U.S. ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND

Mission Engineering and Prototype Warfare: Operationalizing Technology Faster to Stay Ahead of the Threat

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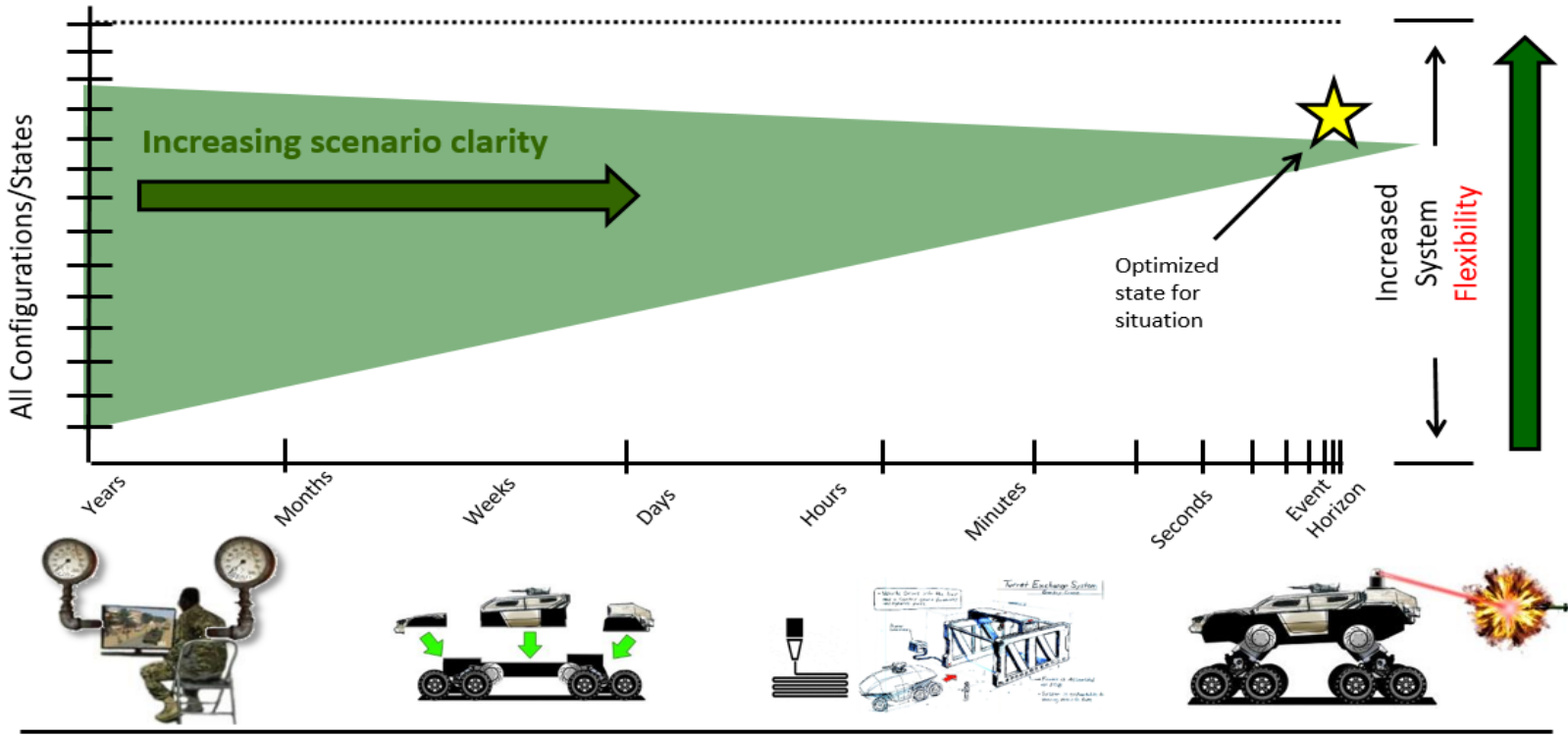
"Success no longer goes to the country that develops a new fighting technology first, but rather to the one that better integrates it and adapts its way of fighting."

-The National Defense Strategy (2018)

TIME / FLEXIBILITY PARADOX



Wargaming of Potential Scenarios
= Pre-Engineered Solution Portfolio & CONOPS

Modularize
Wargaming can help define what must be modular versus inherent.

Rapid Production / Customization S&T
= Conflict-Tailored Solutions

Adaptable/ Flexible
= Technology Overmatch Despite Parity

To achieve an optimal solution, less flexibility is required closer to event horizon

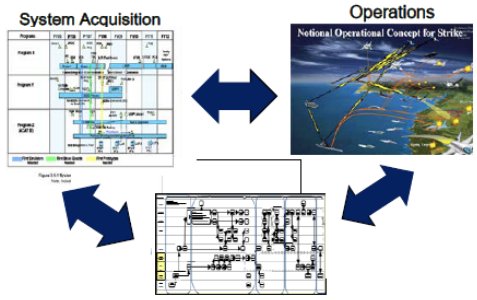
MISSION ENGINEERING

System-of-Systems engineering approach where individual system requirements are optimized to achieve maximum mission performance given operational (METT-TC) and acquisition (Cost, Schedule, Performance) constraints

METT-TC: mission, enemy, terrain, troops available, time, and civilians

WHAT IS MISSION ENGINEERING?

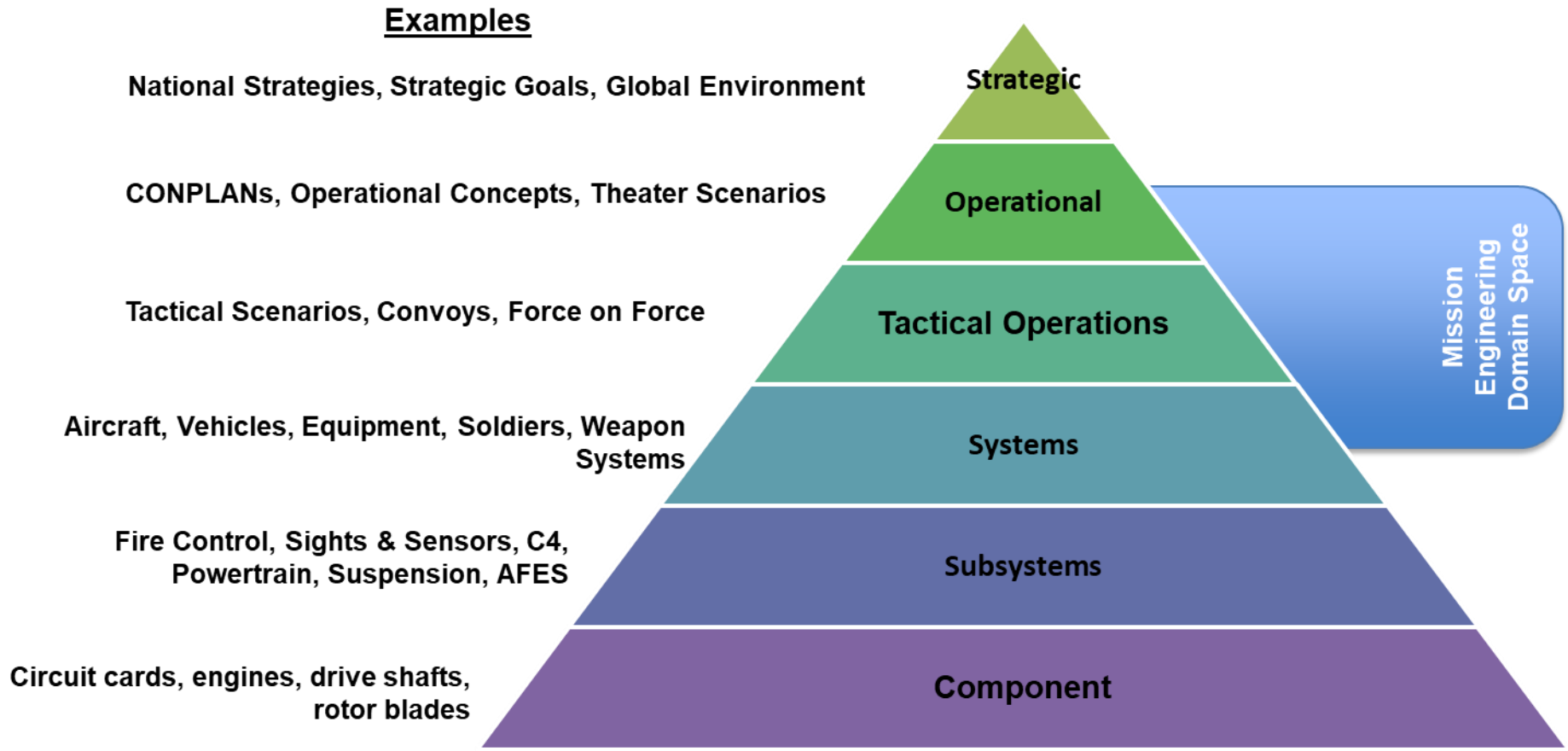
Mission Engineering



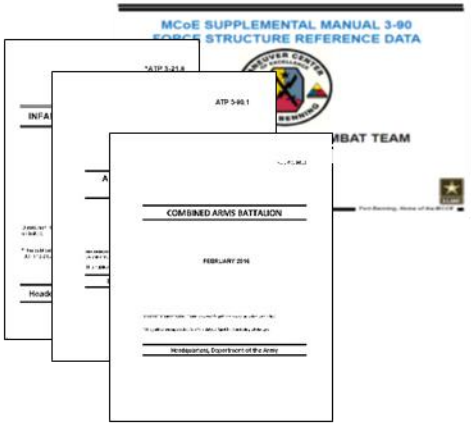
Mission Engineering is the deliberate planning, analyzing, organizing, and integrating of current and emerging operational and system capabilities to achieve desired warfighting mission effects

- Mission engineering treats the end to-end-mission as the 'system'
- Individual systems are components of the larger mission 'system'
- Systems engineering is applied to the systems of systems supporting operational mission outcomes
- Mission engineering goes beyond data exchange among systems to address cross cutting functions, end to end control and trades across systems
- Technical trades exist at multiple levels; not just within individual systems or components
- Well-engineered composable mission architectures foster resilience, adaptability and rapid insertion of new technologies

MULTI-DOMAIN MISSION MODEL

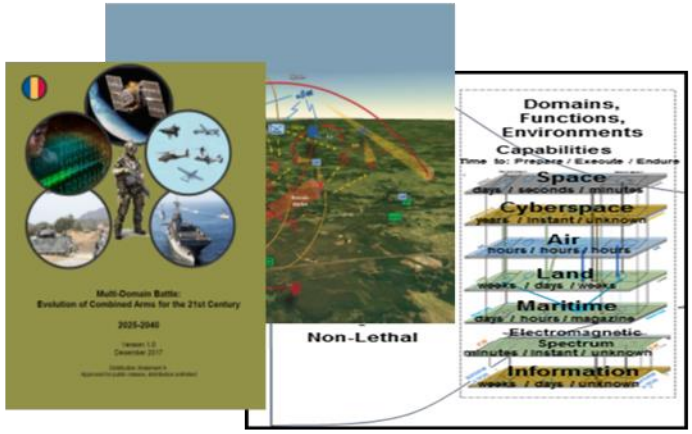


INPUTS – DOCTRINAL & TECHNICAL ANALYSIS, USER COMMUNITY FEEDBACK, ETC.



FM, TC, ATP, Other Doctrine

Current Operations + Threats (classified and unclassified)



Future Operations (Multi Domain)

OMS/MP & other High level Analysis

Acquisition Strategies

Technology Study & Review

Interface with User Community, Technology developers, and NATO partners.

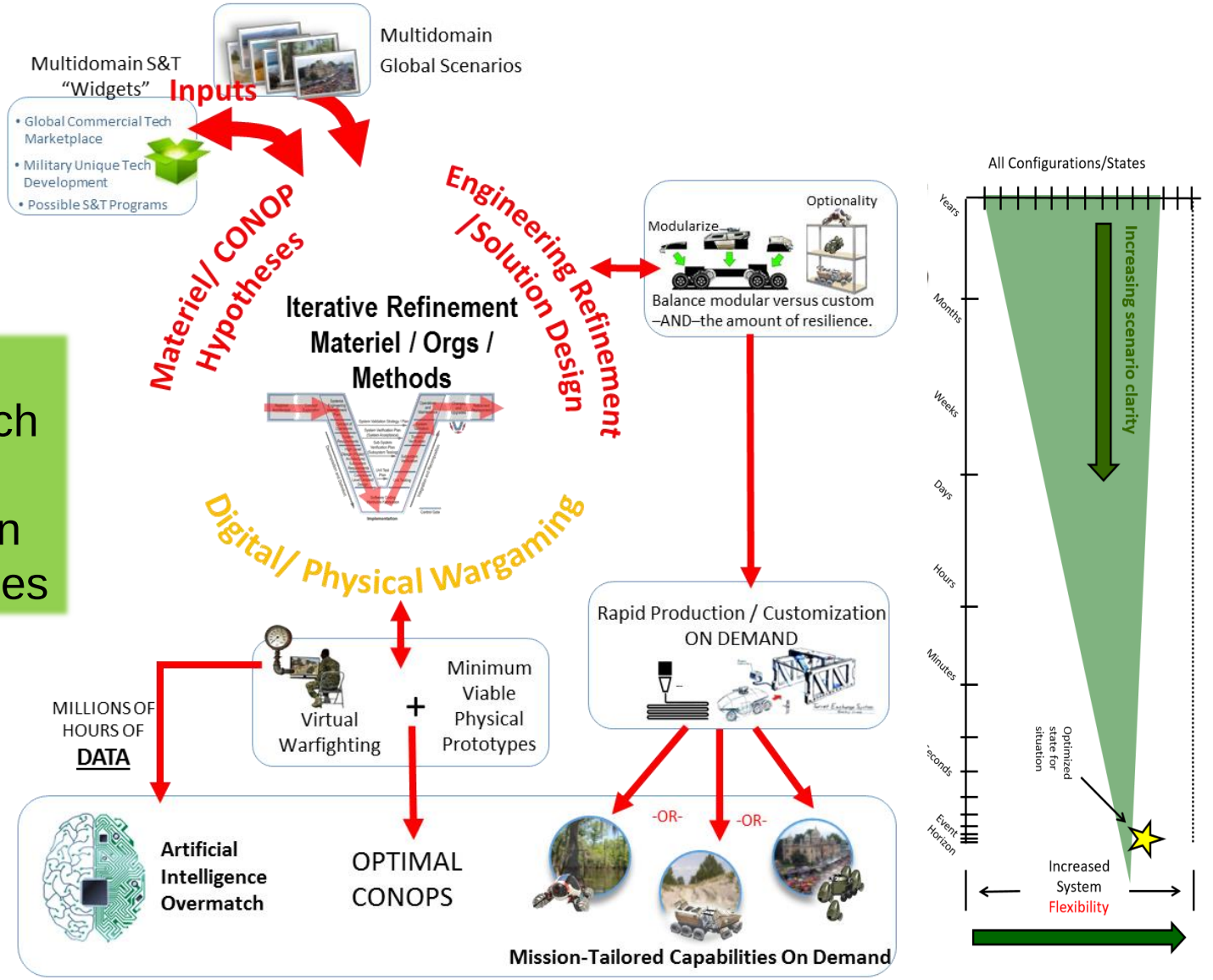
DISTRIBUTION A. See first page

PROTOTYPE WARFARE

Rapid fielding of tailored systems with a focus on specific functions, specific geographic areas, or even specific fights that are inexpensively produced (potentially disposable)

PROTOTYPE WARFARE FRAMEWORK

The Prototype Warfare approach enables rapid need-to-solution development times



3 ENABLING TECHNOLOGY ADVANCES

Early Synthetic Prototyping (ARCIC/RDECOM)

- Physics-based persistent game network that allows Soldiers and engineers to collaborate on exploration of the materiel, force structure, and tactics trade space.
- Over one million of digital battlefield data per year†

Artificial Intelligence needed to derive useful data on tactics and technical performance from the data

Rapid Manufacturing

- Investment in rapid manufacturing techniques
- Understand the trade-offs of custom production versus modularity

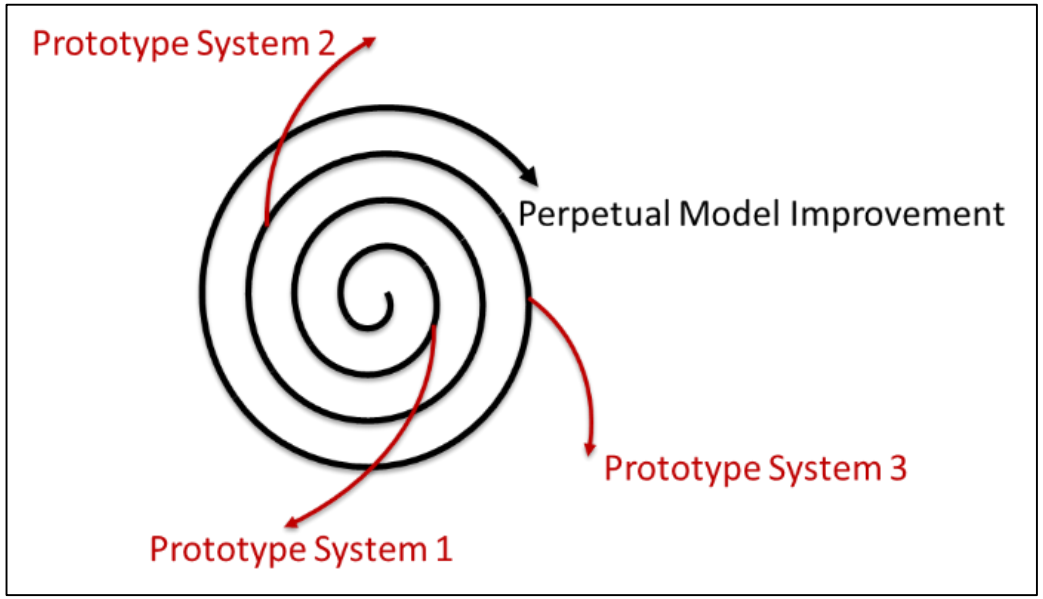
†Vogt, Brian; Megiveron, Michael & Smith, Robert E. Early Synthetic Prototyping: When We Build It, Will They Come? Interservice/Industry Training, Simulation, and Education Conference. Orlando. (2015).

SYSTEMS ENGINEERING REVOLUTION

Heavily reliant on Digital Engineering with strong M&S capabilities

Core system model exists in a perpetual pre-PDR state

Specific prototype systems proceed to design synthesis



Prototype Warfare Digital Engineering Model

PROTOTYPE WARFARE CHALLENGES

Operation and Maintenance of fielded unique systems

- Digital manifesting database of replacement parts
- Use of common components where possible

Operator & Maintainer interfaces

- Standardize and simplify interfaces
- Personalized interface based on individual user credentials

FURTHER QUESTIONS AND DISCUSSION

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