INCOSE Requirements Working Group 2022 Year in Review

INCOSE North Texas Chapter

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INCOSE RWG Overview

RWG Charter

1 **Purpose**
Advance:
- Practices, education, and theory of needs and requirements development and management
- Relationship of needs and requirements to other systems engineering activities.

2 **Goal**
Expand and promote the body of knowledge of needs and requirements and its benefits within the systems engineering community

3 **Scope**
Activities relating to best practices throughout the product lifecycle including:
- Elicitation, Analysis, Allocation, Traceability
- Elaboration, Management
- Change Management
- Expression, Verification, Validation

RWG is About…

- How to improve the practice of systems engineering through excellence in needs and requirements development and management across the lifecycle
- Learning from experiences and sharing with the SE community
- Questioning approaches that yield poor outcomes
- Publishing guidance and continuing research into requirements development and management, including the understanding of Needs, Requirements, Verification, and Validation

Looking Towards the Future

- We fully support the Future of SE (FuSE) Initiative
- We fully support moving toward INCOSE's Vision 2035

"Our situation is not comparable to anything in the past. It is impossible, therefore, to apply methods and measures which at an earlier age might have been sufficient. We must revolutionize our thinking, revolutionize are actions…….."

Albert Einstein (1948) in "A Message to Intellectuals"

Article by John Mauldin "[Technology Rules](https://www.mauldineconomics.com/frontlinethoughts/technology-rules)"

"….it's remarkable how many industries and government agencies are still operating on ancient (as in 1990s) technology, [*just*] muddling through."

"... what happens when those organizations take off their old-tech handcuffs? They will run better and develop new capabilities they never had before. Customers, workers, and investors will all benefit."

"Humans have a comparative advantage at higher levels of abstraction: creativity, intuition, and holistic judgements. Each is necessary. The best technologies do not automate complex problems, as many assume; they equip people to solve them faster and more effectively."

https://www.mauldineconomics.com/frontlinethoughts/technology-rules

We are 23 years into the 21st Century, why are so many still practicing system engineering based on outdated 20th Century electro/mechanical, document-centric methodologies?

Change or Risk Becoming Irrelevant

"Several INCOSE dignitaries have been warning since about 2013 that if INCOSE did not take the lead to quickly understand software and start leading in software-intensive systems, INCOSE would be at risk of becoming irrelevant."
    (Roedler 2018, Stoewer 2017).

"*If the rate of change on the outside exceeds the rate of change on the inside, the end is near,*" as support to the idea that **INCOSE's rate of change must increase to match the rate of change in industry and the rapidly evolving technology universe**. (quote attributed to Jack Welch of GE)

This applies equally to organizations practicing Systems Engineering!

S. Sheard, M. Bouyaud, M. Osaisai, J. Siviy, K. E. Nidiffer; *A Guide for Systems Engineers to Finding Your Role in 21st-Century Software-Dominant Organizations*, Technical Paper presented at IS2021

RWG Leadership

- **Chair**: Tami Katz; Ball Aerospace, USA
- **Co-Chair**: Lou Wheatcraft; Wheatland Consulting, USA
- **Co-Chair**: Mike Ryan; Capability Associates Pty Ltd, AU
- **Co-Chair**: Raymond Wolfgang; Sandia National Labs, USA

- **INCOSE Websites:**
  - https://www.incose.org/incose-member-resources/working-groups/process/requirements
  - https://connect.incose.org/WorkingGroups/Requirements/Pages/Home.aspx
  - https://www.youtube.com/channel/UCadgYaqKWDckenP2SU8-cPw

- **Number of Members: 418 (**591 followers on Yammer), one of INCOSE's largest WG

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** development and management across the system lifecycle.

INCOSE RWG External Website

- The RWG maintains an external website (no INCOSE membership needed to view)

- Information on upcoming meetings and work in effort is provided.

- Anyone interested in participating in requirement working group data share is welcome to use this site to stay informed and obtain links to content.

https://www.incose.org/incose-member-resources/working-groups/process/requirements

How to Become Involved in RWG

- As a large working group, the RWG has been very active in virtual events as well as smaller product team efforts.

- Joining the working group enables the members to learn about the products, provide opportunity to contribute (or review), and participate in the RWG virtual events with other practitioners.

- Members can be very involved (product support) or minimally involved (watch meeting recordings), the intention is to enable all levels of participation and interaction.

➡ **Members**:
  - ➡ Contribute the benefit of their experience
  - ➡ Promote the purposes of the group
  - ➡ Write, edit and review work products
  - ➡ Liaise with other working groups and organizations
  - ➡ Assist the leadership team with specific activities

My Committees/Working Groups *(Join a group here)*

Committee	Position
SE Tools Database	Member

- View My Committees/Working Groups
- Browse / Join a Working Group

RWG Yammer Community

- The INCOSE organization has established Microsoft platforms for INCOSE member engagement.

- Upon obtaining the member login from the INCOSE CIO Barclay Brown, navigate to Communities (Yammer) and join the Requirements Working Group Community.

- This platform enables more interactive announcements, questions, and discussions throughout the year!
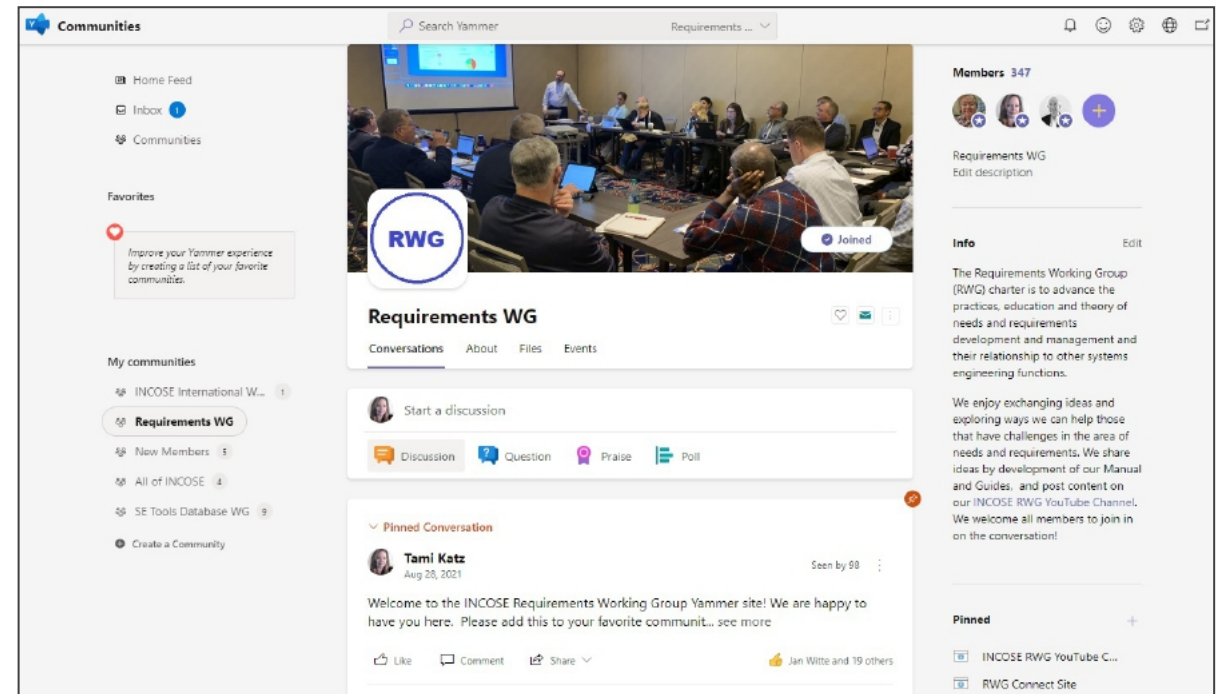
Access to Communities is through the Microsoft Teams App, Yammer App (iOS), or the online Microsoft Teams site.

RWG Outreach Events

- RWG engages the INCOSE community as well as the larger SE community through regular events around the topic of Needs and Requirements.
  - Guest speakers on Requirements Topics
  - RWG Exchange Cafés
- Open to INCOSE members and non-members.
- RWG members contribute ideas towards topics discussed.
- Attendees are encouraged to share their experiences and questions with the broad working group community.

INCOSE RWG YouTube Channel

- [YouTube](#) channel has recordings of meetings and presentations to the broader community.

- Available to everyone to catch up on events and learn more about the RWG efforts and products.

- Also exists to attract interest in joining INCOSE and the RWG and share wisdom, experience, and ideas with all that engage in needs, requirements, verification, and validation activities.

https://www.youtube.com/channel/UCadgYaqKWDckenP2SU8-cPw/playlists

RWG 2022 Activities

RWG Products

RWG Product Tree

- The RWG released multiple new products and supported the development of other INCOSE publications (e.g., SE HB v5)

INCOSE RWG Whitepaper: Integrated Data as a Foundation of Systems Engineering

INCOSE Systems Engineering Handbook
RWG Inputs Provided

SEBok
RWG Inputs Needed

Needs and Requirements Manual
V1.1 Released

Guide to Needs and Requirements
V1 Released

Guide to Verification and Validation
V1 Released

Guide to Writing Requirements
V 3.1 Released

Other Domain Specific Guides
RWG Inputs In work

RWG Products are in the INCOSE Store!

- RWG Products are released in the INCOSE Store!

- Free to INCOSE members

- All are encouraged to download and start using, feedback is welcome!
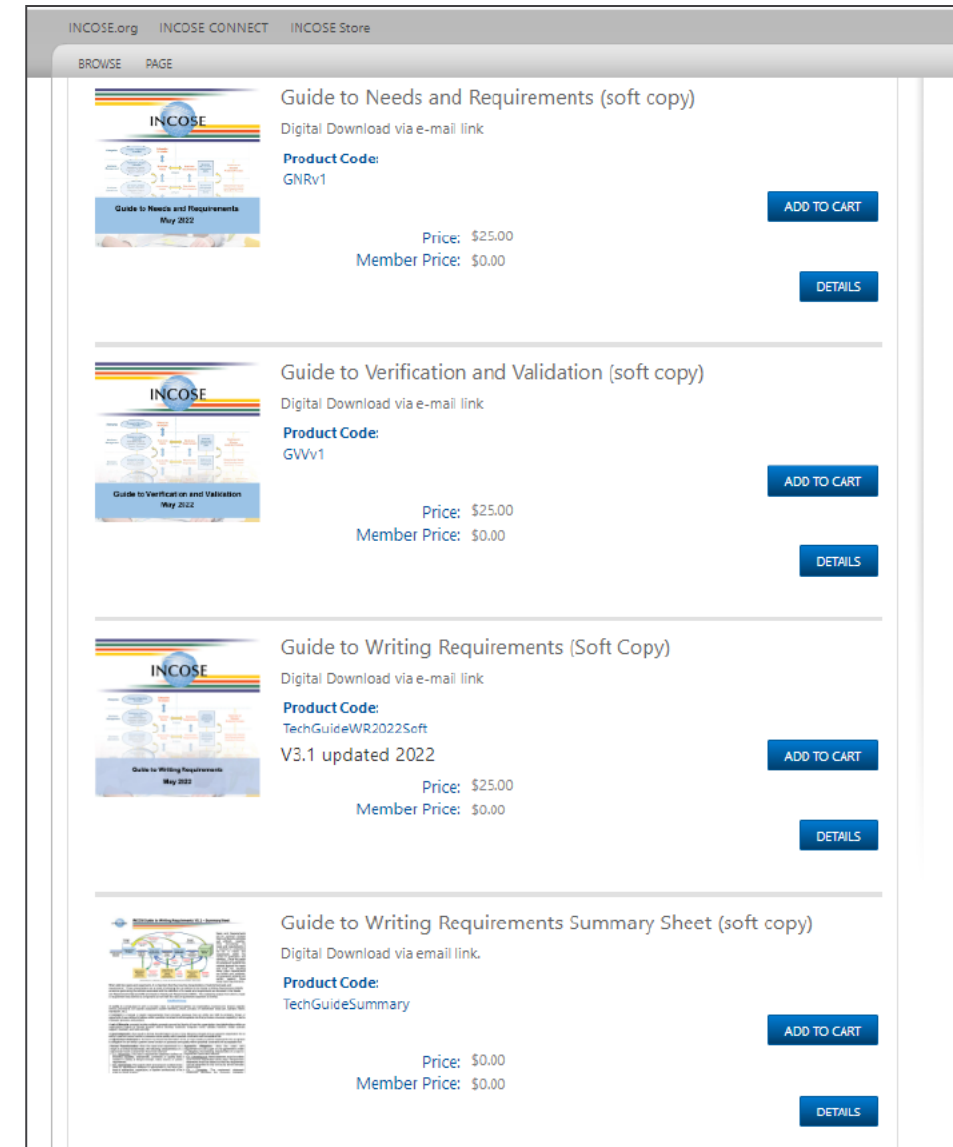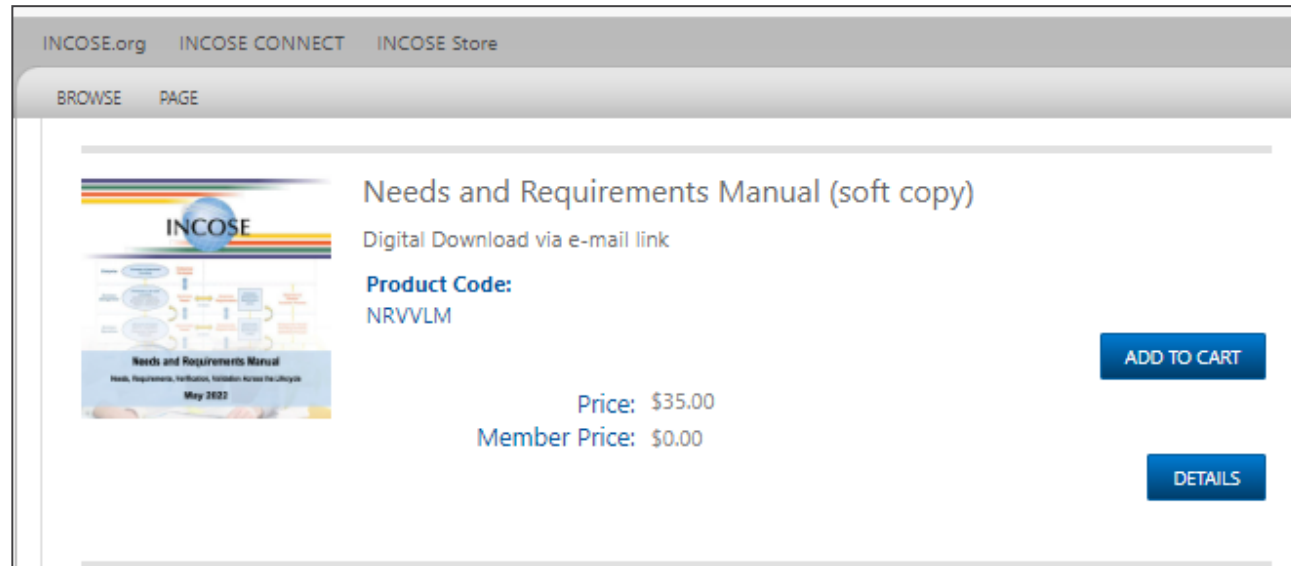
Needs and Requirements Manual (NRM)

- The NRM (was NRVVLM) is the RWG flagship product, V1 released in January 2022

- V1.1 minor updates in May to shorten title, add subtitle, and align with other RWG products

- Content from this aligns with, and expands, the INCOSE SE Handbook version 5 material.

- Includes concepts and activities necessary for needs and requirements and sets of needs and requirements to have the characteristics discussed in the GtWR.
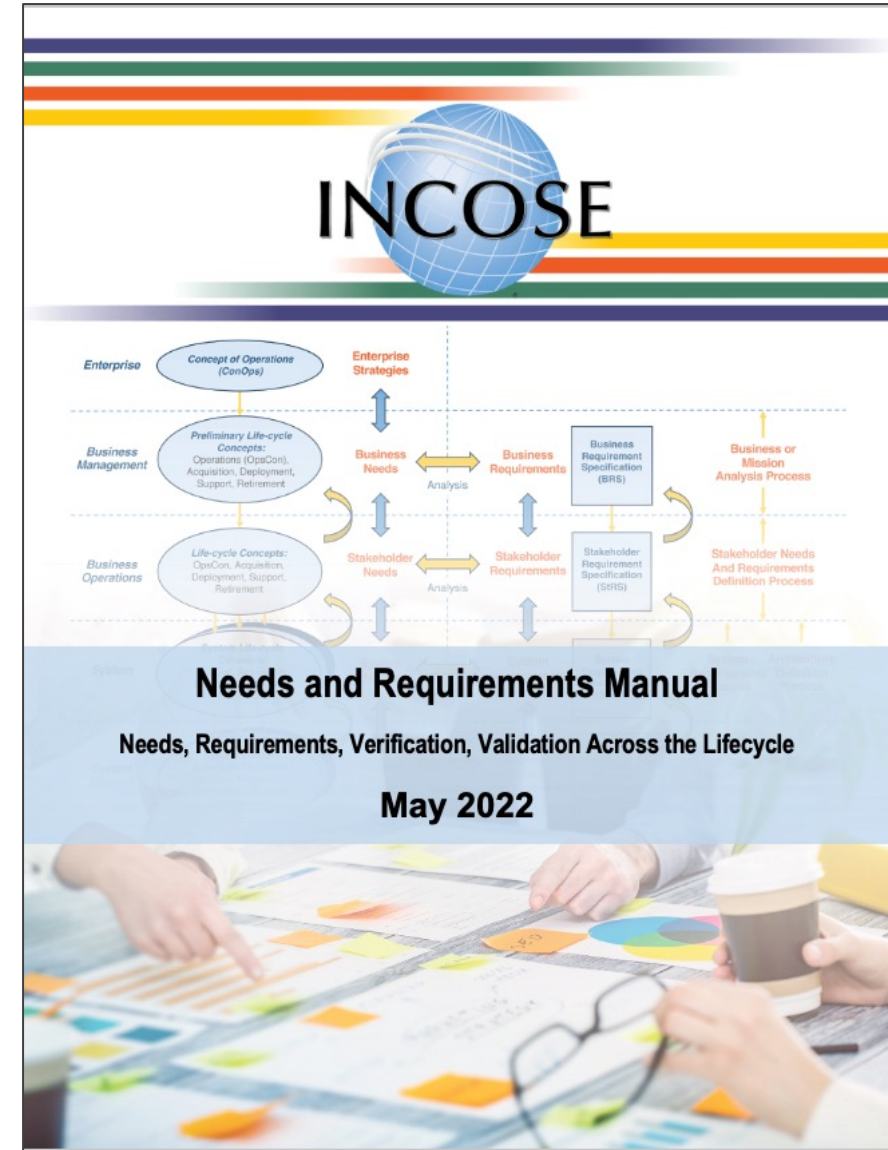
The RWG Guides Provide Practical Application of the NRM

Guide to Needs and Requirements
May 2022

Guide to Writing Requirements
May 2022

Guide to Verification and Validation
May 2022
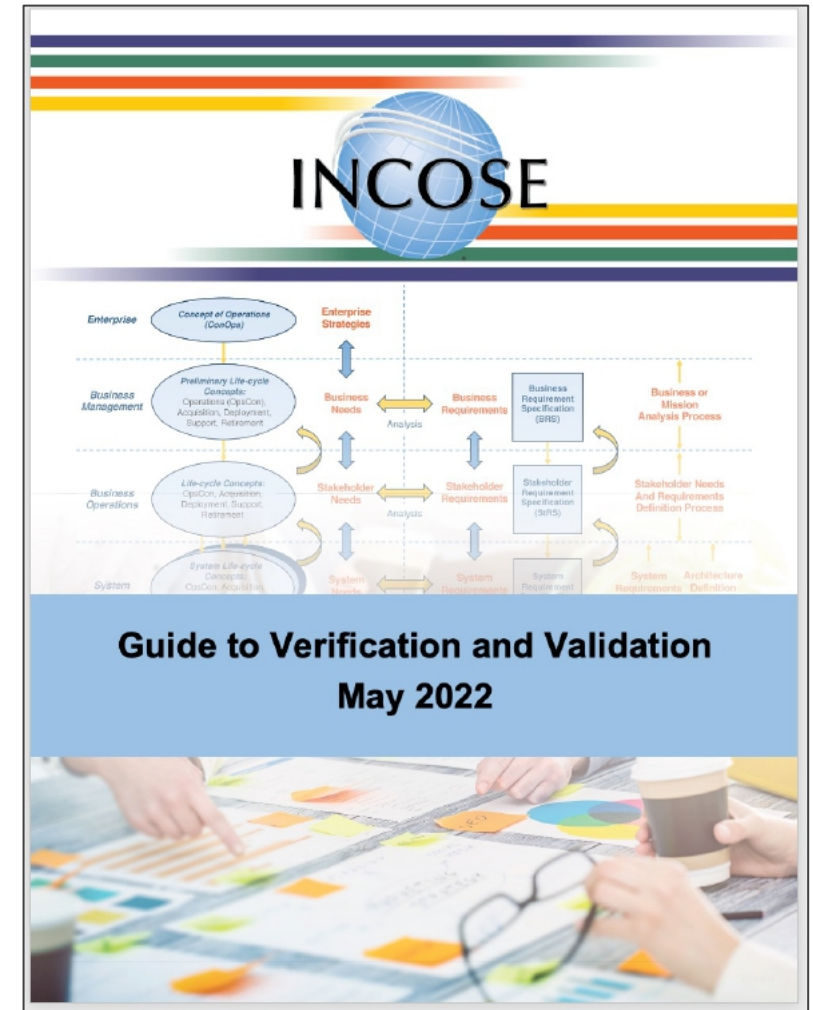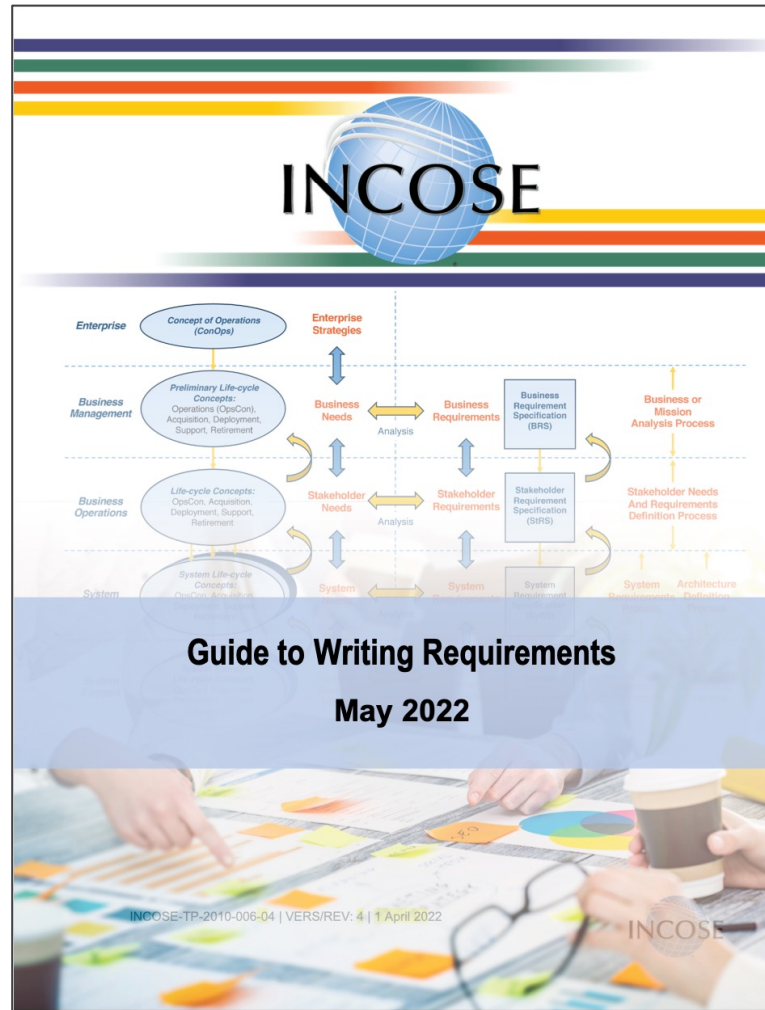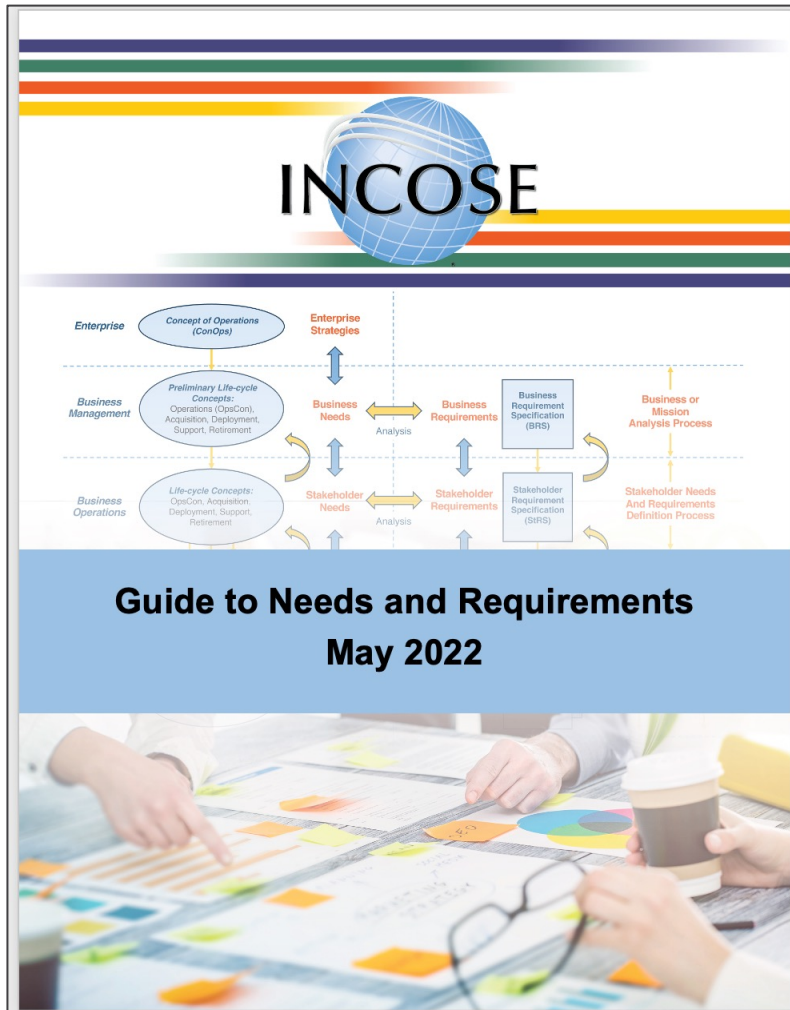
Relationships

GtNR
(120 pgs.)

1: Introduction
2: Needs Definition, Verification, & Validation
3: Requirements Definition, Verification, & Validation
4: Needs & Requirements Management
Appendix A: Acronyms & Abbreviations
Appendix B: Needs and Requirements Definition & Management Plan Content
Appendix C: Needs Elicitation Questions
Appendix D: Checklists
Appendix E: References
Appendix F: Comment Form

NRM
(457 pgs.)

1: Introduction
2: Definitions and Concepts
3: Information-Based Needs & Requirement Development and Management
4: Lifecycle Concepts & Needs Definition
5: Needs Verification & Needs Validation
6: Design Input Requirements Definition
7: Design Input Requirements Verification & Validation
8: Design Verification & Design Validation
9: Production Verification
10: System Verification & System Validation Common Principles
11: System Verification & System Validation Processes
12: The Use of OTS System Elements
13: Supplier Developed SOI
14: Needs, Requirements, Verification, & Validation Management
15: Attributes for Needs &Requirements
16: Features an SE Toolset Should Have
Appendix A: References
Appendix B: Acronyms and Abbreviations
Appendix C: Glossary
Appendix D: Comment Form

GtVV
(109 pgs.)

1: Introduction
2: Verification & Validation Common Principles
3: Needs and Requirements Verification & Validation Process
4: Design Verification & Validation Process
5: Production Verification
6: System Verification & Validation Processes
7: Use Of Off-The-Shelf Parts, Supplier Developed System Elements, & The Supplier-Customer Relationship
8: Needs, Requirements, Verification, & Validation Management
9: Conclusion
Appendix A: Acronyms
Appendix B: Glossary
Appendix C: References

YouTube Presentations

- For a more detailed overview of the NRM, GtNR, GtVV, and GtWR you can watch the following videos:

  – NRM (NRVVLM) overview (IW2022): https://youtu.be/ypgGHHaLbqI

  – NRM and GtNR "Lifecycle and Needs Definition" https://youtu.be/hEGfNLvuyXo

  – Underlying Concepts (IW2021): https://youtu.be/ZRli_wSCmRg

  – GtNR and GtVV Overview (IW2022): https://youtu.be/Uy5oZmneJM0

  – GtWR Overview: https://youtu.be/27k--0stAiM

Collaboration with other WGs

INCOSE RWG Whitepaper: Integrated Data as a Foundation of Systems Engineering

INCOSE Systems Engineering Handbook

SEBok

Needs and Requirements Manual

Guide to Needs and Requirements

Guide to Verification and Validation

Guide to Writing Requirements

Other Domain Specific Guides
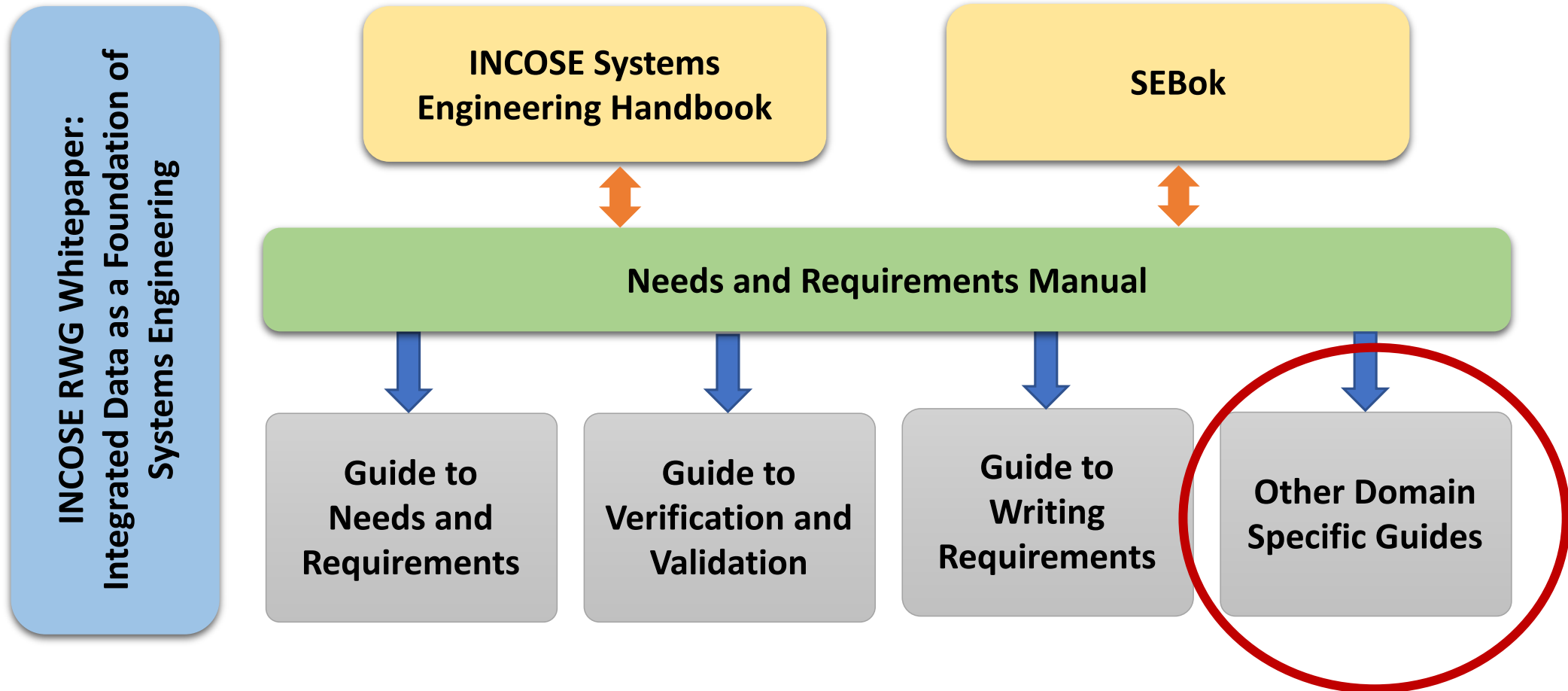
System Security Engineering (SSE) WG

- As our world becomes increasingly digital, the issue of security also known as cybersecurity is a factor that the systems engineer practitioner needs to consider and understand.

- Both hardware and software systems are increasingly at risk for disruption or damage caused by threats taking advantage of digital technologies.

- Security through systems security engineering (SSE) when properly integrated into SE, provides the needed complementary engineering capability that extends the notion of trustworthiness to deliver trustworthy secure systems.

- The SE should understand the basic systems engineering and system life cycle processes and how they are impacted by the needs for organizational mission and/or business security needs including stakeholder protection needs and security requirements.

- The RWG products mention security as an important consideration but provides no guidance in the context of defining security related needs and requirements nor verification the requirements were met nor validation the needs have been met.

Show how the concepts and activities discussed within the RWG products work within the Cyber Resiliency Engineering Framework, cyber resiliency wheel, criticality analysis, and other techniques the SSE WG are trying to elevate for security requirements analysis.

Key Points from these SSE Sessions:

1. SSE is a critical area that all SEs must be aware and address, both customers and suppliers, no matter the type of system.
2. SSE is really about loss protection, prevention, and recovery.
3. SSE is a lot more than just IT.
4. While the cost and time to deal with loss may seem to be problematic, the cost of not doing so will be much more expensive in the long run.
5. SSE is closely linked to safety and resilience and are merging together. Many losses have a direct safety consequence.
6. SSE applies across the lifecycle, not just during use.
7. SSE must be built in from the beginning, not just added on at the end as an after thought.
8. In addition to the standard use cases and operational scenarios, **mis-use cases**, and **loss scenarios** must be addressed. What are the threats and what loss can users and customers not tolerate? The likelihood and impact of these losses are risks to the organization that must be addressed.
9. Lifecycle concepts concerning protection, prevention, and recovery must be defined and needs of those affected by the loss must be defined against which the System of Interest (SOI) will be validated against. The integrated set of needs and resulting requirements will not be complete unless the SSE needs and requirements are included.
10. Requirements to address these needs must be in the form of functional/performance requirements that the SOI can be verified against. These design input requirements address the capabilities needed to be provided by the system to prevent, protect, and recover from loss.

System of Systems (SoS) WG

- A System of Systems (SoS) is a set of systems or system elements that interact to provide a unique capability that none of the constituent systems can accomplish on its own.
- Constituent systems can be part of one or more SoS.
- Each constituent is a useful system by itself, having its own development, management goals and resources, but interacts within the SoS to provide the unique capability of the SoS.
- Challenges
  - Each system has its own owner, stakeholders, users, needs, processes, & development approaches.
  - Lack of common leadership and funding
  - Each system has a specific purpose of its own, but are being leveraged as part of the SoS
  - SoS purpose, stakeholders, constraints, needs, and requirements may conflict with individual constituent systems purpose, stakeholders, constraints, needs, and requirements.
  - Constituent systems may continue to change independently from the SoS
  - SoS verification and validation against the SoS needs and requirements is difficult
  - Emerging properties and behavior of the integrated SoS is difficult to predict and if issues occur which constituent system contributed and how the issue be resolved given their independence.
  - System Security of the SOS is dependent on the system security of the constituent systems.

Need for a practical SoS guide mapping SoS standards to the activities discussed within the RWG products.

Configuration Management (CM) WG

- Co-Authored a paper for submission to IS2023

- Topic: Traceability

RWG 2022 Events

RWG 2022 Completed Events

- **November 16**: RWG Exchange Café – Beth Wilson - System Security Guide vs NRM, GtNR, GtVV
  - Recording: https://www.youtube.com/watch?v=IVdICwMF8Uc

- **October 26**: Presentation by Beth Wilson – System Security Challenges
  - Recording: https://www.youtube.com/watch?v=GV2_qFZFe6g

- **September 28**: RWG Exchange Café – General discission focusing on interfaces
  - Recording: https://www.youtube.com/watch?v=pJlH6nj2TzM

- **August 24**: RWG Exchange Café – Beth Wilson - SoS Guide vs the NRM, GtNR, GtVV
  - Recording: https://www.youtube.com/watch?v=FsDVci-zl2s

- **July 20**: RWG Exchange Café – Beth Wilson - Systems of Systems (SoS) challenges.
  - Recording: https://www.youtube.com/watch?v=_CfOKVDyjWQ

- **June 28:** IS2022 Hybrid Event

  - Recording: https://youtu.be/lz0TvNdZgfI

RWG 2022 Completed Events

- **May 25, 2022 -** RWG Exchange Café - **Cary Bryczek** - Demonstrating SE Value Using Traceability Measurement
    – Slides: INCOSE RWG Jama Software Measurement May 2022.pdf
    – Recording: https://youtu.be/GSpQdachXZU

- **April 27, 2022 -** RWG Exchange Café – General discussion addressing the Operational Environment
    – Slides: RWG Exchange Cafe 042722.pdf
    – Recording: https://youtu.be/Ei81HLUxxAE

- **March 24, 2022 –** Presentation by Mark Eggler "Using Model-Based Systems Engineering Techniques to support Requirements Generation for the Design of New Generation Armored Combat Vehicle Systems" Slides: Presentation-INCOSE-MBSE in Combat Vehicle Design-1hr-Mar 22-v1.0.pdf
    – Recording: https://youtu.be/bMtoDvsKB84

- **February 23, 2022 -** RWG Exchange Café – Lou Wheatcraft - NRM Overview and Q&A.
    – Recording: https://youtu.be/HZo2jR-zDFY

- **January 25-30, 2022** – RWG hybrid sessions at IW2022
    – Playlist of Recordings: https://www.youtube.com/watch?v=IM0eR8P3ixc&list=PLVfZ7HbxxzBXTd8vieYUbHU-RCYTSfbcS
    – 13 presentations and sessions in the playlist.

Other Presentations Added to the RWG YouTube Channel in 2022:

- **September 30, 2022:** "Everything You Wanted to Know About Interfaces but Were Afraid to Ask!"
  - Presentation given by Lou Wheatcraft to the CSU Graduate Requirements Class in November 2021
  - Recording: https://youtu.be/7qcoSeBEJ5Y

- **September 15, 2022**: "Guide to Writing Requirements (GtWR) Overview"
  - Presentation given by Lou Wheatcraft to the graduate class at Colorado State University Requirements Class
  - Recording: https://youtu.be/27k--0stAiM

- **August 9, 2022**: "Achieving Designs that Satisfy Stakeholders Through Better Requirements"
  - Presentation given by Tami Katz to the INCOSE LA Chapter
  - Recording: https://youtu.be/YVtchkhpDFE

- **July 28, 2022**: "These are our Needs - Make it Happen!"
  - Presentation given by Lou Wheatcraft to the Clearlake/Galveston Project Management Institute (CLG PMI) Chapter
  - Recording: https://youtu.be/YdbZk_zK6H0

- **March 17, 2022: "**Lifecycle Concepts and Needs Definition"
  - Presentation given by Lou Wheatcraft to the ChicagoLand INCOSE Chapter providing an overview of Section 4, Lifecycle and Needs Definition, of the Needs and Requirements Manual (NRM) and Section 2 of the Guide to Needs and Requirements.
  - Recording: https://youtu.be/hEGfNLvuyXo

RWG 2023 Planned Activities

Update of SEBoK

- With updates to RWG material, we plan to ensure alignment of the SEBoK with the concepts in the NRM.

- Tami and the co-chairs are seeking volunteer(s) to help find all material on the SEBoK related to Needs, Requirements, Verification, Validation and propose 'pages' that need updates to align concepts and nomenclature.

  – Example presented here ->

Update of SEBoK - Methodology

- As the SEBoK is a large collection of topics, the task would include navigation to various pages and usage of the search function.

- With each page uncovered, the content needs to be scrubbed, and markups can be proposed via PDF or screenshots to Tami and Lou.

- Tami will ensure the material is revised by working with the INCOSE SEBoK leads.

- Objective is to have this done by IS2023.

SEBoK (sebokwiki.org)

GtWR V4

- The RWG plans to continue to evolve the GtWR.

- Planning for a V4 to be released by IS2024 (TBD).

- We need suggestions from the INCOSE community concerning future updates.

- In Fall 2022, we asked all RWG members to do a detailed review of V3.1 and provide comments (typos, errors, further elaboration, more examples, ideas for improving the Guide.)

- We have received multiple review comments to date.
  - These are being incorporated
  - We plan to have a draft V4 ready for IW2023
  - We are planning another review cycle after IW2023

- We will have IW2023 sessions dealing with the GtWR.
  - Focus on concepts discussed in Section 1
  - Detailed discussion on the Characteristics discussed in Sections 2 & 3.

NRM V2

- INCOSE is under contract with Wiley to publish the NRM.

- We used 2022 v1 and v1.1 to get feedback based on actual use

- Response has been very positive

  – e.g., *"The NRM has been a godsend for my organization!"*

- If you have any comments, please provide them to us ASAP.

- Following IW2023, we will start making changes/updates based on comments received to date

  – Will carry across applicable changes to the GtWR to keep both documents in sync.

Continue Collaboration with Other Working Groups

- System of Systems (SoS) WG

- System Security Engineering (SSE) WG

- Configuration Management (CM) WG

Upcoming RWG Meetings for 2023

- January 2023
  - IW 2023 RWG pre-event sessions – Monday and Tuesday before IW
    - Specific agenda is being finalized.
  - IW 2023
    - General RWG sessions planed
    - Collaboration sessions also planned
    - See IW 2023 schedule for specific dates, times, and location.
- Rest of 2023
  - Specific RWG Exchange Café monthly sessions
    - Currently seeking ideas for topics.
    - Please send me an email with ideas for topics and/or if you have a topic you would like to present.

Questions and Discussion

Lou Wheatcraft

- **Lou Wheatcraft** is a senior consultant and managing member of Wheatland Consulting, LLC. Lou is an expert in systems engineering with a focus on needs and requirements development, management, verification, & validation. Lou provides consulting and mentoring services to clients on the importance of well-formed needs & requirements helping them implement needs & requirement development and management processes, reviewing and providing comments on their needs and requirements, and helping clients write well-formed needs & requirements.

- Specialties include: Understanding and documenting the problem; defining project and product scope; defining and maturing system concepts; assessing, mitigating, and managing risk; documenting stakeholder needs; transforming needs into well formed design input requirements; allocation, budgeting, and traceability; interface management, requirement management; and verification and validation.

- Lou's goal is to help clients practice better systems engineering from a needs and requirements perspective across all life cycle stages of system/product development. Getting the needs and requirements right upfront is key to a successful project. Poor needs & requirements can triple the chances of project failure.

- Lou has over 50 years' experience in systems engineering, including 22 years in the United States Air Force. Lou has taught over 200 requirement seminars over the last 21 years. Lou supports clients from all industries involved in developing and managing systems and products including aerospace, defense, medical devices, consumer goods, transportation, and energy.

- Lou has spoken at Project Management Institute (PMI) chapter meetings and INCOSE conferences and chapter meetings. Lou has published and presented many papers concerning needs and requirement for NASA's *PM Challenge*, INCOSE, INCOSE *INSIGHT Magazine*, and *Crosstalk Magazine*. Lou is a member of INCOSE, past Chair and current Co-Chair of the INCOSE Requirements Working Group (RWG), a member of the Project Management Institute (PMI), the Software Engineering Institute (SEI), the World Futures Society, and the National Honor Society of Pi Alpha Alpha.

- Lou has a BS degree in Electrical Engineering from Oklahoma State University; an MA degree in Computer Information Systems; an MS degree in Environmental Management; and has completed the course work for an MS degree in Studies of the Future from the University of Houston – Clear Lake.