# Concept Maturity Framework (CMF)

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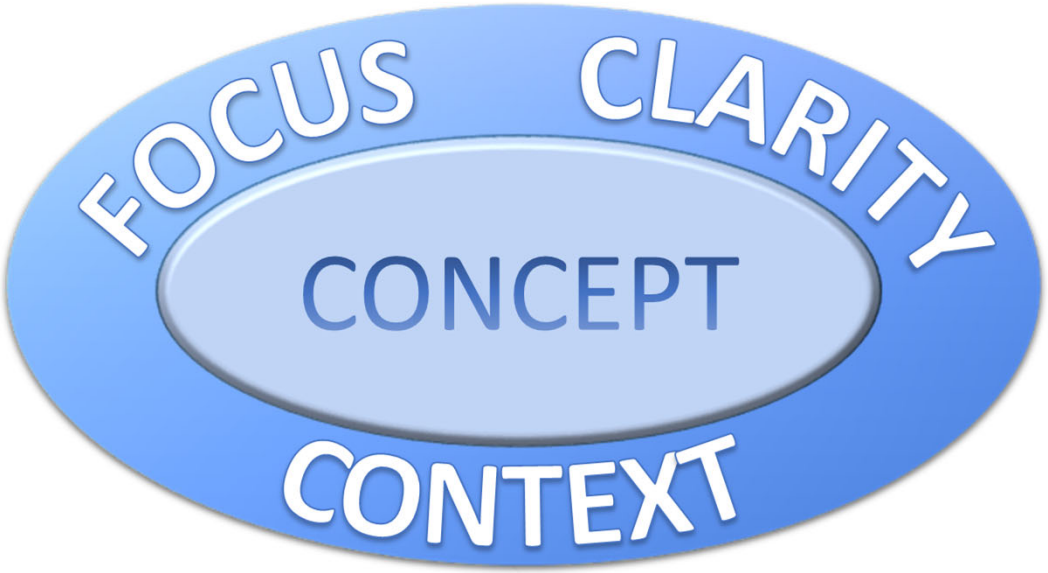
# What is the Concept Maturity Framework (CMF)?

**A framework best practice that yields:**

1. **Transparent and shared understanding about the progress and gaps of maturing the concept**
2. **Clarity and consistency throughout the concept research, engineering, and development process**
3. **Information for decision-making and budgeting**



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# Background of the CMF

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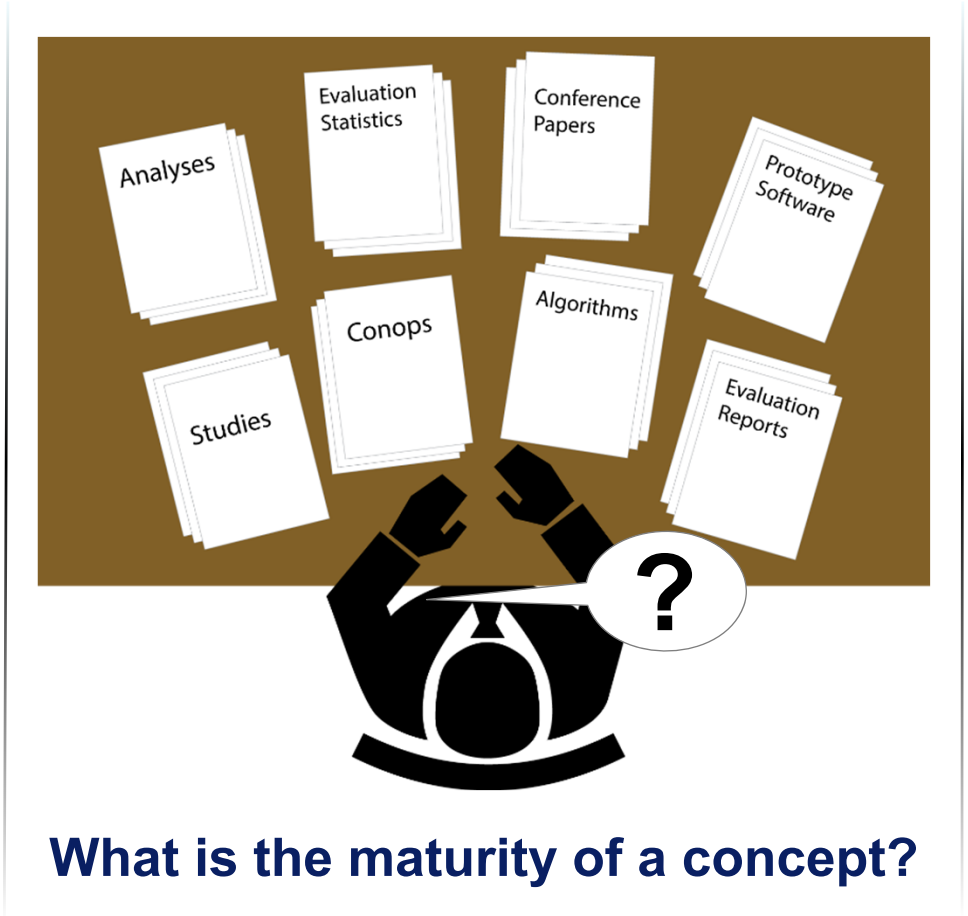
# FAA's Initial Request

## New Concepts & Associated Capabilities

## Concept Development: Exploration, Validation, Evaluation




**What is the maturity of a concept?**



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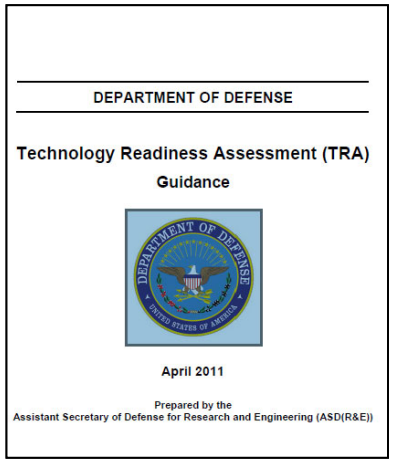
# Current Approaches

## Process: Technology Readiness Assessment (TRA)


DEPARTMENT OF DEFENSE

Technology Readiness Assessment (TRA)
Guidance

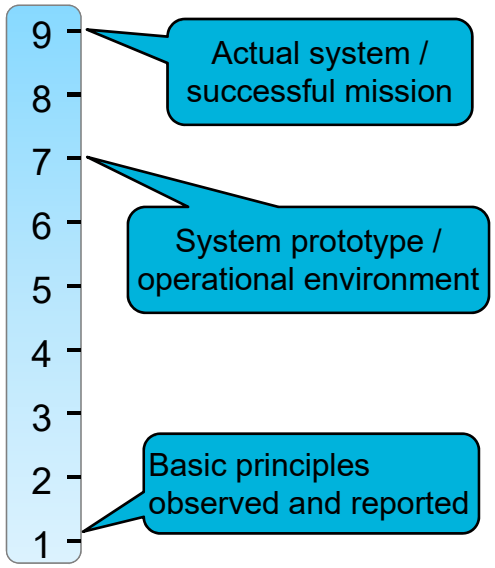
April 2011

Prepared by the
Assistant Secretary of Defense for Research and Engineering (ASD(R&E))

*Image Source: DOD [1]*

*FAA System Engineering Manual [2] specifies 2 TRAs to be conducted for Mission Analysis and for In-Service Analysis*

## Measure: Technology Readiness Levels (TRLs)




*FAA's Levels of Maturity (LOMs) [2]*

## Measure: FAA Concept Maturity Levels (CMLs)

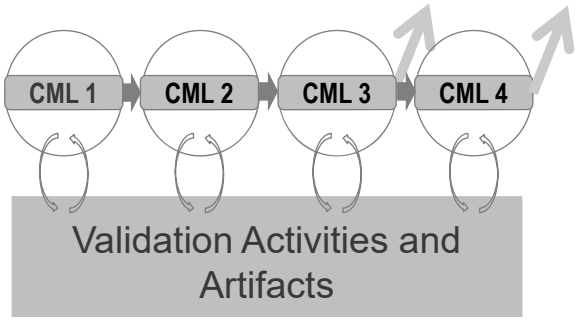



*Image Source: FAA [3]*

*FAA Concept Development and Validation Guidelines [3] identify Concept Maturity Levels: Validation activities, key participants and work products and exit criteria*



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# Responding to Limitations

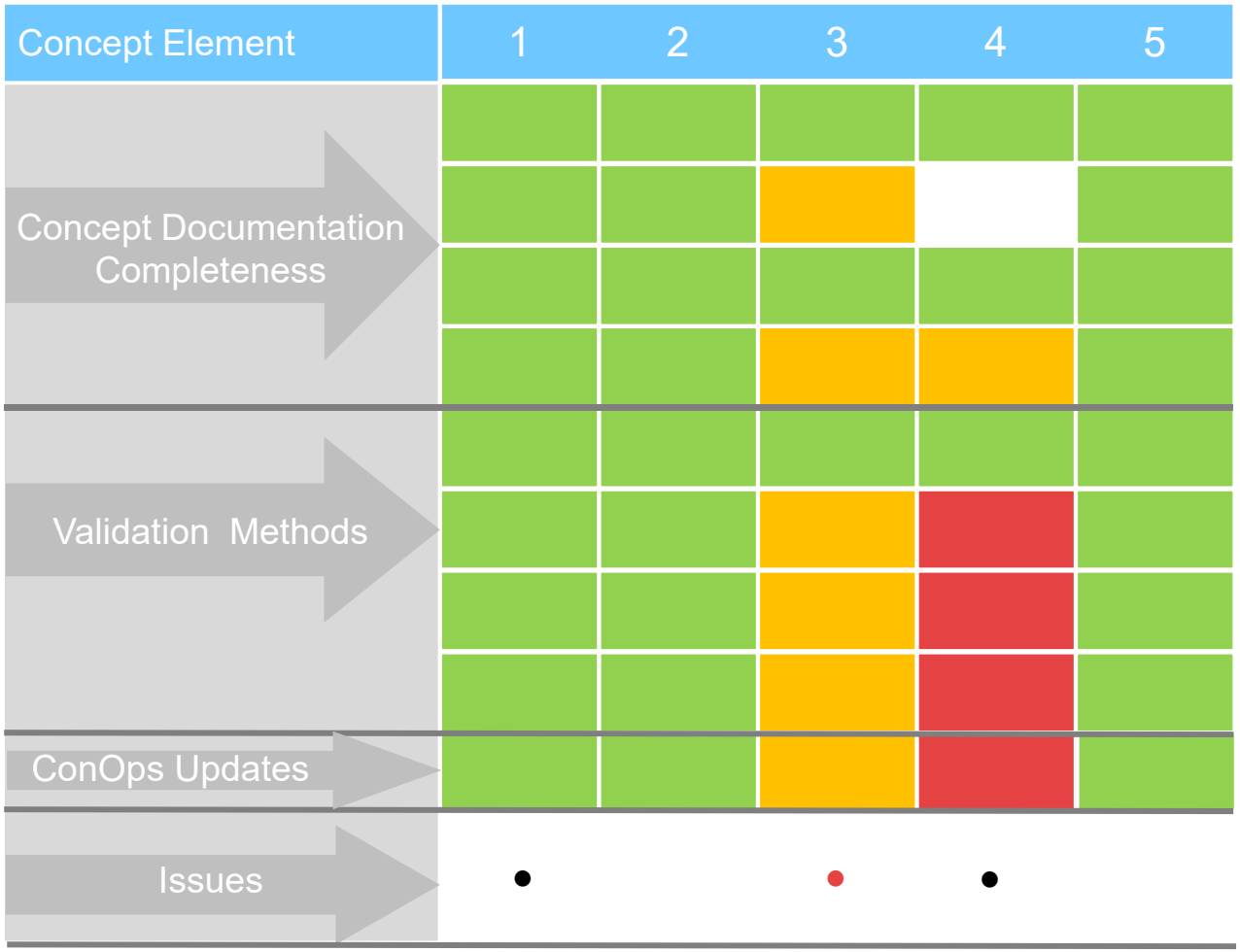
| Today's Limitations | Addressed by CMA |
|---|---|
| A single readiness level describing multiple components [4] | Components of concept and prototype capabilities assessed |
| Illusion of objectivity with a numerical scale (observations) | Standard criteria and responses |
| Subjectivity introduced without defined terms and process [5] | Definitions based on concept documentation |
| Not enough focus on results/findings of concept development activities [5] | Results include user perspective, functionality, and data/data interface issues |
| Time-intensive process to find and extract pertinent information from documents and reports [6] | Can be executed by researchers, checked by sponsor |

# Concept Maturity Assessment

- **Objective**
  - **How much** has been completed/not completed for each component
  - **In what context**
  - **With what results:** User feedback, Issues

- **Framework**
  - **High-level** criteria and standard responses
  - **Applied to a decomposition** of the concept representing both the operation and the capability
  - **Bullets for significant issues**
  - **Evidence** supporting each response

# Notional Concept Element Assessment



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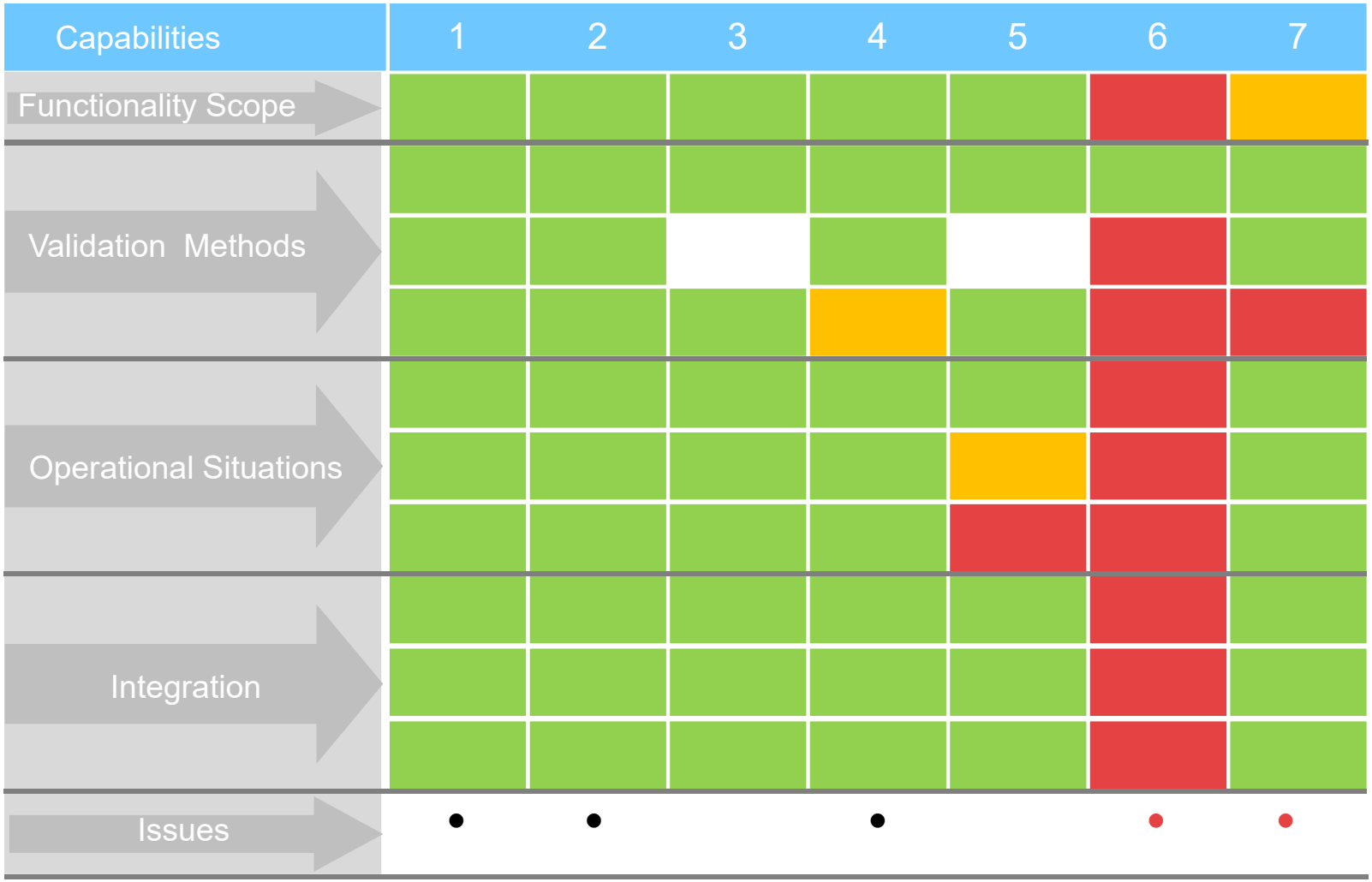
# Notional Capability Assessment



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# Evolution of the CMF

## Extending the CMF throughout the Concept Research, Development and Engineering Process

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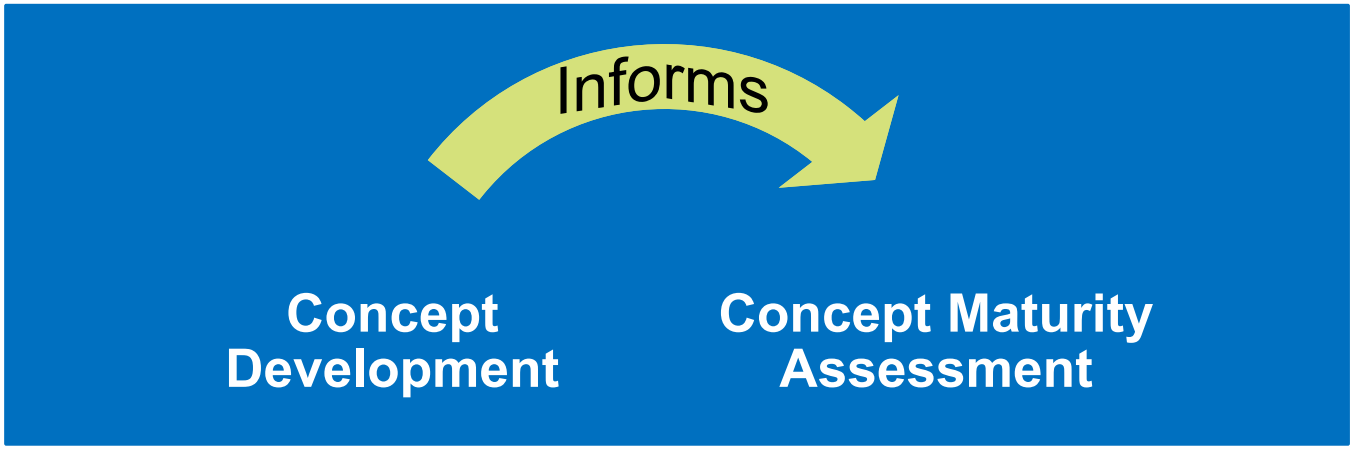
# Concept Development




- Scope: Full and Partial concept elements and capabilities
- Fidelity
  - Operational: simple, typical, complex situations
  - Activity: validation technique
  - Integration: none, internal, external, end-to-end
- Results: user feedback, outstanding issues



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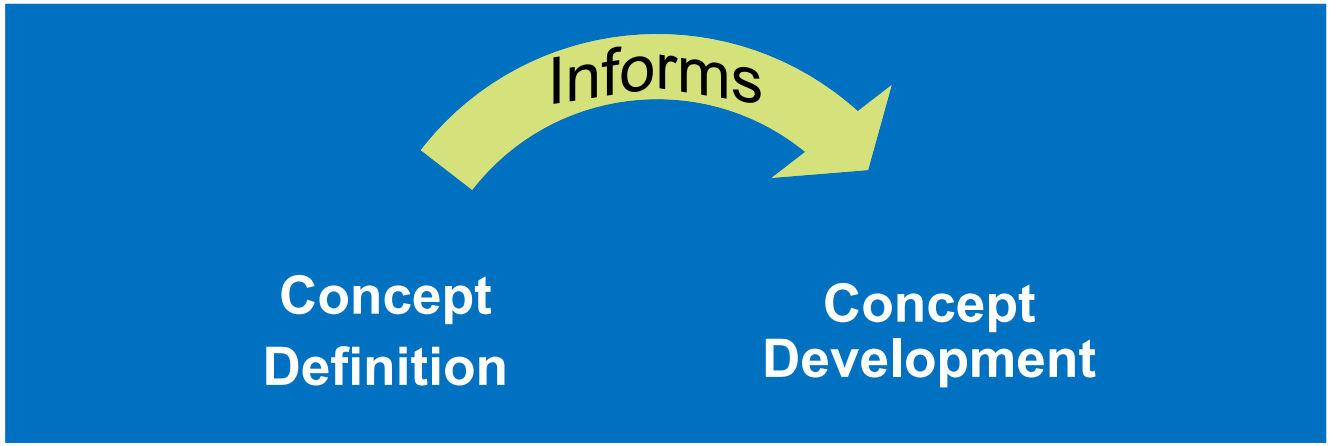
# Concept Definition




- Operational concept elements **and** capabilities: Scope
- Relevant operational environment: Fidelity and technique
  - Operational characteristics
  - Operational connections
  - Technology connections
- Scenarios – simple, typical, complex: Fidelity

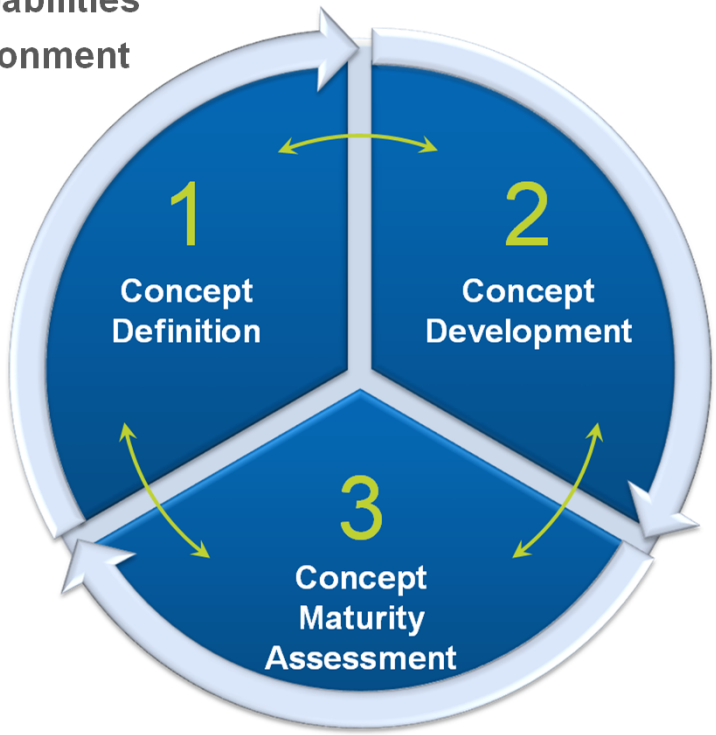
# The Concept Maturity Framework

CONCEPT DEVELOPMENT PLAN

**Defines the following:**

- Concept elements and capabilities
- Relevant operational environment
- Operational and technical integration

Concept Definition

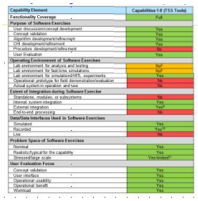



**Addresses the following:**

- Scope of elements
- Fidelity of environment
- Characteristics of problem space
- Extent of integration

Development Activity Plan

Development Activity Report



**For Each Component: Evidence**

- How much has been completed?
- In what context?
- What issues were found (user, functionality, data)?
- Summarize maturity



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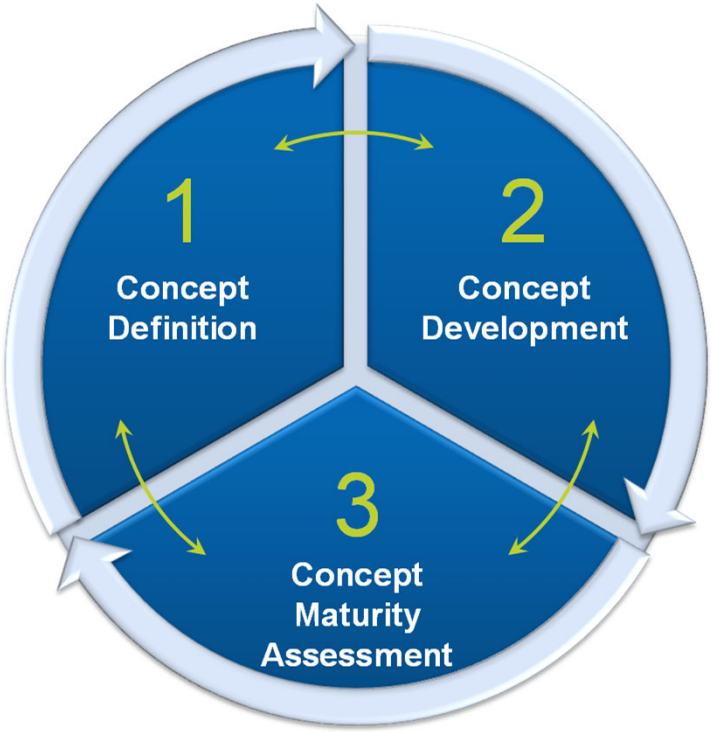
# Value of the CMF

- ✓ Simple
- ✓ Easy to understand
- ✓ Easy to maintain and repeat

CONCEPT DEVELOPMENT PLAN

- Key artifact for stakeholder engagement, risk identification, consensus building
- Focus on the operation
- Concept in context
- Foundation for concept development activities




- Focus on the concept, not the activity
- Information supports a maturity assessment and concept modifications

- Evidence-based assessment
- Easy-to-understand information in a few tables
- Makes transparent and clear: what has and has not been done, what issues remain relative to concept components



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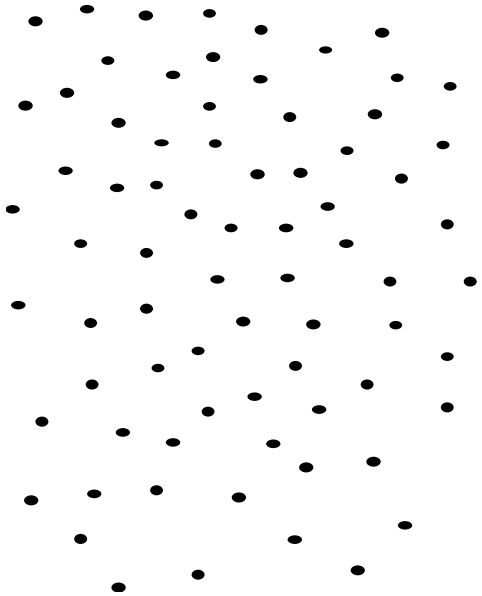
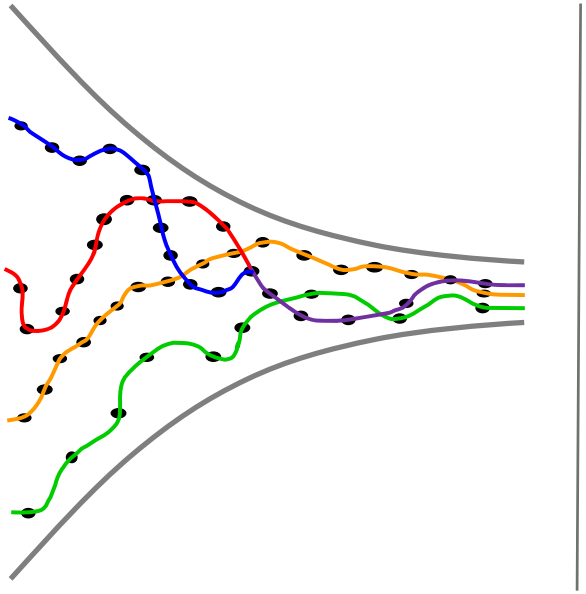
# Bottom Line

**From This…**



**To This…**



**Outcome**

***Better***

***Faster***

***Cheaper***

# How CMF Supports "The Right Things Done Right"

## Concept Research, Engineering, and Development

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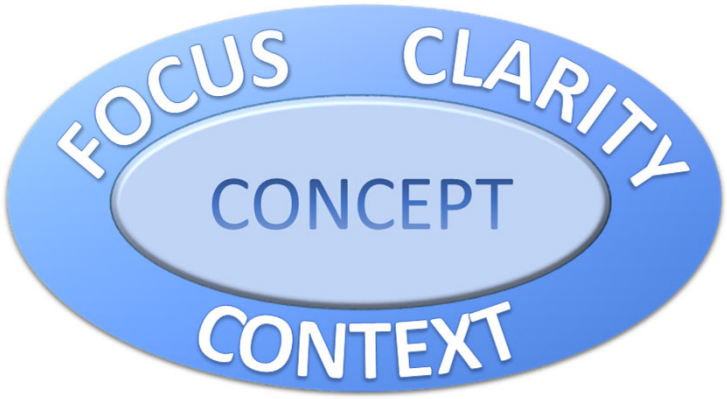
# CMF Maintains Focus on the "Right Things"

- **Decomposition**
  - Operational concept elements
  - Technology capabilities that support them
- **Scenarios starting with simple and typical, then layering on complexities**
- **Concept in context**
  - Assumptions
  - Connections
  - Integration



# CMF Supports "Done Right"

CONCEPT DEVELOPMENT PLAN

- **Engaging with Operational Subject Matter Experts**
  - Confirmation of the problem
  - Evaluations during concept development
  - User feedback reporting
- **Planning and Execution**
  - Operational Context
  - Need-driven technique and activity fidelity
  - Outcome reporting
  - Informing and refining across the 3 CMF components
- **Decision-making**
  - Insight for prioritizing future activities to maximize ROI
  - Gaps, significant issues, integration
- **Traceability**
  - Concept research, engineering and development
  - Acquisition life cycle



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# Questions?

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# References


1. Assistant Secretary of Defense for Research and Engineering, (2016, August 22), “Technology Readiness Guidance,” Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, available http://www.acq.osd.mil/chieftechnologist/publications/docs/TRA2011.pdf.
2. Federal Aviation Administration, “Systems Engineering Manual,” Version 1.1, FAA, Washington, DC, Sept. 2015.
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5. N. Azizian, S. Sarkani and T. Mazzuchi, "A Comprehensive Review and Analysis of Maturity Assessment Approaches for Improved Decision Support to Achieve Efficient Defense Acquisition," in *Proceedings of the World Conference on Engineering and Computer Science*, San Francisco, CA, 2009.
6. C. Graettinger et al., “Using the Technology Readiness Levels Scale to,” Support Technology Management in the DoD’s ATD/STO Environments,” Carnegie Mellon University Software Engineering Institute, Pittsburgh, PA, 2002.

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