



U.S. Army Research, Development and Engineering Command



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Integrating Requirements to Analyze Capability Gaps and Redundancies Across the Army's System of Systems (SoS)

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- **Discussion on Problem**
- **Integrating the Army's Requirements**
- **Analyzing System of Systems (SoS) Requirements**
- **Desired End Results/Goals**





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- Difficult to look across the capabilities and functionality for the System of Systems (SoS) to find gaps and redundancies, given the fact that requirements:
 - Are specified at many levels (e.g. enterprise, family of systems, systems, subsystems)
 - Are of different types (e.g. operational requirements, system requirements, directed requirements, operational need statements)
 - Are specified in a variety of lexicons
 - Are at various stages of development (draft, approved, not written)
 - Have different owners and writers, each with their own situational awareness and contextual understanding
 - Managed in a variety of documents, databases, and knowledge management systems/portals, making them tough to access or find the “latest version”





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- Functionality that cuts across systems or leverages a common infrastructure is not always well-specified
 - Scope of trade space analysis at the system level does not include due consideration and analysis of the system of systems impacts
- Multiple system-solutions often provide unnecessary duplication in functionality
- Each system-solution has complete lifecycle costs (e.g. operations, maintenance, sustainment, training)





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The term "requirement", in and of itself, can be controversial.

In general:

- Army Training and Doctrine Command (TRADOC) Proponents ...
 - ✓ write Capability Documents, IAW writer's guides, which contain requirements (approved and funded by Army G8)
- Program Managers ...
 - ✓ write System Specifications, IAW MIL-STD-961E, which contain technical, functional requirements (these go on contract)
- Headquarters, Department of Army (HQDA) ...
 - ✓ writes memorandums, which contain directed requirements (have expiration and need to be worked back into formal process)
- Approved Operational Need Statements (ONS), Joint Urgent ONS (JUONS) and Quick Reaction Capabilities (QRCs) constitute additional requirements in the SOS environment

***Please note this is currently Army scoped; other considerations may be needed to account for Joint products.**

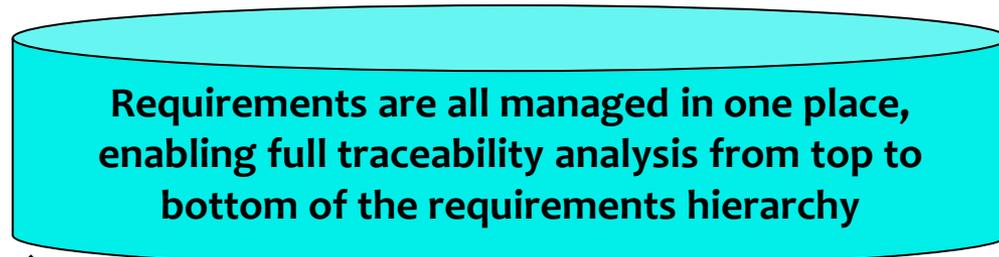


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Imagine a world where:

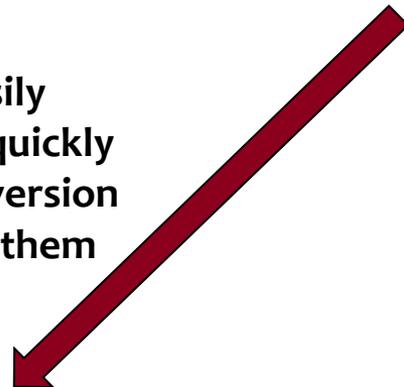
INTEGRATED REQUIREMENTS DATABASE

TRADOC
Capability
Managers



Requirements are easily accessible, so one could quickly find the latest approved version and build traceability to them

Program
Managers

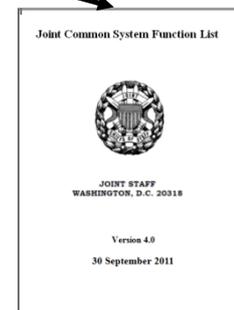


OVs

CVs

SVs

StdVs

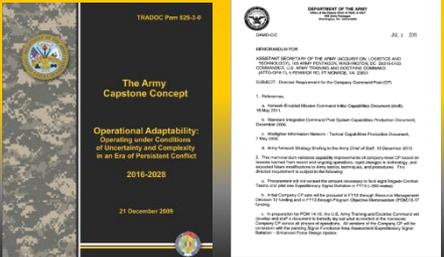


Textual requirements are truly linked to architectural data and authoritative references, to enable stronger analysis when looking for gaps in the architecture or required system functionality

This is our vision!!

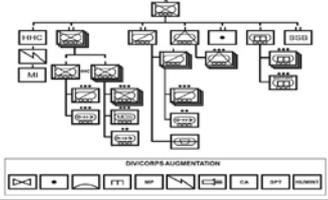
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Guidance/Direction



TRADOC Pam 525-9-0
The Army
Capstone Concept
Operational Adaptability:
Operating Under Conditions
of Uncertainty and Complexity
in an Era of Persistent Conflict
2016-2028
21 December 2009

Operational Requirements

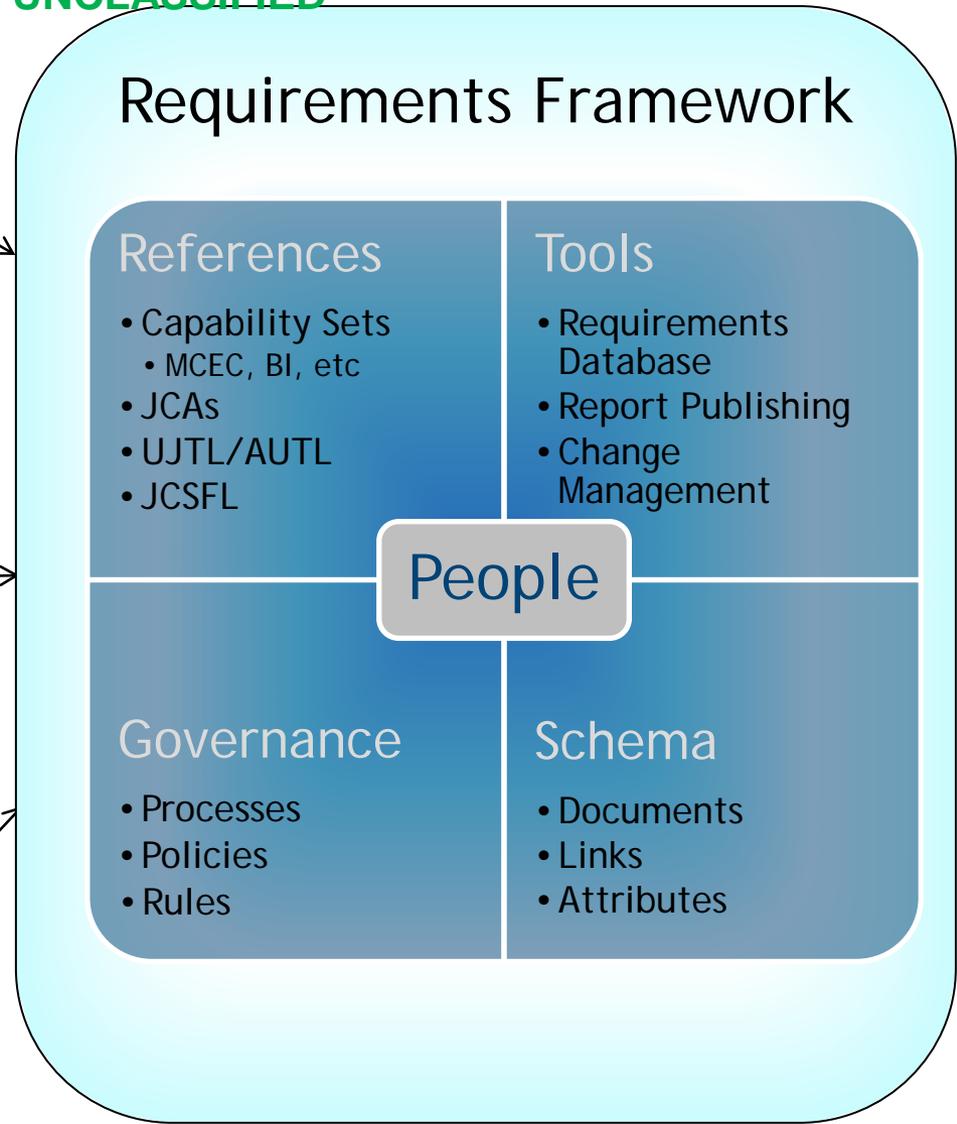


JCIDS documents: ICD, CDD, CPD

Matériel Requirements

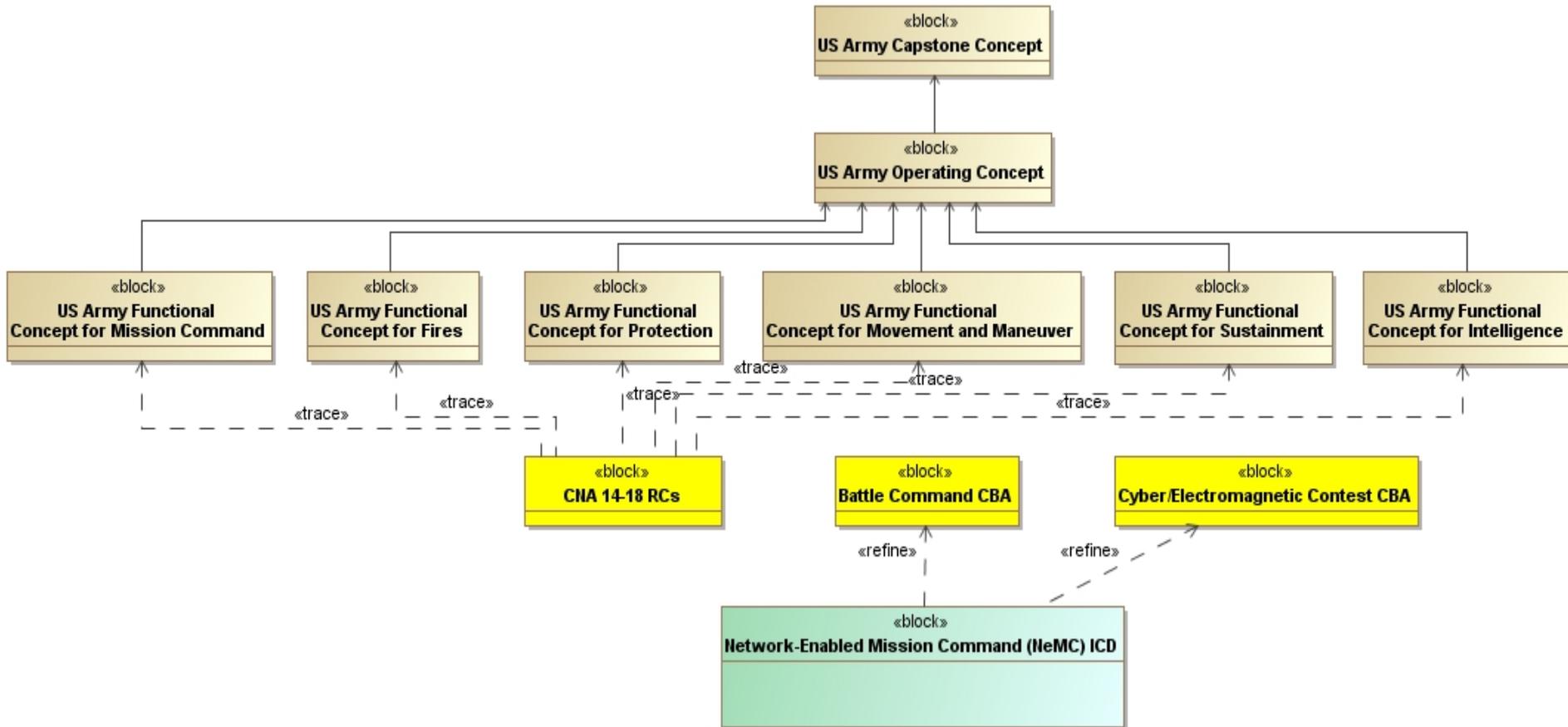


System specifications





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Models used to communicate hierarchy and ensure we “have it right”



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- Constructed a schema to house requirements documentation from various developers, based on type and organization
- Populated database with JCIDS documentation as a pilot to validate schema
 - Requirements within Documents (ICDs, CDDs, CPDs) are now electronic pieces of data that can be tagged with attributes
- Built an Index of all pertinent Requirement Documents
 - Index contains links to all documents that have been loaded, which enables automation against the index



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Need answers to many tough questions being asked today, due to budgetary constraints:

- Where can efficiencies be realized to save dollars, and “do more without more”?
- Which systems need to be sustained to ensure least impact to capabilities and operational effectiveness?
- What capabilities should be converged or migrated across the systems?
- Where should dollars be invested to develop and implement / deploy new capabilities?



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To start, the community is seeking answers to the following:

Where are the “best of breed” requirements in various functional areas?

In terms of capabilities and functionality, what are the best candidates for commonality?



Which lower level capabilities are essential to carry forward? When capabilities are decomposed, what are the gaps that current systems are not fulfilling?

How should the set of approved requirements be reorganized to achieve objectives of the Army’s System of Systems (SoS)?



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- "Normal" Systems Engineering:
 - Small set of source documents/higher level requirements
 - Easier to "draw the box" (clear system boundaries) to scope a requirements analysis effort; "Focuses on boundaries and interfaces for the single system"*
- SoS Engineering:
 - Plethora of requirements documentation, spanning domains
 - "Focus on identifying the systems that contribute to the SoS objectives and enabling the flow of data, control and functionality across the SoS while balancing needs of the systems"*
 - Conflicting political and funding interests (not always a "champion")
 - Need new approaches to analysis based on specified objectives for the SoS

This isn't your Grandparents' Requirements Analysis!

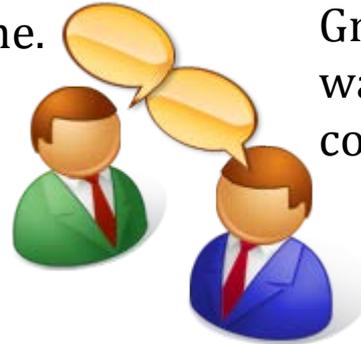


* From "Systems Engineering Guide for Systems of Systems", v1.0, Aug 2008 (USD(AT&L))



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Collaboration is an important cross-cutting capability we need to examine.



Great – which requirements do we want to ensure we carry forward for collaboration?



Wait, what do we mean by “collaboration”? Is “chatting” collaboration? How about “messaging”?

The term “collaboration” is complex; it “leads to shared understanding”, and involves:*

- “Text Messaging/Chat
- Document / Product Viewing and Sharing
- White Boarding / Map Boarding
- Voice
- Video
- Voice Translation/Transcription
- Language Translation/Transcription”

... then there’s shallow (Asynchronous) collaboration, vs. deep (Synchronous) collaboration ...*



* Credit to PEO C3T, PM Mission Command

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- Functionally decompose complex terms
 - Determine which functions are needed at what echelons in the formation, then see how existing systems provide that functionality (leverage links into system views of architecture)
- Perform keyword/term searches across integrated requirements set
 - Leverage functional decompositions
- Map requirements to terms within authoritative references, then use them to look across the SoS
 - Examples include:
 - Universal Joint Task List (UJTL)
 - Army Universal Task List (AUTL)
 - Joint Capability Areas (JCAs)
 - Joint Common System Function List (JCSFL)





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- Key to Integration: Enforce Standard Attributes for Requirements to Enable Mapping and Traceability
 - *Examples:*
 - Traceability
 - Tracing System Requirements to Key Performance Parameters (KPPs), Key System Attributes (KSAs), etc
 - Tracing required capabilities to functional concepts
 - Mapping
 - System Requirements to JCSFL Functions (using JCSFL version number and function identifier)
 - Operational Requirements to capabilities in architectural views (using capability identifier and architecture ID)
- With an enforced standard, scripting can be leveraged to automate the connectivity of requirements to other requirements or data





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- Identify gaps in functionality by leveraging requirements traceability, architectures and mappings
 - Will assist in determining where dollars should be allocated for technology or materiel development
- Ability to look across SoS requirements to look for best candidates for common solutions
 - Where will we get the most “bang for our buck”?
- Influence structure and development of requirements to match Army Strategies and SoS Objectives
 - It will be funded and built based on how approved requirements are specified





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- Ensure the right capabilities and requirements are defined:
 - To develop, acquire and field effective materiel solutions for the Soldier
 - These help successfully accomplish mission objectives against varied threats within equally varied global theaters and operational environments
 - In a manner to reduce overall lifecycle costs, particularly during the Operations & Support Phase (O&S) (Sustainment)



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- By integrating requirements into one place, it will be easier to answer the tough questions in the System-of-Systems space
- Specification of standard requirements attributes will assist in rebuilding traceability between levels of requirements and mapping to authoritative references
- New approaches to analysis are needed to answer SoS questions
 - e.g., decompose terms, search for them and roll back up