How can INCOSE Ensure SE's Future Relevance ?

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The Bridge Team
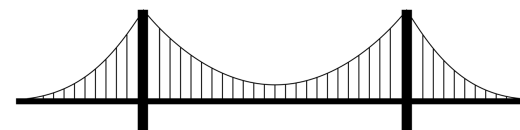
How can INCOSE Ensure SE's Future Relevance?

- **In this talk we cover**
  - The (systems) world we're in
  - Key insights from building the Bridge and consulting members
  - How INCOSE can ensure SE's continuing relevance by resolving problems of ever-widening concern
  - A Vision for how INCOSE can enable this - working with others, and progressively renewing SE's foundations
  - How INCOSE can steer SE in this direction

- **We base our views on the work of the *Bridge Team***
  - Reported in INCOSE INSIGHT April 2024
  - Being refined for SE Journal Special Edition, June 2025
    'Acting to Advance SE in the Face of Complexity'

The challenges facing SE

- Growing interconnectedness and interdependence everywhere
  - Within the techno-sphere: systems, enabling system, smart cities, smart grids…..
  - Extending outwards: Technical → Socio-techni…… …cio-technical systems
  - *'Everything changing everywhere, a…*

- Harnessing new technological o…
  - Digital support, ubiquitou… …global connectivity & sensing, GPS, AI…..

- Engineering 21st C s… …better regard for the consequences
  - Social and en… …at many scales, local to global

- Extrapol… …e knows from the techno-sphere onto the global stage
  - Ensuri… …thwhile human life on a self-sustaining planet
  - Reducing current negative trends, coping with the consequences of past actions and building new futures

Summarised in INCOSE Vision 2035

The world's greatest challenges are systemic in nature

- **We are faced with numerous systems challenges**
  - Eg: UN SDGs, Industry 4.0, Sustainability (in technical systems, homes, towns, cities, world)
  - There are many good places to start, and we may have to address them all eventually

- **Our solutions can join up - for better or worse**
  - Multiple independent interventions will inevitably interact downstream
  - They are all are bounded by a finite world, and contend for the same resources

- **Many of our systems problems differ from those SE is used to:**
  - In scale and complexity: multi-level, dynamic, heterogeneous
  - Open-ended: continually unfolding, interacting and revealing themselves

- **We are all part of the systemic landscape**
  - Human activity is central to our problems and our ingenuity will be central to solving them
  - How we move people to address them collectively is also a systemic problem

Key insights from developing the *Bridge*

- SE must re-discover its roots as a Problem-Solving discipline:

  'Based on determination of the objective to be achieved, and consideration of all of the factors which bear on the possibility of reaching the objective, and the relationships between them'   (Engstrom, 1957)

- The pursuit of *elegance* gives an over-riding purpose to the SE discipline and to all our interventions *(following Frosch, 1969; Griffin, 2010)*

  Satisfy a need, be robust and efficient, and minimize unintended consequences

- SE must shift its focus from Systems to Holons, thus embracing Holonism (Rousseau & Billingham):

  The belief that the world is made of Holons (Koestler); holons are systems that have parts which are also systems; and form part of - or interact with - any number of other holons in dynamic, interacting & evolving Holarchies

An SE equipped for these new futures

- **Principled:** knowing what matters, and grounded in the sciences which can guide it

- **Ambitious:** challenging itself to provide elegant solutions to increasingly complex problems, and inviting others to value it by its success

- **Creative:** both in how it designs solutions, and how it harnesses technology to turn designs into successful outcomes

- **Forward-looking:** motivated to realise INCOSE's vision:

"A better world through a systems approach"

Findings from IW 24 Workshop: *'Ensuring SE's continuing value in a changing world'*

- ## We need to put more focus on outcomes:

  We don't explain HOW SE delivers value - we explain why to do it, and what to do… More focus on impact. "If I don't embrace, I will fail". Value should be this compelling… Let others judge our success rather than ourselves. Our impact in our organizations in their eyes…

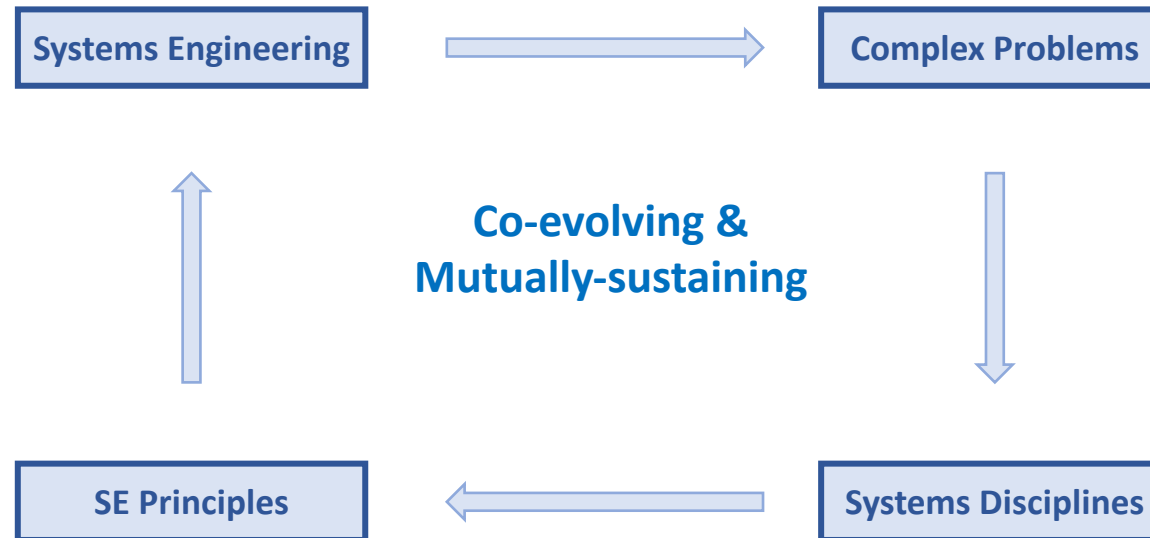- ## SE is about thinking, not just processes and tools:

  Not enough SEs understand what Systems Thinking is (let alone how to use it)… Younger generation is not being taught "how to think"… SE is about critical thinking and applications but we get caught up in tools and processes… Asking better questions and teaching others to do this?... A fool with a tool is a more dangerous fool (tools must enable thinking, not replace it) ….
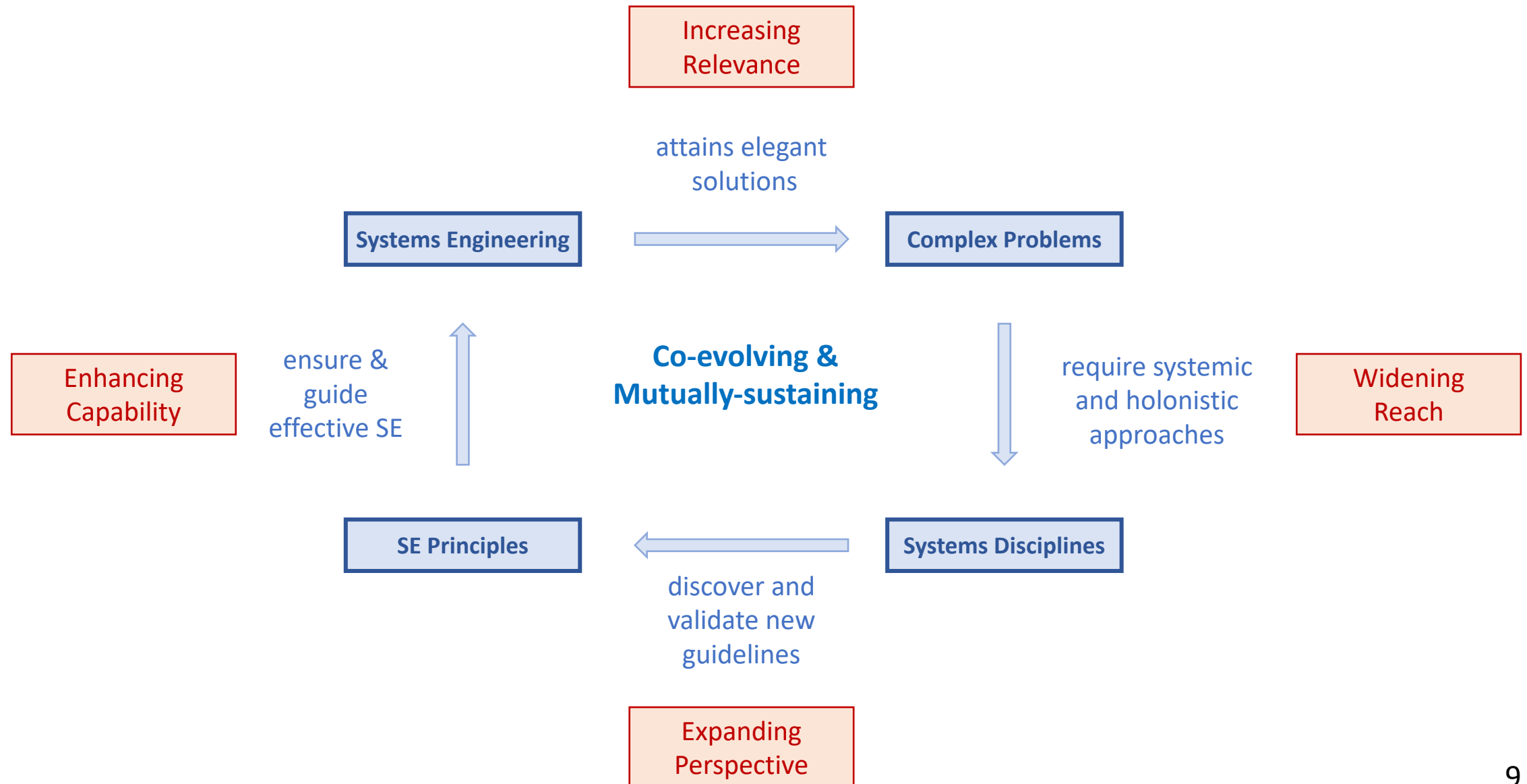
- ## We need to be more open to new ideas:

  Reach out to new domains and applications and meet them where they are… Being open to new ideas and approaches… Need to accept a variety of approaches, there isn't necessarily "one way" to do things… Address the need for more humility as we seek to engage with others…

A view of SE in Context

Systems Engineering → Complex Problems

Complex Problems → Systems Disciplines

Systems Disciplines → SE Principles

SE Principles → Systems Engineering

Co-evolving & Mutually-sustaining

How SE can continually renew itself

Increasing
Relevance

attains elegant
solutions

Systems Engineering ⟶ Complex Problems

**Co-evolving &
Mutually-sustaining**

Enhancing
Capability

ensure &
guide
effective SE

require systemic
and holonistic
approaches

Widening
Reach

SE Principles ⟵ Systems Disciplines

discover and
validate new
guidelines

Expanding
Perspective

9

Important Influences on SE's future

- Collaborating with other disciplines is key to increasing SE's relevance
  - SE cannot reasonably expect to find answers to global problems by working alone
  - SE can learn from disciplines which better understand the unfamiliar settings we all face
- Drawing insights from a richer set of experiences by applying ourselves more widely
  - From our successes and failures we can discern new patterns and relationships
  - Analysis can lead us to more reliable guidance and new principles
- SE Principles give us something we can share with other disciplines
  - Making possible a growing base of useful and practical knowledge we can hold in common
- SE Principles also give us something we can share with engineers of the future
  - Passing on what we believe to work, and providing the basis for education
- What emerges is more widespread Transdisciplinarity – matched to our expanding worldview
  - Transdisciplinary Systems Science (TDSS) and Transdisciplinary Systems Engineering (TDSE), working together

Our Vision for a Holistic SE of the Future

Systems Engineering

- Principled
- Self-aware
- Confident
- Outward- looking
- Purposeful
- Transdisciplinary

Complex Problems

- Significant progress on UN goals
- Increasing global systemic health
- Beneficial 4th industrial revolution

SE Principles

- Consolidated
- Assured
- Understood
- Accessible
- Utilized
- Evolving

Systems Disciplines

- Widely valued
- Widely applied
- Widely taught

How INCOSE can steer SE towards this vision

- Reach out to other professional bodies
  - Encourage joint studies – eg selected UN SDGs – initially to test SE's current capability
  - Extended progressively – say in conjunction with National Academies (eg NAE, RAEng?)

- Provide a focus for supporting research
  - Develop a Transdisciplinary Research Agenda
  - Work with the Systems Science community to probe the nature of '*Elegant solutions to complex problems in a holonistic world'*

- Actively manage SE's Guiding Principles
  - Develop/host an accessible and evolvable *Repository of Principles for Transdisciplinary SE*
  - A Concept Study would shed light on practicalities, building on existing INCOSE work

- Broaden the professional development of Systems Engineers
  - Making *Transdisciplinarity* part of SE curricula, training courses etc
  - INCOSE White paper *'Building the Engineering Workforce of the Future'* provides a basis
  - Solving eco-social problems as *SE Capstone Projects*

Discussion

For more background: see INCOSE INSIGHT April 2024

To contribute ideas: submit a paper to SE Journal Special Edition
Advancing SE in the Face of Complexity, by 1st Nov, 2024

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