A Preview to the INCOSE Systems Engineering Vision 2035

## NDIA SE Division Meeting

25 January 2022

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SE Vision 2035 Background & Milestones

- SE Vision **2025** rollout at the INCOSE IS on July 3, 2014
- SE Vision 2035
    - Core Team kickoff on January 26-27, 2020
    - Preliminary Review conducted Feb-March, 2021
    - Final Review (executive level) conducted Sept-Oct, 2021
    - Planned Rollout at INCOSE IW, January 2022

SYSTEMS ENGINEERING
VISION 2035

ENGINEERING SOLUTIONS FOR A BETTER WORLD

Vision35
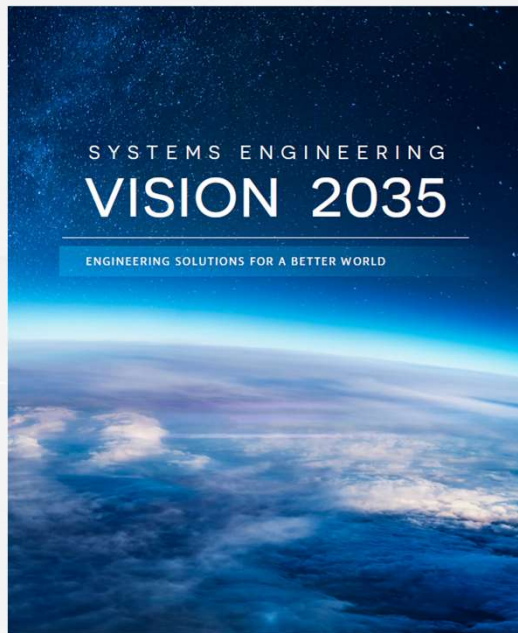*Systems Engineering*
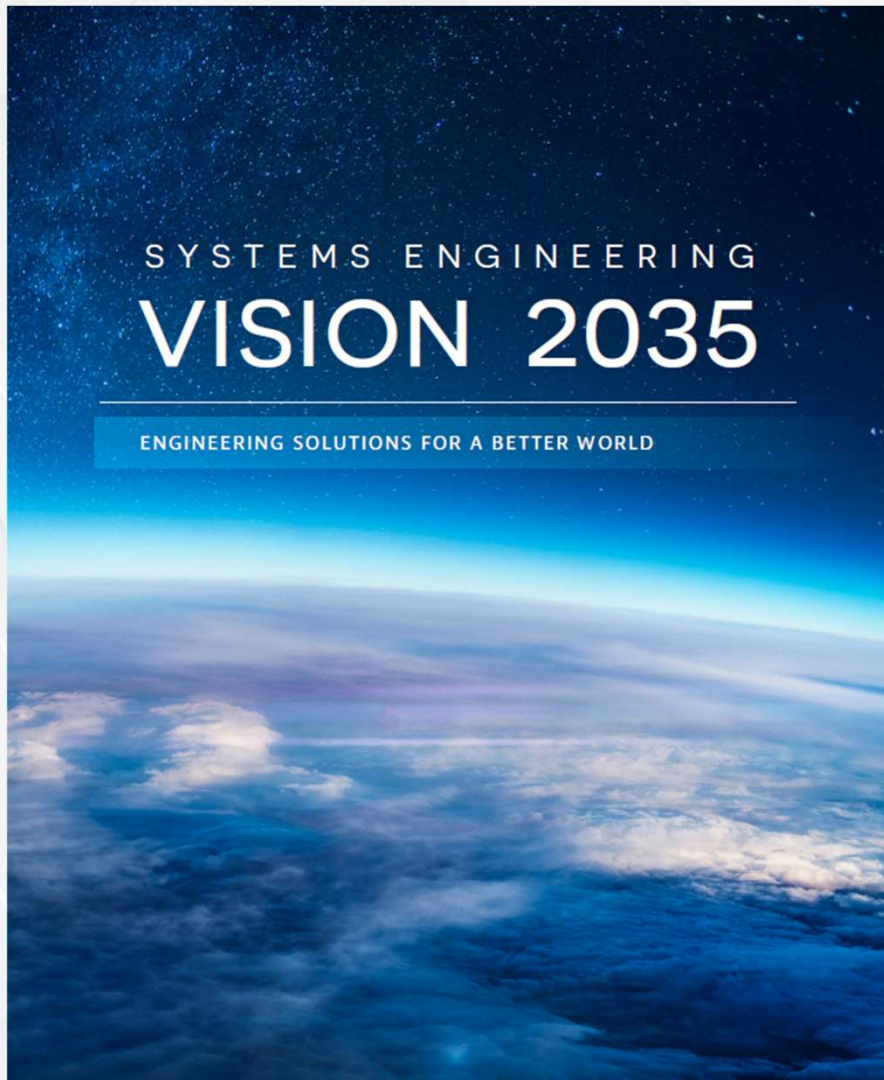
- **Purpose:** Inspire and guide the strategic direction of systems engineering across diverse stakeholder communities, which include:
  - Engineering & Executive Leadership
  - Engineering Practitioners
  - Policy Makers
  - Professional Organizations
  - Researchers, Educators, & Students
  - Standard Bodies
  - Tool Vendors
- **Objectives**
  - Align Systems Engineering Initiatives
  - Address Future Systems Engineering Challenges
  - Broaden the Base of Systems Engineering Practitioners
  - Promote Systems Engineering Research
- **Evolution:** This vision will continue to evolve based on on-going collaborations with the stakeholder community

Intended Formats
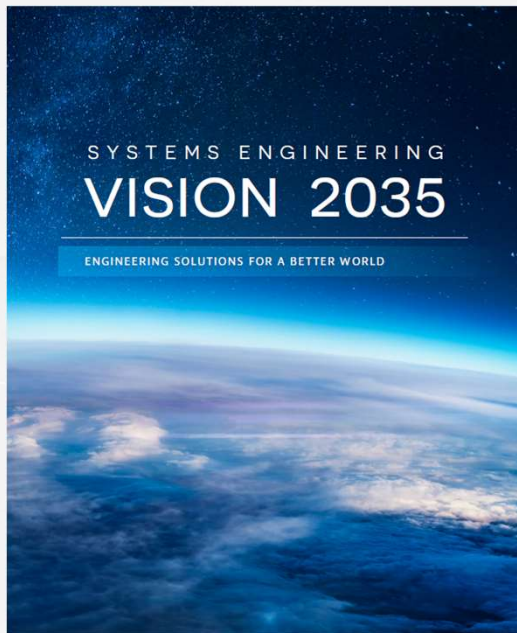
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- Glossy Hard Copy

- Web Version with Scroll-overs & Links
  - www.incose.org/sevision
  - Goes live on January 28

- Interactive PDF with Scroll-overs & Links
  - Download from link above

- Separate Executive Summary

- Informative Brochure

1 The Global Context for Systems Engineering

- Human and Societal Needs
- Global Megatrends
- Technology Trends
- Sta...
- The...

- Historical Perspectives
- Roles & Competencies
- Practices (Emerging, Transitioning & Standard)
- Industry Adoption

- Overview & Introduction
- Impacts of the Digital Transformation
- Model Based Practices (including SoS)
- SE Theoretical Foundations
- SE Applied to Major Societal Challenges
- Building the SE Workforce of the Future

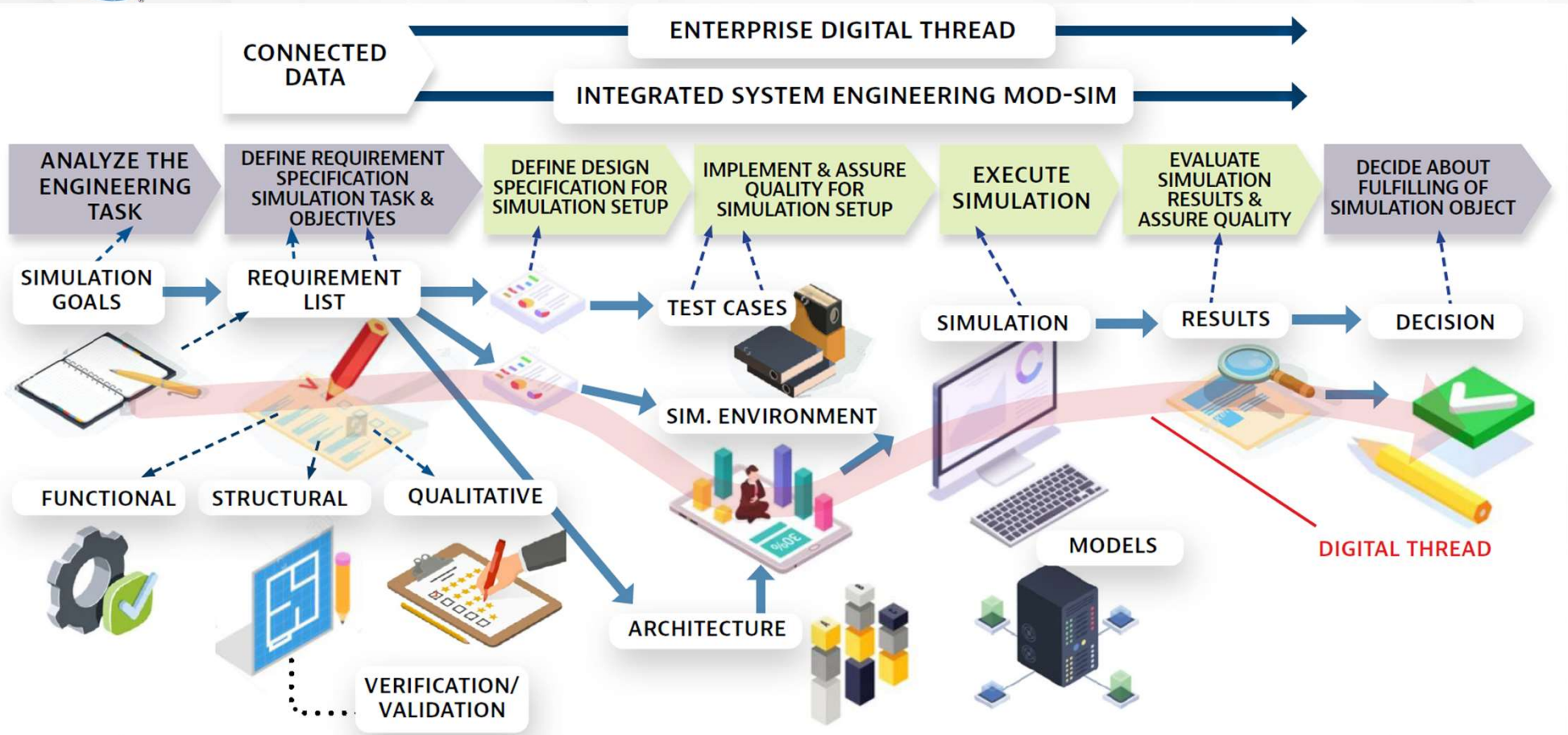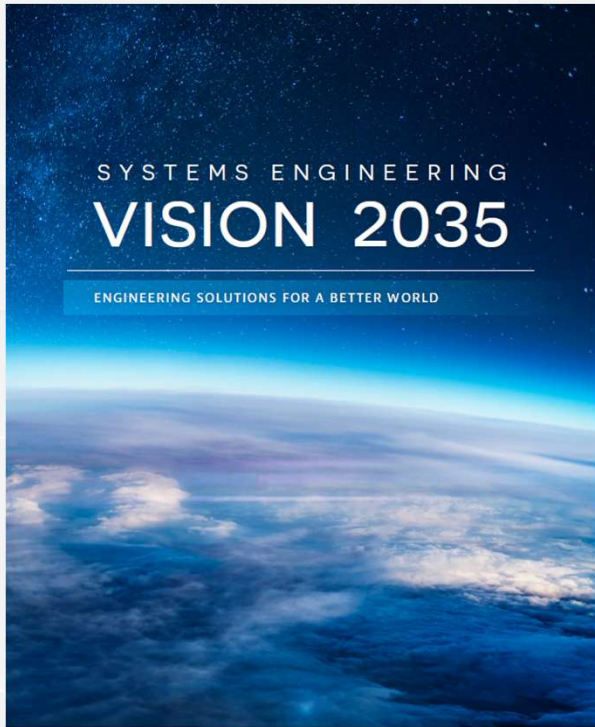## The Future of Systems Engineering Is Model Centric

FROM → **TO**

Although a growing number of systems engineering organizations have adopted model-based techniques to capture systems engineering work products, the adoption is uneven across industry sectors and within organizations. Custom, one-off simulations are used for each project, and there is still limited reuse of models especially during critical early phases of system architecting and design validation.

Systems engineers can auto-generate work products and simulations from reference architecture-patterns that auto-build from high-quality reusable model assets. The use of extended reality provides immersive simulation experiences including 4D navigation throughout the systems engineering lifecycle from concept, through design, production, fielding and disposal. Use of models enable exploration of design and operational margins using virtual prototypes with full traceability. Distributed virtual platforms support massive simulations global across high capacity compute infrastructure.

Topic Example (cont'd)

SYSTEMS ENGINEERING
VISION 2035

ENGINEERING SOLUTIONS FOR A BETTER WORLD

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- The Path Forward
- Collaboration
- Changing the Engineering Ecosystem
- Systems Engineering Challenges
- Specific Recommendation
- Top Level Roadmap

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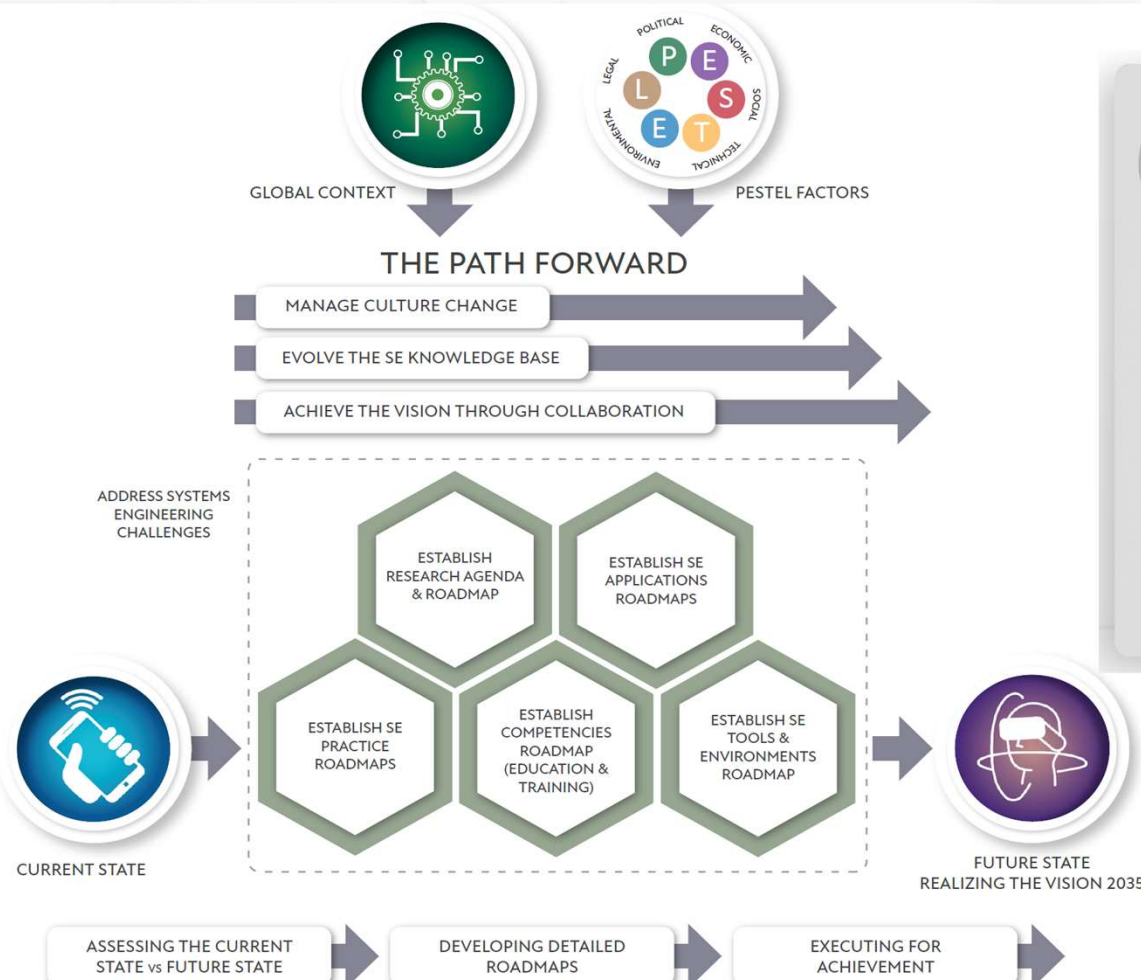
"Our situation is not comparable to anything in the past. It is impossible, therefore, to apply methods and measures which at an earlier age might have been sufficient. We must revolutionize our thinking, revolutionize our actions... "

Albert Einstein (1948) in

"A Message to Intellectuals"

Realizing the Vision Through Collaboration

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SE Challenges – Outcomes Needed for Success

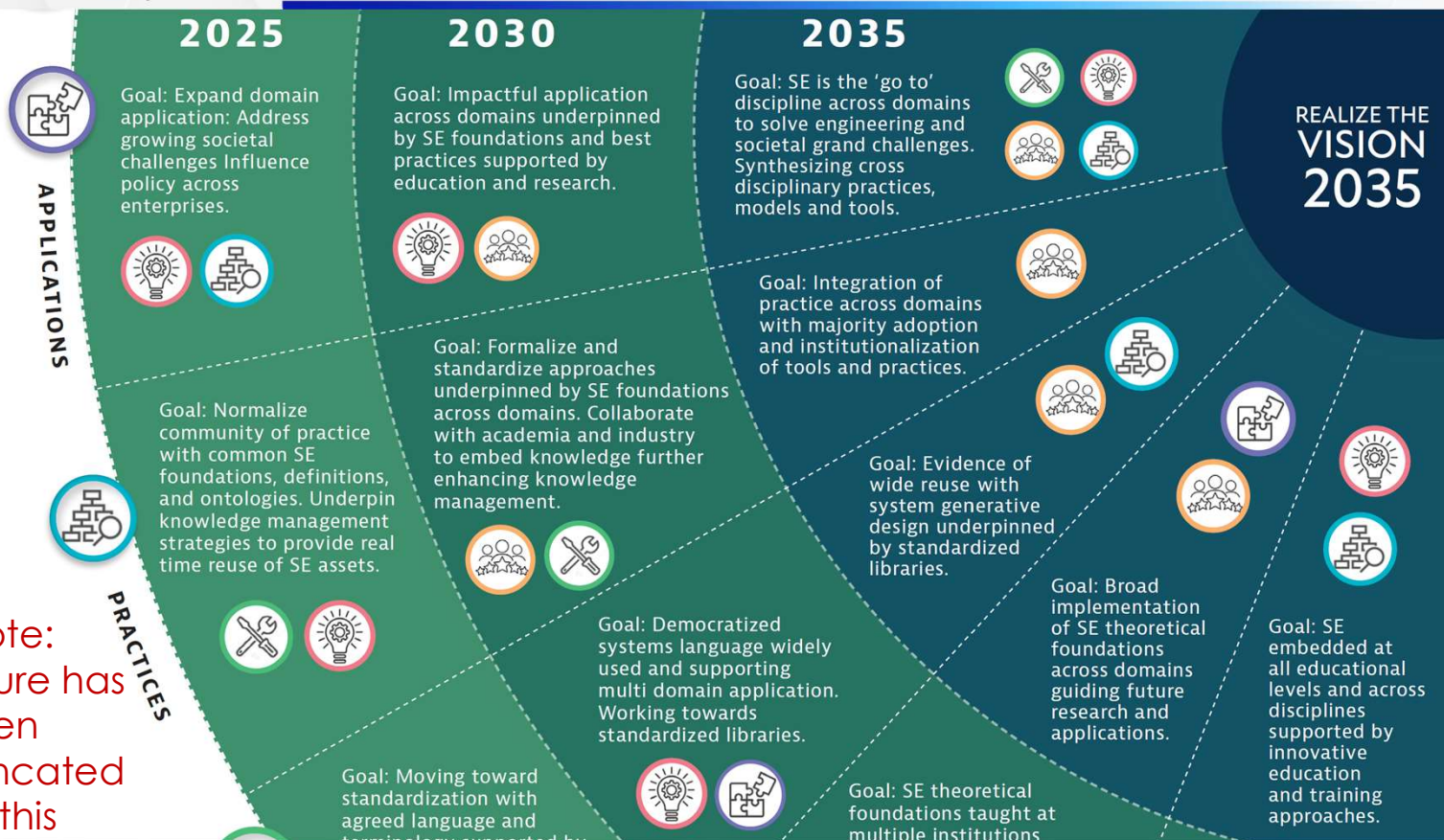| CATEGORY	SYSTEMS ENGINEERING CHALLENGES
Applications	1. Systems engineering contributes innovative solutions to major societal challenges. 2. Systems engineering demonstrates value for projects and enterprises of all scales, and applies across an increasing number of domains.
Practices	3. Systems engineering anticipates and effectively responds to an increasingly dynamic and uncertain environment. 4. Model-based systems engineering, integrated with simulation, multi-disciplinary analysis, and immersive visualization environments is standard practice. 5. Systems engineering provides the analytic framework to define, realize, and sustain increasingly complex systems. 6. Systems engineering has widely adopted reuse practices such as product-line engineering, patterns, and composable design practices.
Tools and Environment	7. Systems engineering tools and environments enable seamless, trusted collaboration and interactions as part of the digital ecosystem.
Research	8. Systems engineering practices are based on accepted theoretical foundations and taught as part of the systems engineering curriculum.
Competencies	9. Systems engineering education is part of the standard engineering curriculum, and is supported by a continuous learning environment.

SE Challenges reflect necessary accomplishments that must be addressed for Systems Engineering to evolve and be prepared for the future

The SE Vision will identify the changes needed and link to roadmaps to address each of the SE Challenges

Top-Level Roadmap

2025

Goal: Expand domain application: Address growing societal challenges Influence policy across enterprises.

Goal: Normalize community of practice with common SE foundations, definitions, and ontologies. Underpin knowledge management strategies to provide real time reuse of SE assets.

APPLICATIONS

PRACTICES

Goal: Moving toward standardization with agreed language and terminology supported by

2030

Goal: Impactful application across domains underpinned by SE foundations and best practices supported by education and research.

Goal: Formalize and standardize approaches underpinned by SE foundations across domains. Collaborate with academia and industry to embed knowledge further enhancing knowledge management.

Goal: Democratized systems language widely used and supporting multi domain application. Working towards standardized libraries.

2035

Goal: SE is the 'go to' discipline across domains to solve engineering and societal grand challenges. Synthesizing cross disciplinary practices, models and tools.

Goal: Integration of practice across domains with majority adoption and institutionalization of tools and practices.

Goal: Evidence of wide reuse with system generative design underpinned by standardized libraries.

Goal: Broad implementation of SE theoretical foundations across domains guiding future research and applications.

Goal: SE theoretical foundations taught at multiple institutions

Goal: SE embedded at all educational levels and across disciplines supported by innovative education and training approaches.

REALIZE THE VISION 2035

(Note: Figure has been truncated for this briefing.)

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- SE Vision 2035 includes a top-level roadmap
  - Integrated view across the categories of challenges
  - Shows interrelationships
- Work has been started on lower level roadmaps for each challenge
  - These will be further developed and matured as part of the realization activities

Invitation: Join the Realization of this Vision

- *COMMUNICATE and COORDINATE*
  - across engineering communities and leadership
  - with other forums that could help advance SE and analyses per the Vision

- *COLLABORATE and CONTRIBUTE*
  - within your environment to support it's implementation
  - join the relevant implementation activities (FuSE projects, INCOSE working groups, collaborators)

- *CUSTOMIZE*
  - Develop derivatives of Vision 35 for your constituency (domains, chapters, regional, etc)

- *COACH*
  - Teach, mentor, train, and educate

"C" the Way Forward

Other Key SE Initiatives

- Revision to INCOSE SE Handbook (5th Edition)
- Development/Revision to key SE related standards
  - ISO/IEC/IEEE 15288, System Life Cycle Processes
  - ISO/IEC/IEEE 42010, Architecture Description
  - ISO/IEC/IEEE 24748 series (-1, -2, -4, -6, -7)
  - ISO/IEC 24641, MBSSE
- SE Principles / SE Heuristics
- Digital Engineering Measurement Framework
- Future of Systems Engineering (FuSE) Initiative
- Ongoing Revisions of the SE Body of Knowledge (SEBoK) – added Emerging Knowledge
- Ongoing work of WGs, including:
  - Digital Engineering Information Exchange WG (DEIXWG)
  - Artificial Information WG (AIWG)
  - System Security Engineering WG (SSEWG)
  - Agile Systems and SE WG
  - …

Many of these are collaborative projects