Questions on Requirements Development and Management? New Guides from INCOSE

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What Problem are We Solving

- There is a gap in guidance on how to perform several key requirements activities
  - Managing requirements, especially large sets
  - Organizing and managing Verification and Validation (V&V)
- INCOSE Requirements Working Group (Tami Katz, chair)
  - Guide being developed as part of RWG
  - Will be aligned with existing product, “Guide to Writing Requirements”
  - Lou Wheatcraft, Co-chair

Two guides and one manual are currently in development. All will align with each other.

Outline

- Description of current state
- Context: Evolution of the Guide to V&V, and other guides in development
- Progress: Status and proposed schedule
- Content: High-level outline

What Exists Today

- Two main sources for reference
  - INCOSE's own SE Handbook
  - SE Body of Knowledge (SEBoK)
- Existing INCOSE *Guide for Writing Requirements*

INCOSE Systems Engineering Handbook

Systems Engineering Body of Knowledge (SEBoK)

Guide for Writing Requirements

Guide to Writing Requirements

- First edition, April 2012
  - Version 3.0, July 2019
  - Well received by SE community
- Requirements and requirements sets
  - Background theory
  - Writing and authorship: singularity, accuracy, completeness
  - Attributes, other characteristics of requirements and sets
  - Elicitation

While well received, community asked for additional guidance specifically on management and V&V

Creation of Two Additional Guides

- Managing requirements
  - How to organize large requirements sets
  - Name change: Guide to Developing and Managing Requirements became Guide to Needs and Requirements
- V&V
  - How to organize, link and map large bodies of verification evidence

INCOSE Systems Engineering Handbook

Systems Engineering Body of Knowledge (SEBoK)

Guide for Writing Requirements

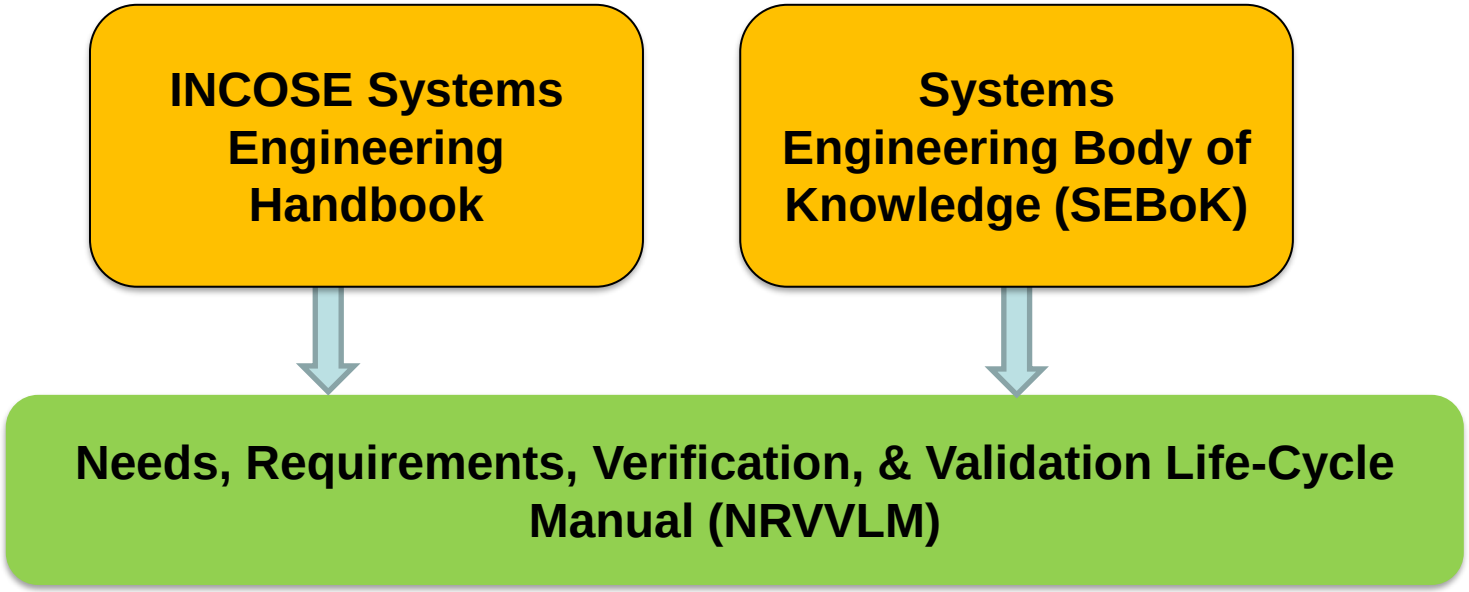
Guide to Needs and Requirements

Guide to Verification and Validation

Something was still missing …

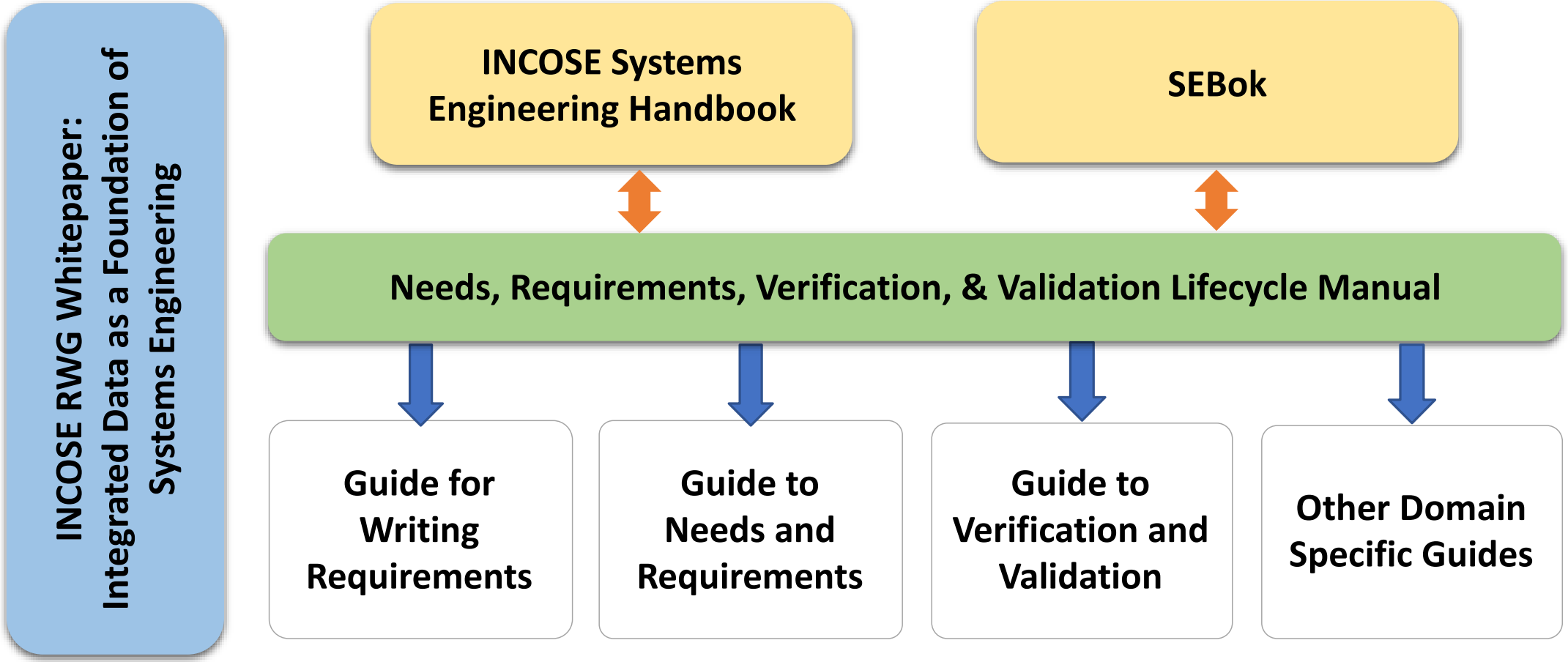
Needed a Home for Background and Theory

- Guides about 50-70 pgs
  - Much more digestible for entry/mid-level practitioner
- Larger: Needs, Requirements, V&V Lifecycle Manual
  - Background and theory; the “Why” behind the “How”



Current Approach Provides Full Coverage

- SE Handbook / SEBoK feed NRVVLM, which feeds smaller “How-to” guides



Mapping of Common SE Terms

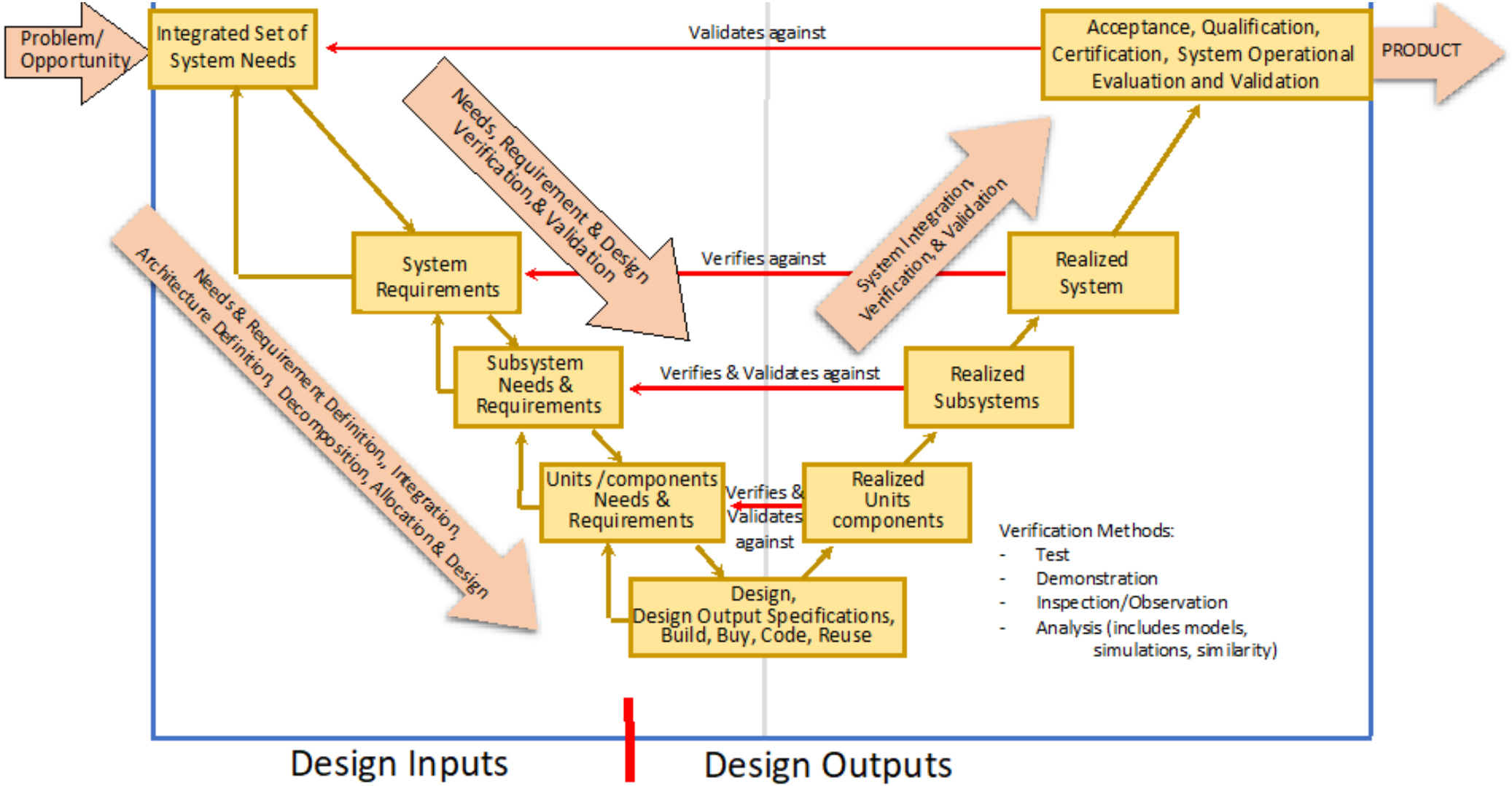
- CONOPS, Goals, … -> *Integrated Set of System Needs*
- Requirements -> *Design Input Requirements*
- Design -> *Design Output Requirements or Specifications*
- Product, part, item -> *System (or component) of Interest (SOI)*

Idea is to "***transform***" from one stage to the next

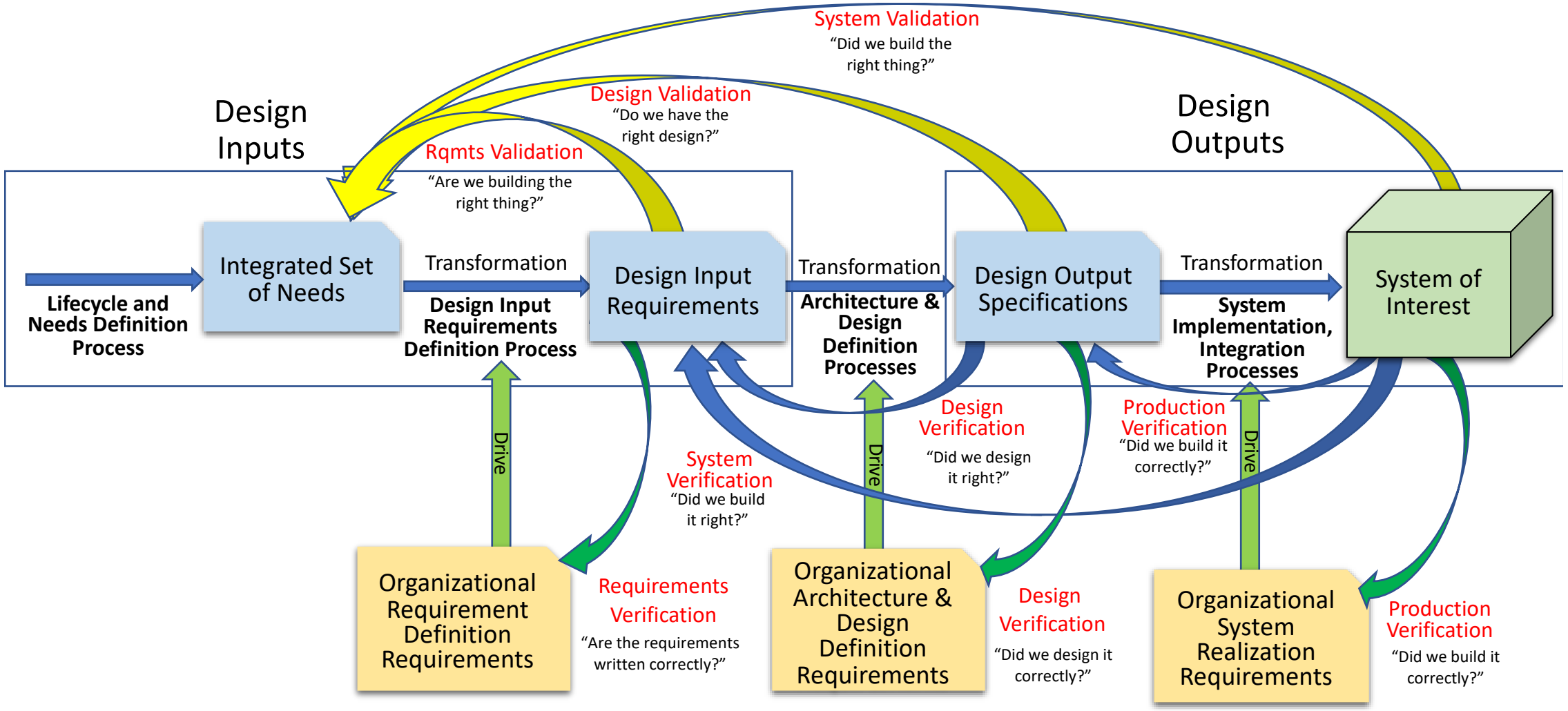
Same ideas, standardized vocabulary will facilitate communication, and help forward the technical work

We Start with the Systems Vee

- The Vee we are familiar with still holds true
- If we draw the Vee out into a straight line, left to right …
- We can open up our model to more clearly show the SE process
  - Including V&V!
  - Easier to see the difference between Verification and Validation
- The model used in our manual and guides, tracks the Vee



Adapted from Ryan, M. J.; Wheatcraft, L.S., "On the Use of the Terms Verification and Validation", February 2017 and INCOSE SE HB, Version 4, Figures 4.15 & 4.19



Derived from Ryan, M. J.; Wheatcraft, L.S., "On the Use of the Terms Verification and Validation", February 2017

Systems Engineering Model for NRVVLM

On the Left - Going Back Further: Lifecycle Concepts

- What are “System Needs”, and where do they come from?
  - Parent needs
  - Drivers and constraints
  - KPPs
  - Measures of Effectiveness

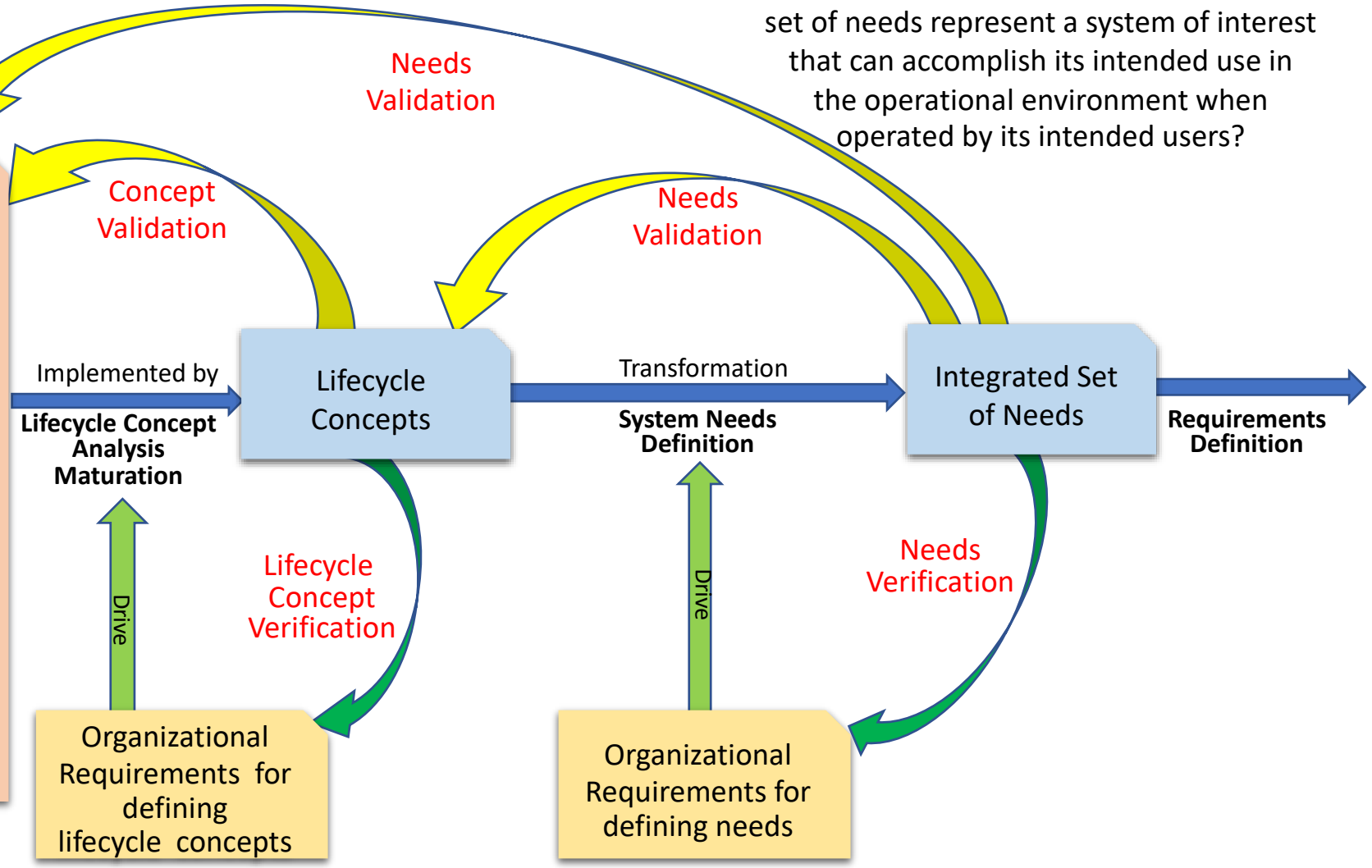
- Lifecycle Concepts
  - Mission
  - Use cases
  - User stories
  - Goals
  - Objectives
  - Concept of Operations (CONOPS)

Can perform V&V on ***both*** the needs and the lifecycle concepts

Do the lifecycle concepts and integrated set of needs represent a system of interest that can accomplish its intended use in the operational environment when operated by its intended users?

- Problem or opportunity Mission, goals, objectives
- MOE's, MOPs, TPMs, KPPs
- Preliminary stakeholder needs & requirements
- Use cases, user stories, system concepts, OpsCon, ConOps
- Higher level Needs
- Higher level Requirements
- Higher level lifecycle concepts
- Drivers & constraints,
  - External systems
  - Standards
  - Regulations
  - Technology
  - Operating Environment
- Risks

Business & Mission Analysis Processes



Outline of Needs, Requirements, V&V Manual

Outline of Manual

- General Sequence
  - Needs
  - Requirements
  - Design
  - System, SOI, Produced Product
- Guides roughly reflect the overall NRVVLM outline
  - Guide to Needs and Requirements: first half of manual
  - Guide to Verification and Validation: approximately the second half
    - Covers design, SOI verification and validation
- *There is some minimal overlap*

The concepts are covered in the NRLM; the Guide provides process steps and some examples to show how the concepts might look

Each Guide Covers Half of the NRVVLM

- First Half: Guide to Needs and Requirements
  - Needs elicitation and creation
  - Requirements development
  - Requirements management
  - Needs and requirements V&V – in particular, validation
- Second Half: Guide to V&V
  - Picks up with the design (design output specifications)
    - Drawings, logic flow, prints
    - Design is then verified, and validated
  - System (built or coded product) V&V follows

Will now present outline of the Manual – Guide outlines follow this

NRVVLM Outline; *Green Ital. is GtNR*, **Blue bold is GtVV**

- 1. Introduction
  - Purpose, scope, and definition of process areas
- 2. Definitions and Concepts
  - Includes types: organizational, business unit, programmatic, technical
- 3. Information-Based Requirement Development and Management
  - Expands beyond ‘text-based’ requirements; models, diagrams
- *4. Lifecycle Concepts and Needs Definition Process*
  - *From fuzzy ideas of a concept, to a defined set of needs*
- *5. Needs Verification and Needs Validation*
  - *Verification and validation of the needs statements*

NRVVLM Outline

- *6. Design Input Requirements Definition Process*
  - *Creating the "requirements" for a product or system, from needs and more*
- *7. Design Input Requirements Verification and Requirements Validation*
  - *Performing a verification on the requirements statements and diagrams per se*
- **8. Design Verification and Design Validation Process**
  - **Creating, verifying, then validating**
- **9. Production Verification**
  - **Short section, most of this covered in an organizations Quality Mgmt. System**
- **10. System Verification and System Validation Common Principles**
  - **Now dealing with built product and SOIs**

NRVVLM Outline

- **11. System Verification and Validation Process**
  - **Verifying the SOI to input requirements, validating it to needs**
- **12. The Use of Off-The-Shelf System Elements**
- **13. Supplier-Developed Systems and System Elements**
- 14. Needs, Requirements, and V&V Management Process
  - Plans, monitoring, communication, change management, interface management
- 15. Attributes for Needs and Requirements
  - Needs, requirements, V&V, management attributes, guidance for use
- 16. Features a Systems Engineering Toolset Should Have
  - Functionality, attributes, reporting capability, other considerations

Guidance is On The Way!

- Multiple guides answer the SE community's request
  - Goes beyond current Guide to Writing Requirements
  - More detail provided than SE Handbook, SEBoK
  - Multiple documents provide different levels of detail and background
  - **Goal is to make our work as complete as possible, and accessible**
- Team effort
  - Over 20 different contributors and reviewers
  - Four different document leads
  - RWG participation at IS and IW

Large volume of new work will benefit SE community across disciplines
Target is to release the documents by Jan 2022.

RWG Leadership

- **Chair**: Tami Katz; Ball Aerospace, USA
- **Co-Chair**: Lou Wheatcraft, Wheatland Consulting, USA
- **Co-Chair**: Rick Zinni, Harris Corp, USA
- **Co-Chair**: Mike Ryan, Univ. of New South Wales, Retired

- **INCOSE Connect address:**
- https://connect.incose.org/WorkingGroups/Requirements/Pages/Home.aspx

The RWG is comprised of members from industry and academia with a common purpose of improving the practice of systems engineering through improvement of **Needs and Requirements** definition and management

Joining the RWG

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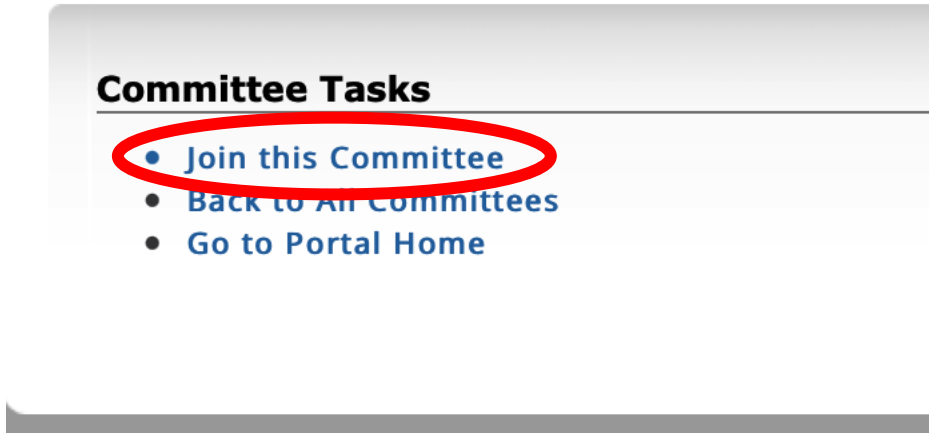

Product Line Engineering	151	(view)
Professional Development Initiative	33	(view)
Profl Development Steering Grp	29	(view)
Publications	1	(view)
Publications Office	4	(view)
Requirements	382	(view)
Resilient Systems	73	(view)
Risk Management	111	(view)

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4

Go to
“Edit Your Information”
and under
“Communications Preferences” be sure to ”opt in” for Working Group emails

YouTube Channel, “INCOSE RWG”: Answering Other Questions

- What is the new paradigm, we are asking the community to consider?
  - https://www.youtube.com/watch?v=ZRli_wSCmRg
- Here is a presentation on the Guide to V&V (IW2021)
  - https://www.youtube.com/watch?v=_33sZ0IntwY
- What is the RWG all about?
  - https://www.youtube.com/watch?v=L_Z6XitproI
- How about an overview of the manual?
  - NRLM: https://www.youtube.com/watch?v=g_fJk_UBONM
- If I wanted to focus on the Integrated Data piece?
  - https://www.youtube.com/watch?v=Rc3O6lPO5x4


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