FuSE: Methodologies Disrupters to Solutions

Monday 30 Jan 2023, 8:00-10:00 PST

Chris Hoffman
FuSE Methodologies Lead

Purpose / Reason Why & Desired Outcomes:

- Selected disrupters clarified
- Solution concepts identified
- Solution concepts prioritized
- Change requests completed

Nice to Have:

- Mapping of disrupters to existing items (products, publications, projects) completed
- Working Groups or other teams have been identified to develop the solutions
- Identified teams have accepted the challenge to develop the solutions

Agenda.

8:00 – 10:00 h

- All: Introduction (10 min)
- Groups: (90 min)
  - Disrupter clarification (20 min)
  - Concept generation (45 min)
  - Prioritize & elaborate (25 min)
- All: Debrief (20 min)

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FuSE Program Mission Statement

FuSE refines and evolves the SE Vision 2035 across competencies, research, tools & environment, practices, and applications.

FuSE identifies critical gaps towards the vision realization and initiates & supports relevant actions

FuSE fosters involvement and collaboration within and outside of INCOSE.

FuSE educates, shares success, and expands.

FuSE Program Charter

Vision Statement

Inspire the global community to realize the Vision of SE

Mission

Engage and inspire the systems community for sustaining the future of systems engineering in realizing the SE Vision 2035

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FuSE **educates, shares success, and expands**.

Success Factors

Inclusive: From an exclusive club to inclusive initiative

Attractive: Engage members and non-members

Implementation: The degree to which the road map is realized

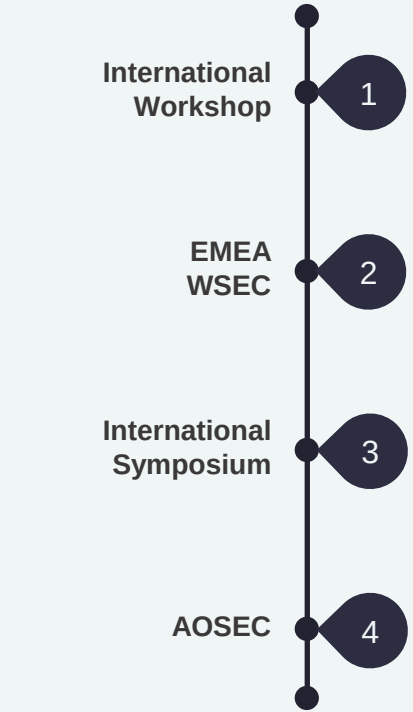
Fresh: Relevant and updated road map and context

Close to application: Involvement of companies and domains

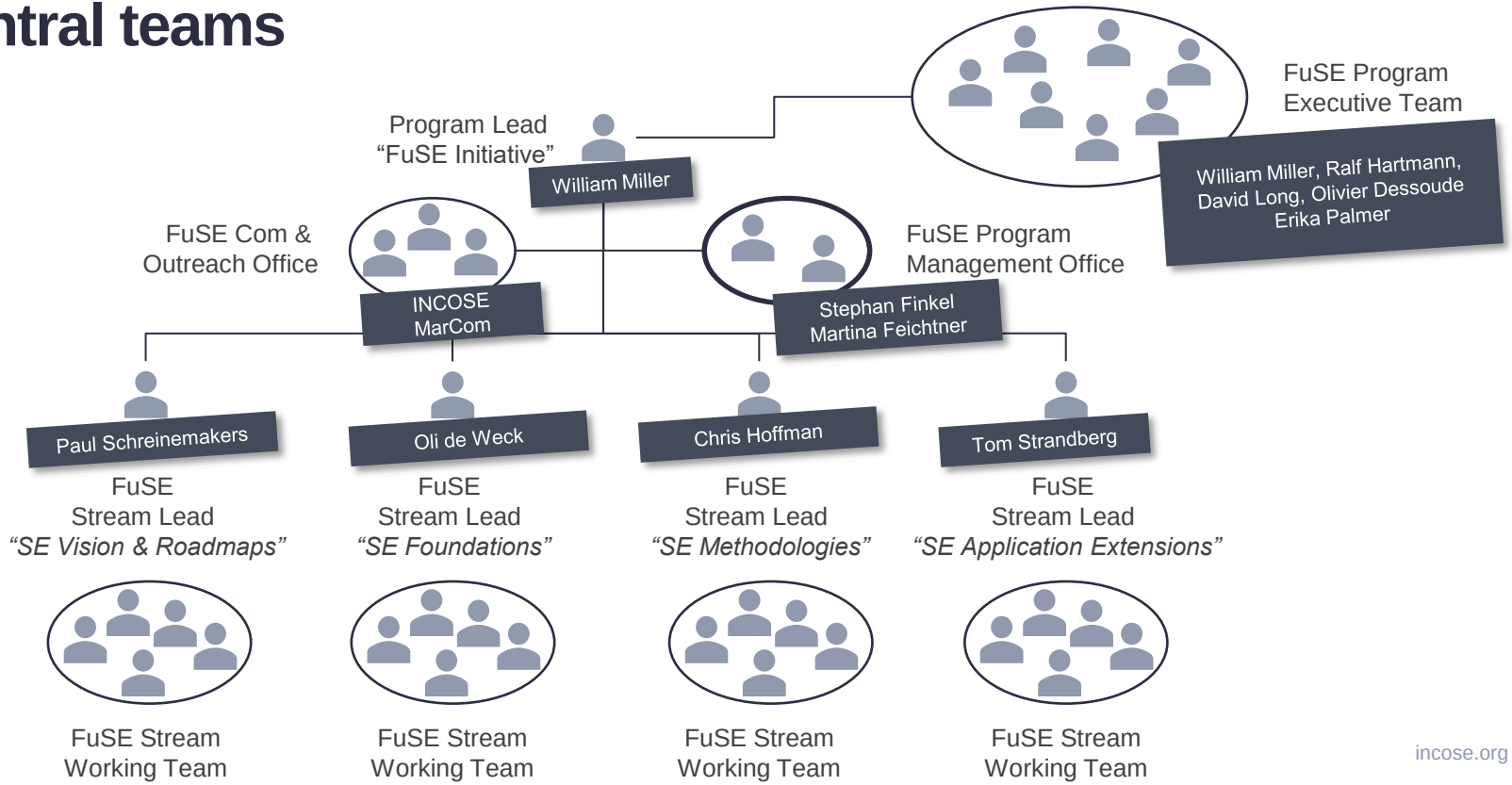
Global promotion: Attractive global digital marketing

Passion: To get the working group proud to be part of it

2023 Milestones



The FuSE program is organized in 4 streams with additional central teams



The FuSE program is organized in 4 streams

Vision & Roadmaps

The Systems Engineering Vision and Roadmaps stream continuously refines, evolves, and complements the SE Vision 2035. Furthermore, we create an integrated set of roadmaps across the four interrelated FuSE streams. The concurrently executed streams will guide and influence each other.
The IW 2023 goal is to frame the structural relationships and value models for the roadmaps' creation.

Foun-dations

In order to yield predictable results Systems Engineering methods and tools need to be built on foundational principles that are provably true and based on laws and axioms that can be tested for falsifiability similar to those in other well-established disciplines of science and engineering like Chemical Engineering, Electrical Engineering or Biological Engineering. This stream will formulate a set of candidates underlying Laws of Systemics, the science at the foundation of Systems Engineering.
The IW 2023 goal is to assess the foundational value of the "Conservation of System Complexity," which parallels the Conservation of Energy in the First Law of Thermodynamics and the Conservation of Mass in continuum mechanics.

Metho-dologies

The SE Methodologies stream guides the advancement of practices, methods, and tools for the effective engineering of systems to be fit for purpose in the presence of varying scale, interrelatedness, complexity, non-determinism, and emerging technology innovations such as AI and agility.
The IW 2023 goal is to assess the adequacy of current INCOSE technical products and ongoing FuSE projects in this stream and identify gaps.

Application Extensions

The SE Application Extensions stream integrates social sciences, soft systems, as well as initiatives such as Smart Cities to address grand challenges to meet human and societal needs as stated in the United Nations Sustainable Development Goals.
The IW 2023 goal is to frame the value model to justify systems engineering's role at the policy table for these grand challenges.

7 success factors the FuSE program

Key Insights of SUN FuSE Sessions

Vision & Roadmaps

Session Topics & Key Insights:

1. *Vision Feedback Collection:* Feedback needs to be collected from different sources e.g., industries and universities.
2. *SE Vision Roadmap:* The vision needs to be more user-centric and non-SE oriented. It needs to be enrichend with execution and planning guidelines
3. *SE Challenges:* Challenges and roadmaps are closely tied in. A reference architecture to support the vision is one way forward.
4. *Vision gaps:* The focus should be on content, integration, validation, responsibility.

Foundations

Session Topic:
Technical Complexity

Key Insight:

1. Participants were supportive of the key aspects of the proposed definition of technical complexity and suggested addtiional aspects to be considered.
2. Additional areas for case studies to generate data on the evolution of technical complexity were identified and need to be decided upon.

Methodologies

Session Topic: Major Disrupters

Key Insight:

1. People are not trained enough, which makes it difficult to implement new SE methodologies due to failures in the past of the people and lack of trust in others.
2. Limited resources and difficulty in understanding stakeholder needs also impede the development of practical and implementable SE methods.
3. Lack of organizational leadership support to change leads to a stagnating culture not ready to change.

Application Extensions

Session Topics:
Smart Cities and *Innovation* - Value proposition, Target Groups and Messages, How and Who to engage

Key Insight:

Smart Cities – the work done by the Smart Cities Initiative serves as a good foundation for reaching out to internal and external groups. Needs to be validated by application together with mayors or alike.
Innovation – an innovation framework based on systems thinking (as the one presented) would be a useful means to engage with new target groups. Good potential for collaboration between WGs.

Systems Engineering Methodologies Stream

Chris Hoffman
Stream Lead “SE Methodologies”

e christopher.hoffman@incose.net

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	SAT	SUN	MON	TUE
08:00		Elaborate disruptors: 1. Scale & Interrelatedness 2. Complexity, Chaotic, Complicated, Clear 3. A.I. for SE, other technologies 4. TBD by participants	Clarify problems / opportunities: 1. Digital ecosystem 2. Software as the capability driver 3. Continuous iterative model development 4. Evolution in learning systems	
08:30				Wrap-up FuSE (for participants)
09:00				
09:30	Break			
10:00	FuSE Kick-off	Break		
10:30				
11:00				Wrap-up FuSE
11:30				
12:00	Lunch			
12:30				
13:00				
13:30				
14:00	Introduction, Activities for 2023, Initial feedback, Opt-in participation			
14:30		Break		
15:00	Break			
15:30	Introduction, Activities for 2023, Initial feedback, Opt-in participation			
16:00				
16:30				

Agenda.

8:00 – 10:00 h

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- All: Debrief (20 min)

“A problem well stated is a problem half solved.”

Charles F. Kettering

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Purpose / Reason Why & Desired Outcomes:

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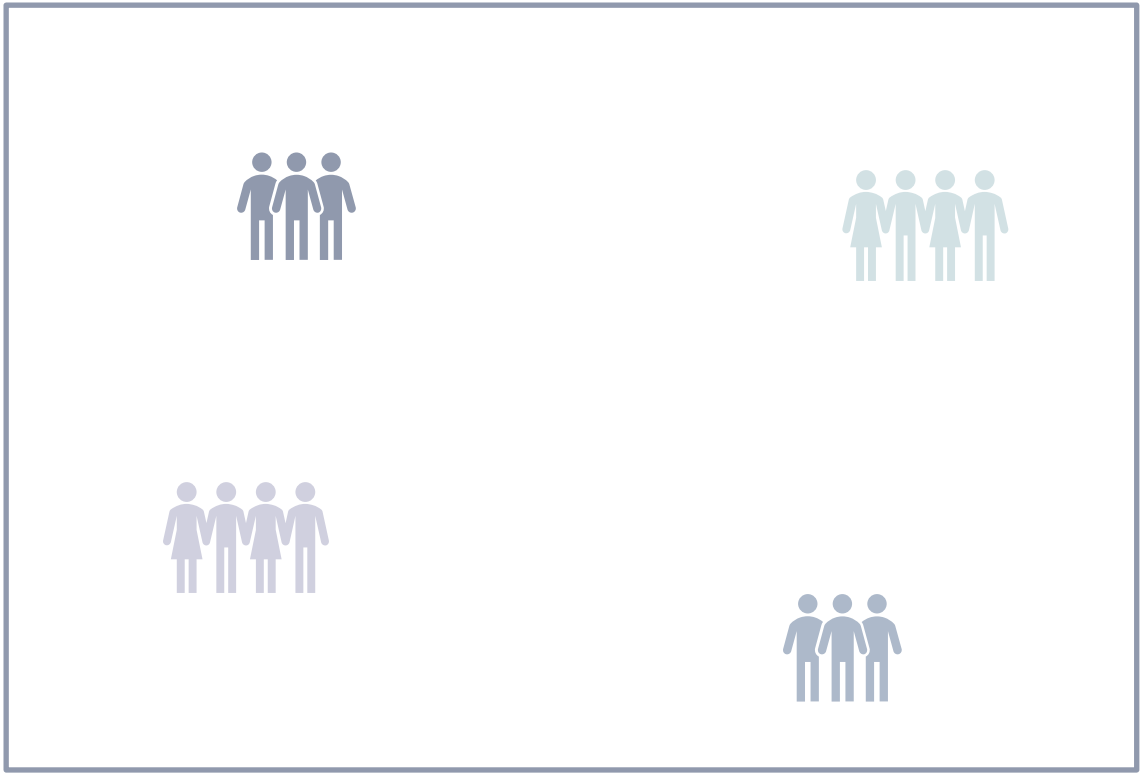
FuSE Methodologies: Disrupter Breakouts

Theme	Conclusion
What is preventing the advancement of practices/methods/tools in the presence of new technologies?	Uncertainty in ecosystem discourages adoption.
What is preventing advancement of new technology for systems engineering methodologies?	Even if I had the infrastructure and resources, I have tried before and failed, and I don't have time to learn a new way from people I don't trust.
What are obstacles in advancing practices/ methods/ tools?	Because resources are limited, we are not able to fully understand stakeholder needs to develop mature methods that are practical and implementable.
What are the obstacles in advancing MBSE?	People are incompetent.
What is preventing the advancement of SE practices and methods?	There are three main causes preventing the advancement of SE methodologies: Organizational leadership willingness to changes, lack of training and best practices, challenges to tool interoperability.
What are the attributes of "successful" "methodology"?	Scientific basis with improved intuitiveness is critical to overcoming organizational inertia and leading to rapid organizational acceptance.
What are obstacles related to practices/ methods/ tools?	Without leadership championing using the methodology there are multiple pitfalls that prevent its' successful use.

Quickly split into groups and find an area.



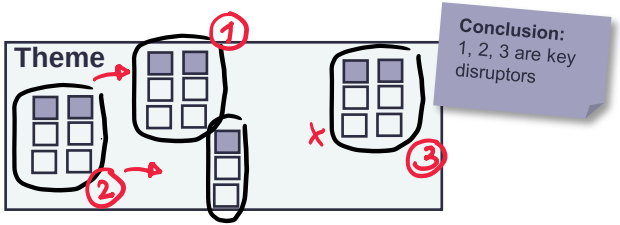
Resources needed (per group)

- 3 Flipchart papers
- 5 pads of 3x3 sticky notes
- 2 pads of 3x5 sticky notes
- 10 med point black markers
- 4 med point red markers
- 2 med point blue markers
- 2 large black markers
- 2 large red markers
- 2 large green markers
- 2 large blue markers
- Colored dot stickers
- ¾” Masking Tape
- Functioning Brains
- Vertical surface for hanging flipcharts

Pick two disrupters

5 min to **pick** two disrupters

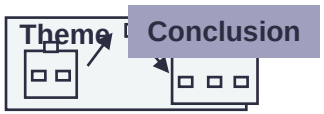
Review disrupter KJs



Hints:

- Using the arrows (cause-effect) read the top voted groups in context of the other groups
- It may be as straightforward as selecting from the top voted disrupter groups (dots)
- Pick one or two disrupters that significantly impact the advancement of practices, methods, and tools for the effective engineering of systems to be fit for purpose.

References: SE Vision 2035, WG plans, company input…



Pick Disrupters

- Pick two that will be used as the prime focus for which to generate solution concepts.
- If you have time, find references to these disrupters in existing publications (SE Vision 2035, sebokwiki, …)

- All: Introduction (10 min)
- Groups: (60 min)
  - Disrupter clarification (20 min)
    - **Pick two disrupters (5 min)**
    - Clarify disrupters (15 min)
  - Concept generation (45 min)
  - Prioritize & elaborate (25 min)
- All: Debrief (20 min)

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Disrupter Clarification

- **Your goal is not to redo prior work, however…**
  - capture enough for the group to understand each disrupter,
  - in order to brainstorm solutions & next steps for advancing practices, methods, and tools.
- **Discuss and Document Disrupters**
  - Where are they mentioned in SE Vision 2035? Other citations?
  - *Include Relationships to:* People (Working Groups, Initiatives, Organizations, …), Competencies, Process, Tools (applications, …), Data (patterns, meta-data, …).
  - Be specific, don't 'boil the ocean': Trend towards impacts we can make now and in the next two years
- **The final statement should allow an individual or team to know what the disrupter is, why it is important, and to be able to know when they have sufficiently addressed it.**

Clarify

15 min to **clarify** ONE disrupter

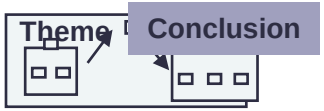
Clarify ONE Disrupter:

1. Who is addressing this today? MOU/MOA Orgs?
2. What is this disrupter?
3. When is this relevant?
4. Where is this relevant?
5. Why should we care?
6. How does this relate to SE?
7. How well is this addressed today?
8. What examples or descriptions exist (URLs)?

Hints:

- *Include relationships:* Process, Tools, Competencies, People (Working Groups, Initiatives, Organizations, …), Data & Patterns.
- Individually validate the answers and adjust the content if necessary.
- Send references (URLs, citations, etc.) to Chris!

References: SE Vision 2035, WG plans, company input…



Clarify Disrupters

- Answer the 8 questions
- Capture at least one reference to your disrupters in existing publications (SE Vision 2035, sebokwiki, INCOSE papers, …)

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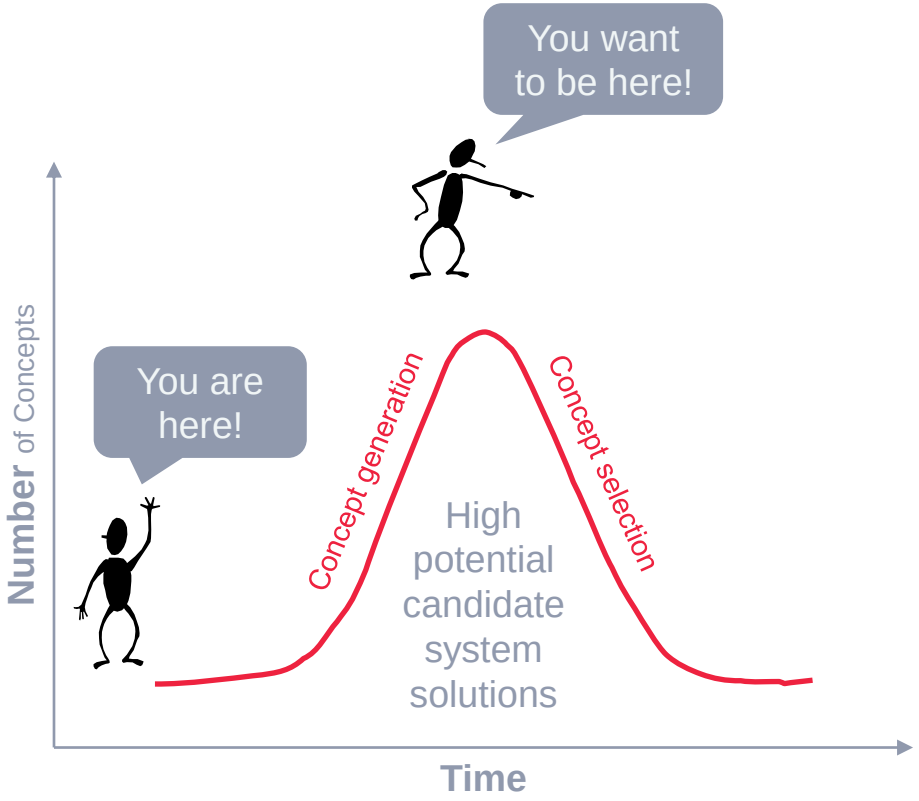
Concept generation



How do we positively respond to Disrupters?

Discussion

- Person to Person
- Presentations, Panels, Webinars, Mini-events
- Major events (EMEA WSEC, IS, AOSEC, CSER, …)

Documentation

- Papers & Periodicals
- Technical Products (primers, guides, manuals, …)

Consortium

- INCOSE Working Groups & Initiatives
- INCOSE to Org. Agreements (MOU, MOA)
- Non-INCOSE groups (OMG, SERC, IEEE, …)

Global Norms

- Practices
- Standards

FuSE Methodologies Stream
Partial Baseline

Products (various stages):
- DE Measurement Framework,
- SE Principles,
- Model Portfolio Management Guide,
- Digital Systems Engineering Process Model,
- Human Systems Integration Reference,
- Agile SE Decision Guidance Method,
- SE-AI Primer,
- SE Handbook 5th Edition

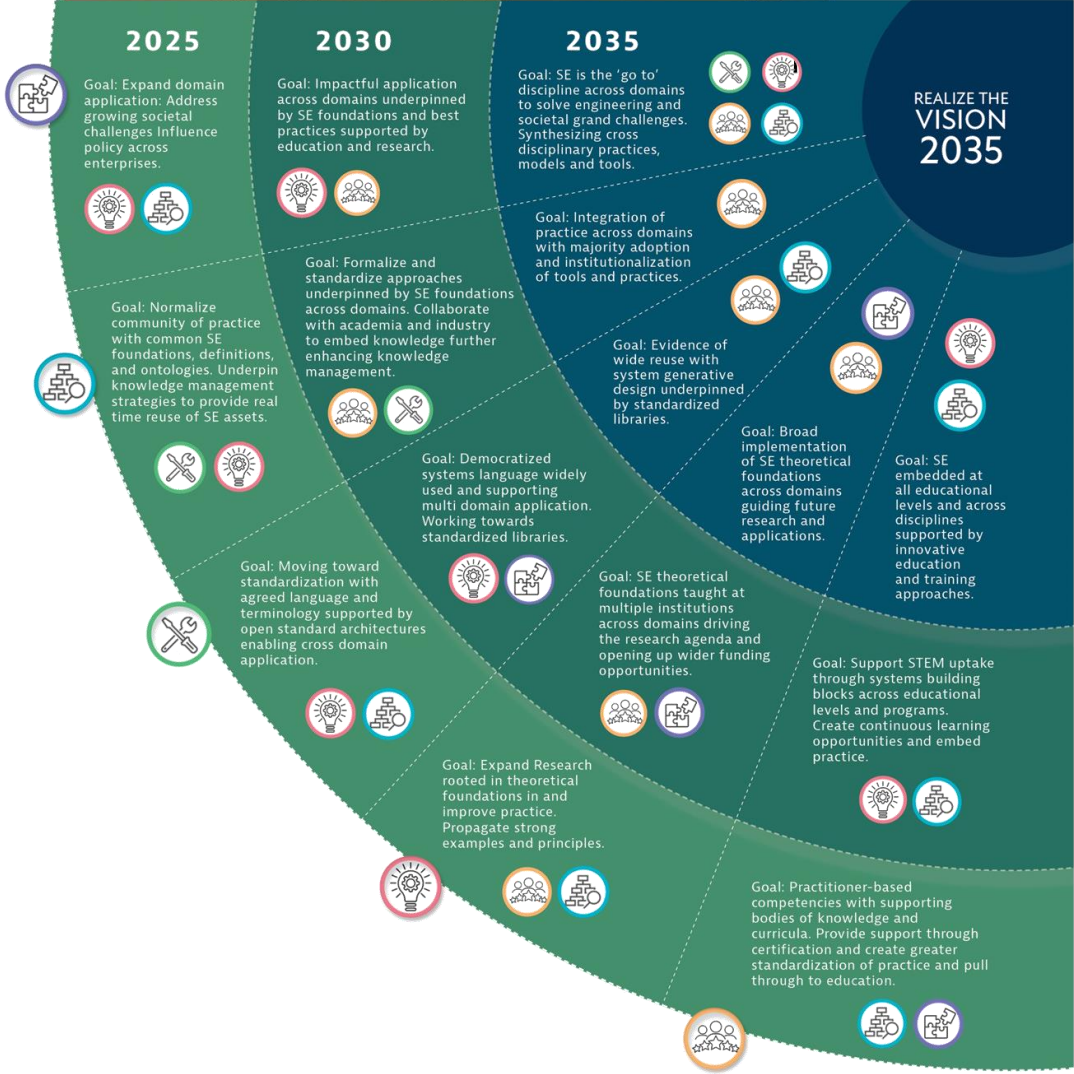
Related working groups & initiatives (partial list):
- Agile Systems and Systems Engineering
- Artificial Intelligence Systems
- Competency
- Complex Systems
- Configuration management
- Digital Engineering Information Exchange
- Enterprise Systems
- Integration, Verification & Validation
- Knowledge Management
  - Lean Systems Engineering
- MBSE Initiative
- MBSE Patterns
- NAFEMS-INCOSE Systems Modelling & Simulation
- Product Line Engineering
- Professional Competencies & Soft Skills
- SE Tools Database
- Small Business Systems Engineering
- Social Systems
- System of Systems
- Systems and Software Interface
- Systems Security Engineering
- Tools Integration & Model Lifecycle Management
- Value Proposition Initiative
- SE Handbook Team

SE Vision 2035 roadmap

As focused on the Methodologies Stream

On our chosen disrupters:

- **How might we progress:**
  - from 2023 to 2025?
  - from 2025 to 2030?
  - from 2030 to 2035?
- **What Working Group yearly plan outcomes (activities, TPPs) are related?**



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Concept Generation Approaches

5 min to **chose an approach**

Silent Brainstorming
Capture everything

Open Brainstorming
Build off each idea, trim and build dynamically

Mind Mapping
Includes relationships among captured ideas

Idea Checklists
Aids idea completeness

Benchmarking

Literature Search

List the Available Resources

Inventive Principles

Hierarchical
Requirements (disrupters) > Functions (processes) > Logical > Physical (product)

Functions (processes) > Risks (disrupters) > Mitigations (solutions)

Lead Users
what are others doing, perhaps in a different industry, that REALLY has this disrupter?

Leverage Patterns
Specific (new) disrupter > General (old) disrupter > General (old) solution > Specific (new) solution

Ideal Final Result
“The disrupter takes care of itself”

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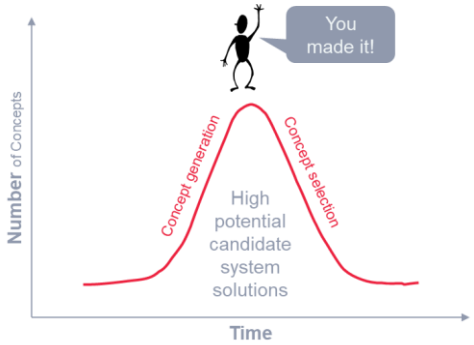
Generate

30 min to **generate** concepts

Generate concepts:



Hints:

- If a group is already working on a solution, include a point of contact and the group's name.
- If a solution is already in progress, consider the % effectiveness. Shoot for 100%!

References: SE Vision 2035, WG plans, company input…

Generate Concepts

- Using your approach…
- Document as many high-potential candidate system solutions as possible
- Create hybrid solutions from other solutions

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Create the Matrix

Team shall discuss criteria (requirements or metrics) before down-selecting.
Good criteria will distinguish one concept from another – qualitatively!

Concepts across the top horizontal

Criteria (requirements) on left vertical axis

Criteria:	Concept A	Concept B	Concept C	…
Criteria 1				
Criteria 2				
Criteria 3				
…				

Potential Criteria

1) Time to complete (<18 months)
2) Resource availability
3) Technology Readiness
4) Uniqueness
5) Perceived value
6) Utility

Run & Evaluate the Matrix

Tip: Build hybrid solution concepts by combining +'s. Add that hybrid concept and re-run the matrix.

Reference Datum:
- Most promising concept
- Best in Class
- Current Solution
- Competitors Solution

Concepts across the top horizontal

Criteria (requirements) on left vertical axis

	Concept A DATUM	Concept B	Concept C	…
Criteria 1		**+** (better)	**S** (same)	**-** (worse)
Criteria 2				
Criteria 3				
…				

Potential Criteria
1) Time to complete (<18 months)
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Relative Comparison:
- One row at a time
- Compare each concept to the datum
- Rate Better / Same / Worse than the datum
- Repeat for all criteria
- The Concepts with most +'s are the ones to keep!

Generate

15 min to **select top 2** solutions

Select strongest concepts:

Hints:
- Selection criteria should answer, “Why, specifically, is this solution better than the others?”.
- Systematically select & order, don’t just ‘do-it’.

Potential Criteria
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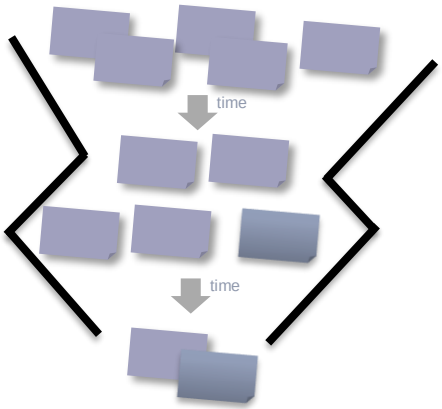

References: SE Vision 2035, WG plans, company input…

Select Concepts
- Document screening criteria
- Start with your prior solution concepts
- Quick screen for the best few
- Create better hybrid solutions from top solutions
- Select top 2!

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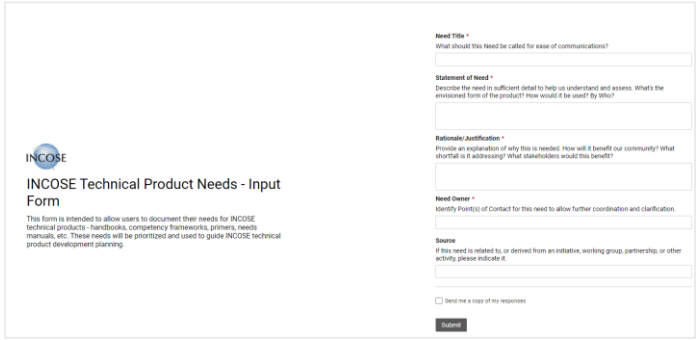
Generate

5 mins to **create requests**

Record Top 3 Solutions:



Hints:

- Identify Working Groups or other teams that should develop the solutions
- The entry form should be complete enough such that another group can launch from that input to advance us towards the Future of SE!
- Parallel processing – two people per concept solution!

Concepts

Create Record

- Take top 2 solutions
- Detail the solution concept for each
- Enter each solution concept into the Technical Product Needs Input Form

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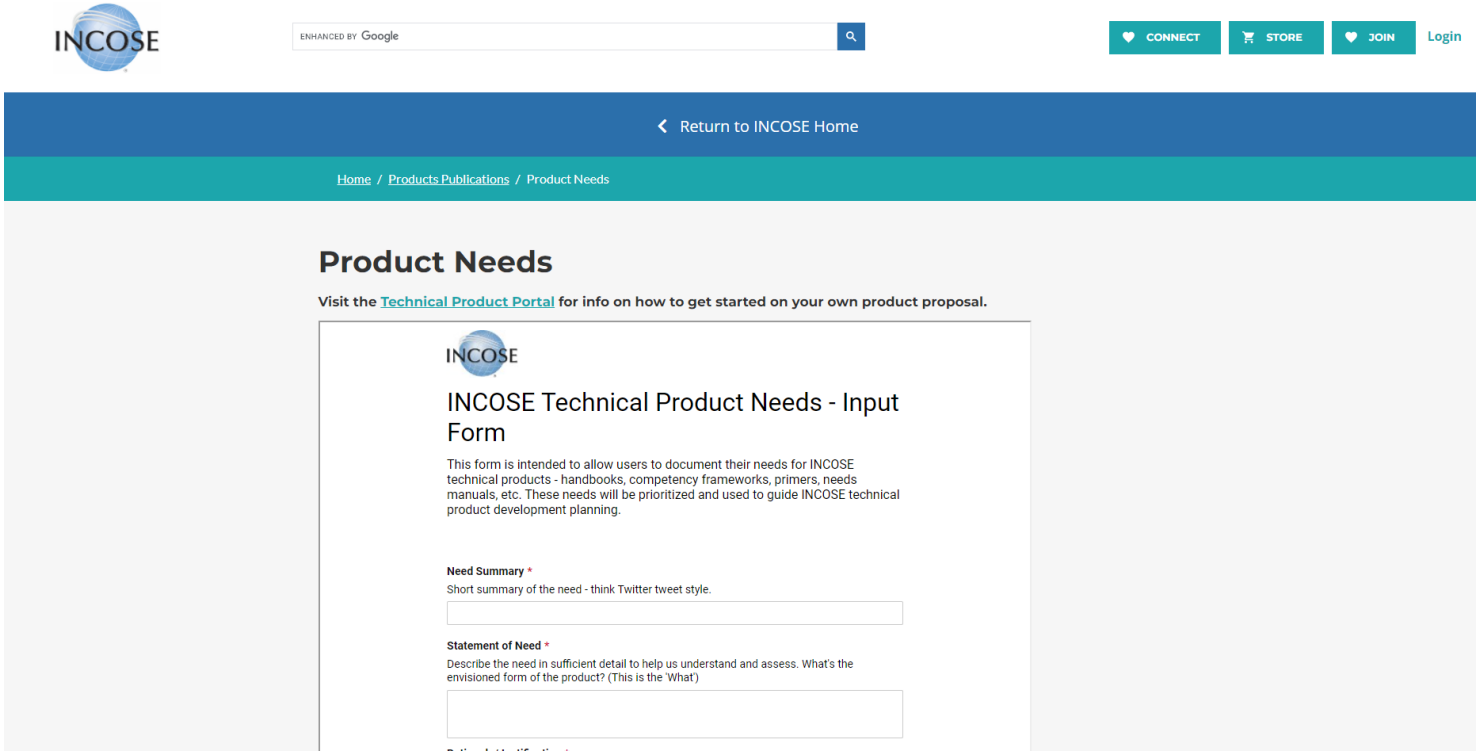
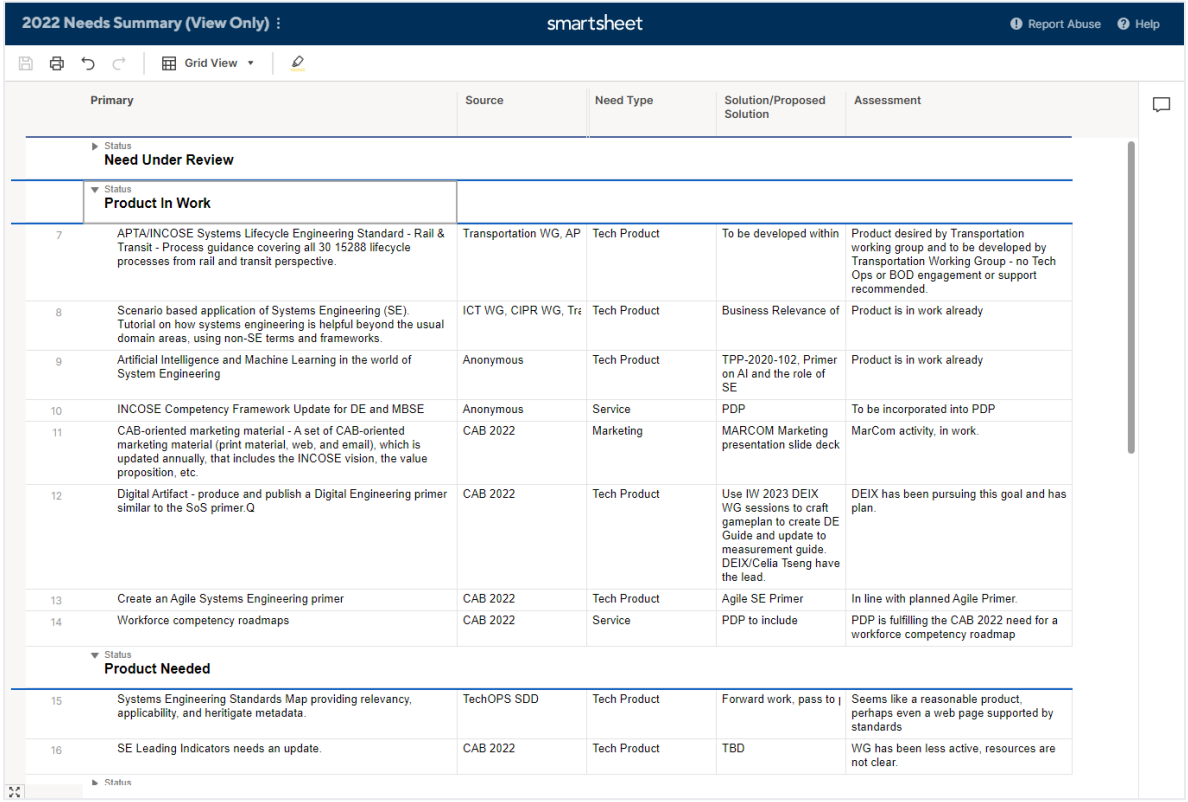
INCOSE Needs Input Form @ incose.org/needs



INCOSE Need Summary

https://app.smartsheet.com/b/publish?EQBCT=c61cf99b3c6c451496b0ea555e422135



2022 Needs Summary (View Only) — smartsheet — Report Abuse — Help

Grid View

	Primary	Source	Need Type	Solution/Proposed Solution	Assessment
	Status: **Need Under Review**				
	Status: **Product In Work**				
7	APTA/INCOSE Systems Lifecycle Engineering Standard - Rail & Transit - Process guidance covering all 30 15288 lifecycle processes from rail and transit perspective.	Transportation WG, AP	Tech Product	To be developed within	Product desired by Transportation working group and to be developed by Transportation Working Group - no Tech Ops or BOD engagement or support recommended.
8	Scenario based application of Systems Engineering (SE). Tutorial on how systems engineering is helpful beyond the usual domain areas, using non-SE terms and frameworks.	ICT WG, CIPR WG, Tra	Tech Product	Business Relevance of	Product is in work already
9	Artificial Intelligence and Machine Learning in the world of System Engineering	Anonymous	Tech Product	TPP-2020-102, Primer on AI and the role of SE	Product is in work already
10	INCOSE Competency Framework Update for DE and MBSE	Anonymous	Service	PDP	To be incorporated into PDP
11	CAB-oriented marketing material - A set of CAB-oriented marketing material (print material, web, and email), which is updated annually, that includes the INCOSE vision, the value proposition, etc.	CAB 2022	Marketing	MARCOM Marketing presentation slide deck	MarCom activity, in work.
12	Digital Artifact - produce and publish a Digital Engineering primer similar to the SoS primer.Q	CAB 2022	Tech Product	Use IW 2023 DEIX WG sessions to craft gameplan to create DE Guide and update to measurement guide. DEIX/Celia Tseng have the lead.	DEIX has been pursuing this goal and has plan.
13	Create an Agile Systems Engineering primer	CAB 2022	Tech Product	Agile SE Primer	In line with planned Agile Primer.
14	Workforce competency roadmaps	CAB 2022	Service	PDP to include	PDP is fulfilling the CAB 2022 need for a workforce competency roadmap
	Status: **Product Needed**				
15	Systems Engineering Standards Map providing relevancy, applicability, and heritigate metadata.	TechOPS SDD	Tech Product	Forward work, pass to	Seems like a reasonable product, perhaps even a web page supported by standards
16	SE Leading Indicators needs an update.	CAB 2022	Tech Product	TBD	WG has been less active, resources are not clear.
	Status				

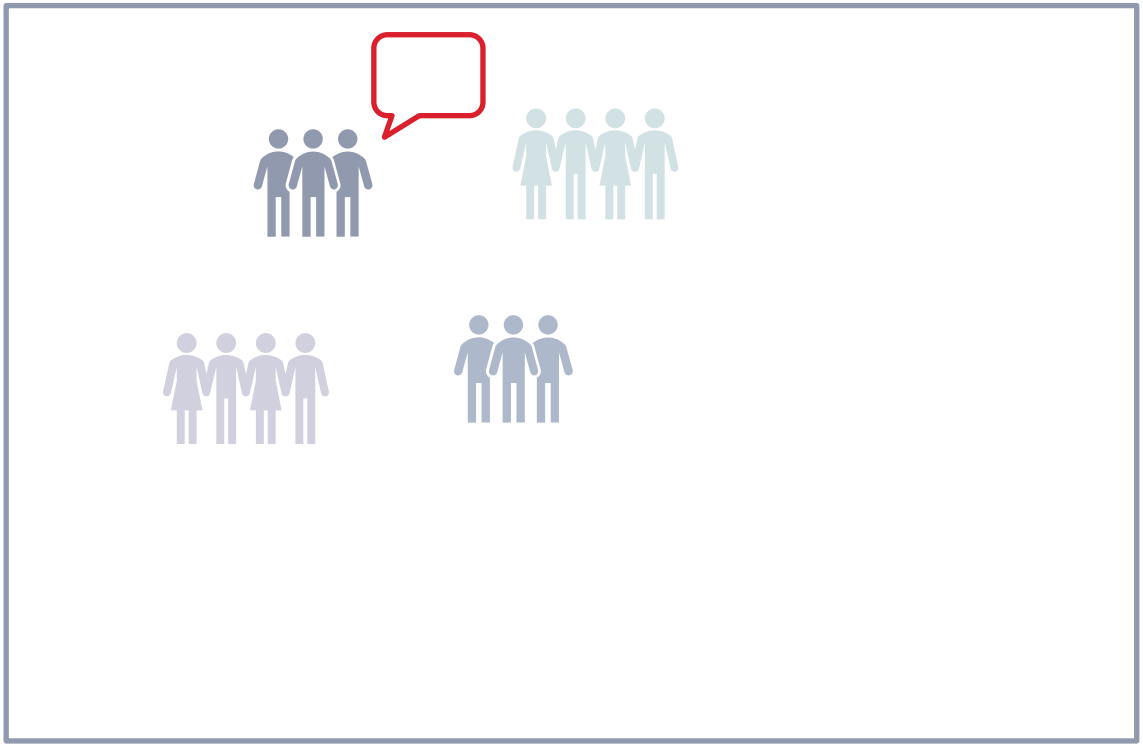
Agenda.

8:00 – 10:00 h

- All: Introduction (10 min)
- Groups: (90 min)
  - Disrupter clarification (20 min)
  - Concept generation (45 min)
  - Prioritize & elaborate (25 min)
- **All: Debrief (20 min)**

Share your findings!

~3 mins per group to **share their problem statement and top 3 solutions**



Share with the whole room

- Gather around the first group's concept selection matrix
- Group spokesperson reads their problem statement and top 3 solutions
- Rotate to the next group
- Leave content on the walls for FuSE team to capture

Systems Engineering Methodologies Stream

Chris Hoffman
Stream Lead “SE Methodologies”

e christopher.hoffman@incose.net

The SE Methodologies stream guides the advancement of practices, methods, and tools for the effective engineering of systems to be fit for purpose in the presence of varying scale, interrelatedness, complexity, non-determinism, and emerging technology innovations such as AI and agility.

The IW 2023 goal is to assess the adequacy of current INCOSE technical products and ongoing FuSE projects in this stream and identify gaps.

	SAT	SUN	MON	TUE
08:00		Elaborate disruptors: 1. Scale & Interrelatedness 2. Complexity, Chaotic, Complicated, Clear 3. A.I. for SE, other technologies 4. TBD by participants	Clarify problems / opportunities: 1. Digital ecosystem 2. Software as the capability driver 3. Continuous iterative model development 4. Evolution in learning systems	
08:30				Wrap-up FuSE (for participants)
09:00				
09:30	Break			
10:00	FuSE Kick-off	Break		
10:30				
11:00				Wrap-up FuSE
11:30				
12:00	Lunch			
12:30				
13:00				
13:30				
14:00	Introduction, Activities for 2023, Initial feedback, Opt-in participation			
14:30		Break		
15:00	Break			
15:30	Introduction, Activities for 2023, Initial feedback, Opt-in participation			
16:00				
16:30				

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16:00				
16:30				

TOMORROW's PLAN

- All FuSE streams will share learnings from the prior 3 days of workshops.

FuSE Targeted Events in 2023

Where to engage

Going forward

How to participate?

- Join our SE Methodologies Meetings
- Visit the targeted events 2023
- Join FuSE Yammer Community
- Visit our Website www.incose.org/fuse
- Propose new or updated products, activities, services, initiatives… - Share with Chris Hoffman (christopher.hoffman@incose.net)
- Engage with WGs & Initiatives that are related to FuSE Methodologies goals with their activities & products

Let's connect.

Or find us on
www.incose.org/fuse

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Return to INCOSE Home

FUTURE OF SYSTEMS ENGINEERING (FUSE)

Vision: Inspire the global community to realize the SE Vision

Home / About Systems Engineering / Future of Systems Engineering - FuSE

The FuSE Program is organized in 4 streams.

Vision & Roadmaps

Foundations

Methodologies

Application Extensions

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