31st Annual INCOSE international symposium

virtual event

July 17 - 22, 2021

An Overview
and Conceptual Development

Putting the Social in Systems Engineering

www.incose.org/symp2021

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Agenda

- Introduction
- Early Pioneers of Social Systems Engineering
- Social Systems Science, Complexity and Systems Engineering
- Social Systems
- Systems Engineering in the Social Domain
- Co-Evolving through Social Systems Engineering Education

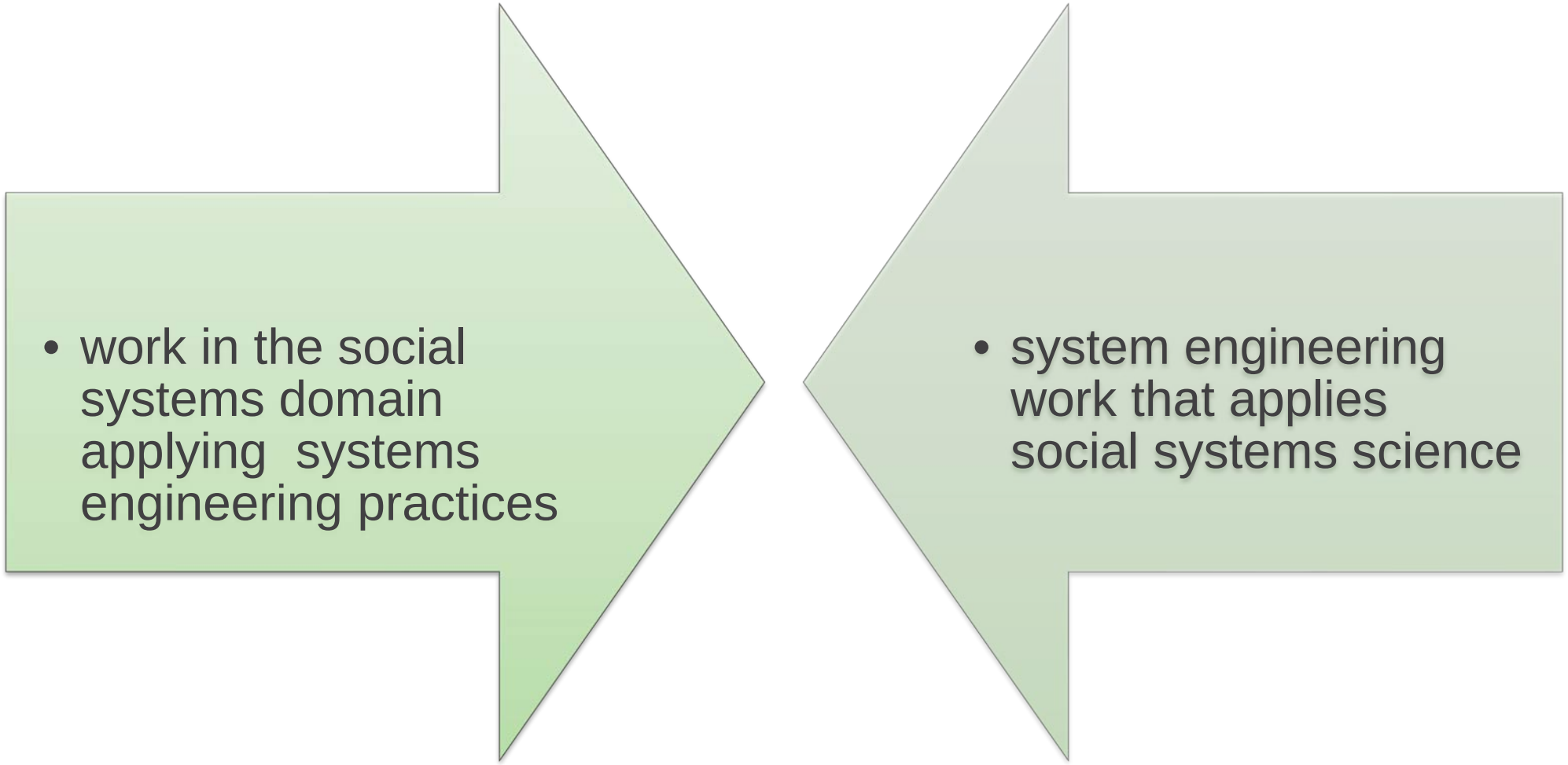
Introduction: INCOSE SE Vision 2025

SE applied to social problems: poverty, public health, education, and other "wicked problems" such as the SDG and engineering grand challenges

"When we look for ways to meet fundamental human needs, we see that the solutions often lead to large and complex engineered systems — systems that can only be realized in the context of societal behavior."

(Vision 2025)

Conceptual Overview Social Systems Engineering



Early Pioneers of Social Systems Engineering

Simon Ramo, INCOSE pioneer

- "*A city is a system, whether or not we choose to regard it in that light. If we choose not to, then it will simply be a bad system.*"

Arthur D. Hall

- "*The environment is the source of knowledge for every phase of systems engineering*."
  - Environment = (1) physical or technical, (2) business or economic, and (3) the social

Early Pioneers of Social Systems Engineering

Harold Chestnut

- *"… control systems people, working with persons skilled in other professions, can increase the likelihood for a considerable improvement in international relations in the years ahead."*

Andrew P. Sage

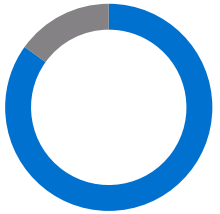
- *"Modeling of social systems, even those of the simplest nature, has often been a frustrating endeavor."*

Social Systems Science, Complexity and Systems Engineering

Social interactions mean that even the simplest systems engineering effort is complex

Principles of social systems science drive design

Integration of the different discipline generated ideas, designs and procedures is a significant social challenge for systems engineering



The **social structure** and culture of the organization can facilitate or block the flow of important information about the system

Many social concepts affect the flow of information – a matter of deep concern

- specification of ignorance
- **discipline terminology**
- opportunity structures
- socially expected durations
- role-sets
- organizational **culture and cultural subsets** (i.e., discipline cultures)
- manifest and latent social functions
- social dysfunctions
- social adaptation
- social ambivalence
- social polarization
- self-fulfilling prophecy
- unintended consequences

Social Systems examples

- Component social structures that interact with the larger system
  - Steel helmet
  - High-speed train
  - Commercial passenger aircraft
  - City
  - Refrigerator …
- Predominantly social systems with sociotechnical components at the interface of society and technology
  - Smart cities
  - Massive multiplayer online video games
  - Transportation systems

Social Systems – organizations

- Artifact designs might be intentional up to a point, but they cannot be completely determined or planned beforehand; these designs are also emergent, dynamic, incomplete, always ‘in the making’, unpredictable, self-organizing, adapting and evolving
- SSE relies more on trial and error, failure, iteration, experimentation and adaptability – relies on end-user feedback to improve

Social systems engineering is challenging

Influencing

- SSE aims at **stimulating self-organization** (as opposed to direct intervention)
- SSE highlights the need for developing solutions that should be **context-dependent**, iterative, experimental

Intervention

- SSE differs from a purely scientific viewpoint that prefers direct intervention to achieve desirable properties (e.g., resilience)
- SSE represents a challenge for building interdisciplinary teams that include social scientists alongside systems engineers

Systems Engineering in the Social Domain

- Systems thinking in social science disciplines is not ubiquitous, but one can find systems thinking in the social sciences on both the theoretical and methodological level.
- System Dynamics Modeling Applications
    - Social Policy
    - Healthcare
    - Gender Inequality

Co-Evolving through SSE Education

View	Role of higher education	Role of engineering in society	Social role of engineers
Scientific	Oriented toward the development and **transfer of knowledge** as inherently good	**Translate** scientific knowledge into practical applications	The engineer is a **specialist** whose main role is as advisor
Economic	Oriented toward professional training with focus on **promoting economic growth**	**Create applied technological innovations** that enable entrepreneurial and industrial development	The engineer is a **professional innovator** who creates commercial products
Service to humanity	Oriented toward the **personal development** of the personality and character of the student	**Provide public service** to society, oriented toward social justice and sustainability	The engineer is an actor and **active participant in social construction and change**

Co-Evolving through SSE Education

- Engineering education needs paradigm shift
  - From traditional focus on products and systems that enhance economy and business objectives to the role of a service to humanity, oriented toward social justice and sustainability

Summary – co-dependence of SE and Social Systems Sciences

Questions?

- Get in touch!
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