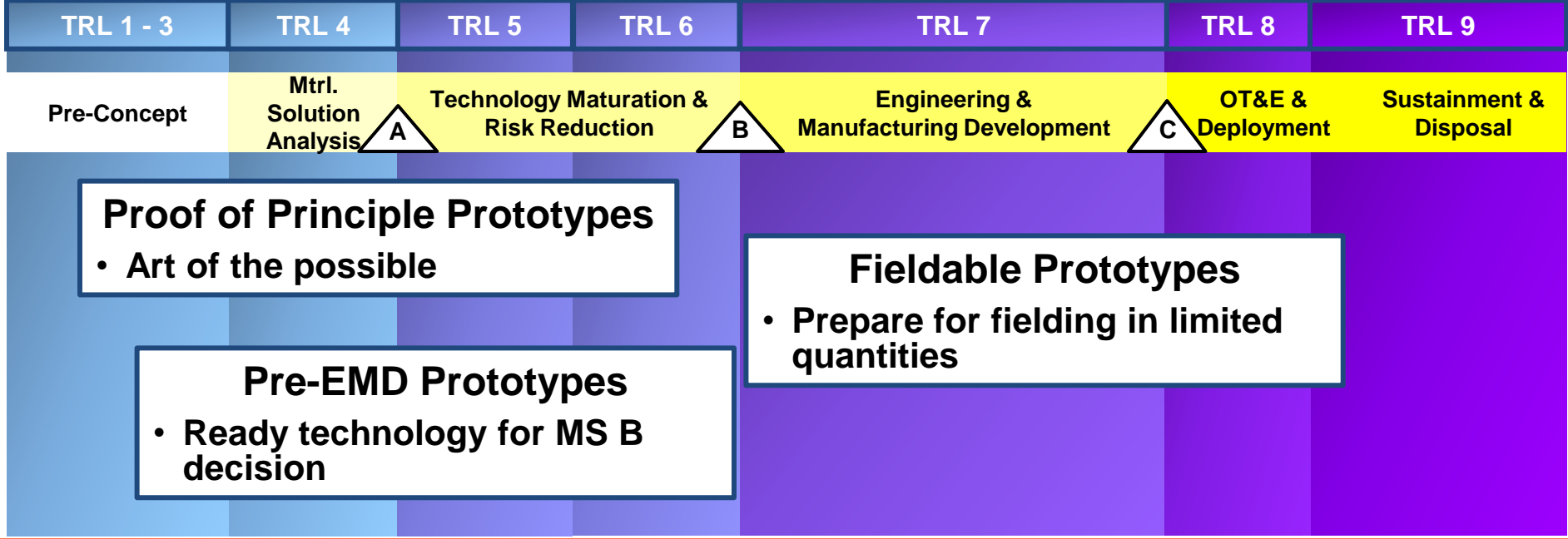
# DoD Prototyping

## What do we mean by Prototyping?

**"A set of design and development activities intended to reduce technical uncertainty and to generate information to improve the quality of subsequent decision making."**

**– On Prototyping, *RAND Corporation*, 2009**

### Prototyping Categories

| TRL 1 - 3 | TRL 4 | TRL 5 | TRL 6 | TRL 7 | TRL 8 | TRL 9 |
|---|---|---|---|---|---|---|
| Pre-Concept | Mtrl. Solution Analysis | Technology Maturation & Risk Reduction | | Engineering & Manufacturing Development | OT&E & Deployment | Sustainment & Disposal |

A  B  C

**Proof of Principle Prototypes**
- Art of the possible

**Fieldable Prototypes**
- Prepare for fielding in limited quantities

**Pre-EMD Prototypes**
- Ready technology for MS B decision

# Roles of Prototyping

## Technology

- **Clear a specific technical hurdle**
- **Explore art of the possible**
- **Inform requirements process**
- **Aid technology integration**

## Production

- **Offer rapid response to emerging capability shortfalls**
- **Improve development methods and manufacturing**

## Affordability

- **Inform and validate cost estimates**
- **Leverage the investment of non-traditional and international performers**

## Supporting Policies

- **Demonstrate open standards**
- **Promote competition throughout the product lifecycle**
- **Stimulate industrial base to advance the state of the practice**

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# JCTD Program

**Created in 1995, the Advanced Concepts Technology Demonstration Program (precursor to JCTDs) emerged from the Packard Commission as a way to reduce cost and risk of entering full-scale acquisition.**

## Mission

- Execute prototypes and experimentation through operational demonstrations of game-changing technologies to meet DoD strategic needs while addressing Joint Force and Combatant Commands (CCMDs) capability gaps.

## Objectives

- Stimulate innovation by bridging Science and Technology (S&T) to operational use and formal acquisition
- Accelerate fielding of decisive technical capabilities within 3 to 5 years
- Leverage open architectures to enhance interoperability and promote affordability
- Reduce technical risks and mitigate operational risk to the warfighter

## Unique project structure

- Integrated management team consisting of individuals from the operational, technical, and acquisition communities
- Jointly develop the technology with CONOPS & TTP

*A long history of accelerating the transition of affordable, game-changing capabilities that mitigate operational risk to the warfighter*

# Capabilities and Operational Concepts to Support a Third Offset Strategy

## Autonomous Learning Systems

Delegating decisions to machines in applications that require faster-than-human reaction times

## Human-Machine Collaborative Decision Making

Exploiting the advantages of both humans and machines for better and faster human decisions

## Assisted Human Operations

Helping humans perform better in combat

## Advanced Manned-Unmanned System Operations

Employing innovative cooperative operations between manned and unmanned platforms

## Network-enabled, autonomous weapons hardened to operate in a future Cyber/EW Environment

Allowing for cooperative weapon concepts in communications-denied environments

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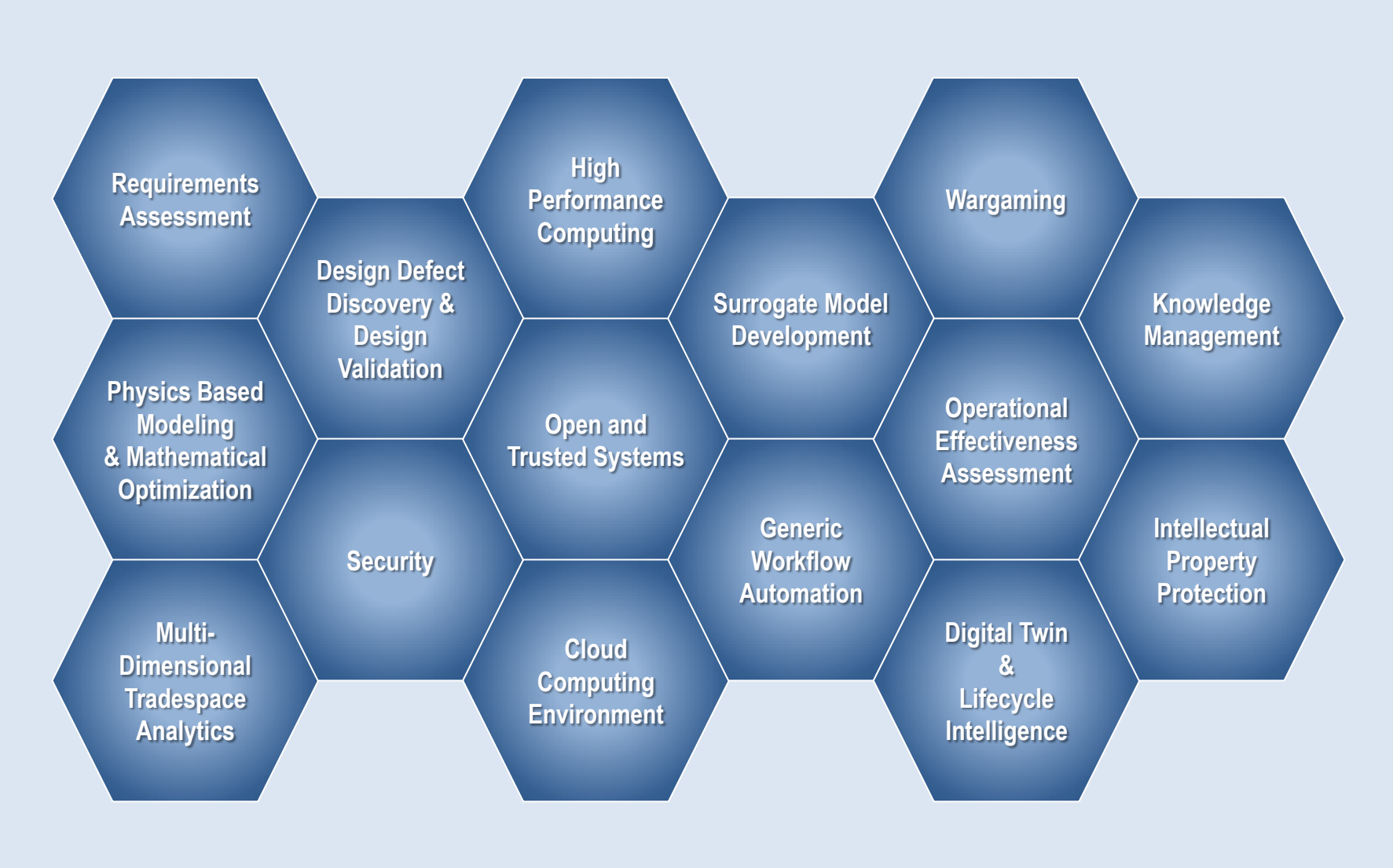- **Areas of Prototyping Employment**

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# Computational Prototyping Environment (CPE)

*CPE objective is to accelerate the adoption of transformational capabilities by demonstrating their viability in a representative acquisition framework.*

# Characteristics of CPE



Requirements Assessment

Design Defect Discovery & Design Validation

High Performance Computing

Surrogate Model Development

Wargaming

Knowledge Management

Physics Based Modeling & Mathematical Optimization

Open and Trusted Systems

Operational Effectiveness Assessment

Security

Generic Workflow Automation

Intellectual Property Protection

Multi-Dimensional Tradespace Analytics

Cloud Computing Environment

Digital Twin & Lifecycle Intelligence

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# Outcomes of CPE

- **Provides forums that promote interactive information exchanges between the technical community and other stakeholders**

- **Affordably enables exploration and analysis (performance, cost, etc.) of game changing capabilities to inform the requirements process**

- **Improves our understanding of what is to be built and the expectations for how it is to be built**

- **Provides for a robust, data driven, decision-making process at multiple levels across the acquisition life-cycle**

- **Improves design, development and manufacturing methods**

- **Provides the toolset to enable DoD compliance with Rapid Prototyping and Rapid Fielding Policy**

# BACKUP