FuSE: Systems Engineering Application Extensions.

Saturday 28 Jan 2023, 14:00-15:00 PST & 15:30-17:00 PST

Tom Strandberg
FuSE Application Extensions Lead

Introduction

Systems Engineering Application Extensions Stream

Tom Strandberg
Stream Lead “SE Application Extensions”

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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.

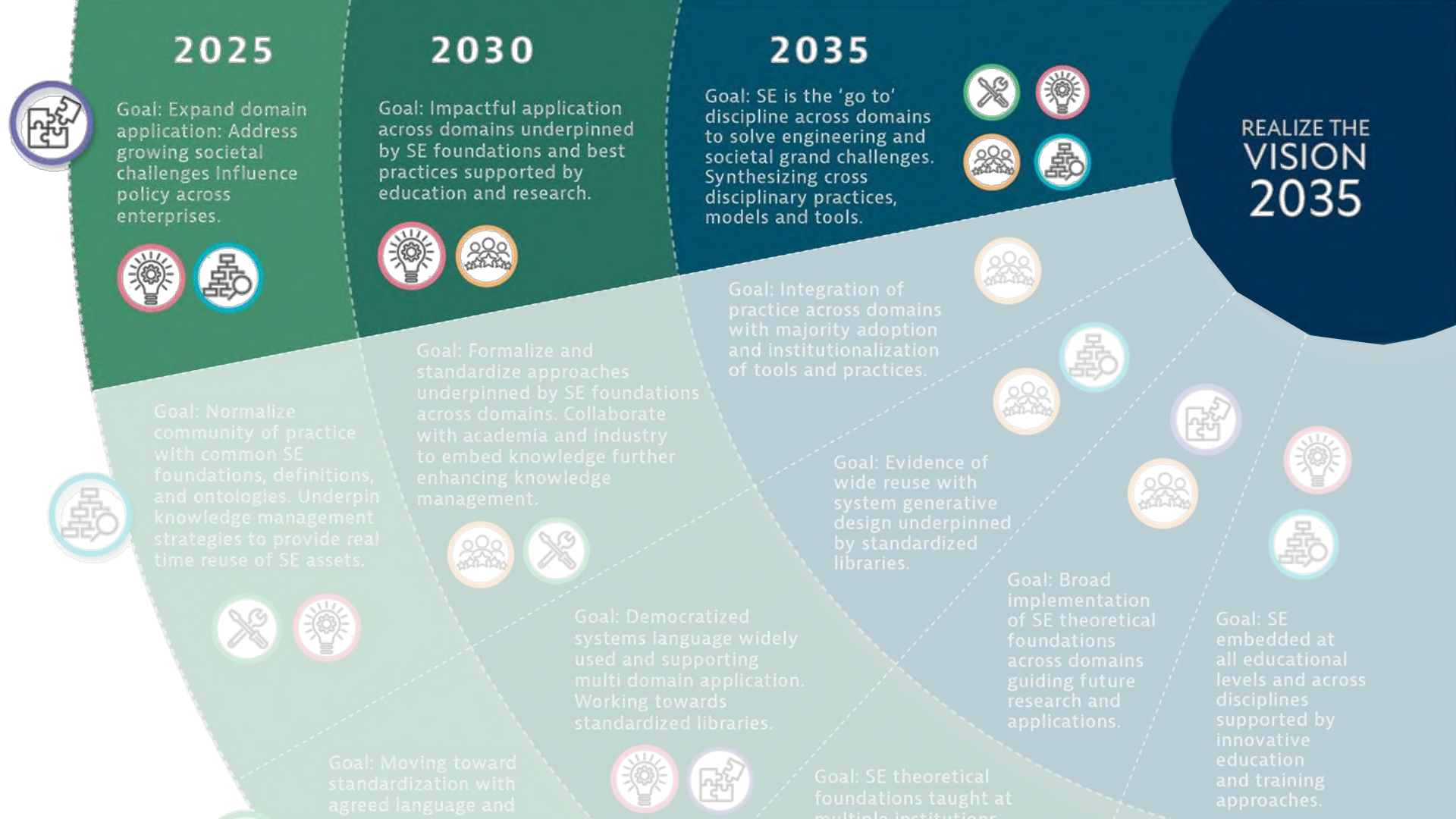
The IW 2023 goal is to frame the value model to justify systems engineering’s role at the policy table for these grand challenges.

	SAT	SUN	MON	TUE
08:00		1. How SE supports sustainable cities 2. How SE supports innovation	1. SE to improve public spending (joint effort – physical – asset management) 2. Integrate soft systems, social systems and other initiatives for grand challenges	
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			
14:30		Break		
15:00	Break			
15:30	Introduction, Activities for 2023, Initial feedback			
16:00				
16:30				

The world is coming to a conclusion that we need to take a systems approach to solve our challenges.

A better world through a systems approach

The world's recognition of systems engineering and INCOSE is still very limited.


2025
Goal: Expand domain application: Address growing societal challenges Influence policy across enterprises.
2030
Goal: Impactful application across domains underpinned by SE foundations and best practices supported by education and research.
2035
Goal: SE is the 'go to' discipline across domains to solve engineering and societal grand challenges. Synthesizing cross disciplinary practices, models and tools.
REALIZE THE VISION 2035
Goal: Integration of practice across domains with majority adoption and institutionalization of tools and practices.
Goal: Formalize and standardize approaches underpinned by SE foundations across domains. Collaborate with academia and industry to embed knowledge further enhancing knowledge management.
Goal: Normalize community of practice with common SE foundations, definitions, and ontologies. Underpin knowledge management strategies to provide real time reuse of SE assets.
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 embedded at all educational levels and across disciplines supported by innovative education and training approaches.
Goal: Democratized systems language widely used and supporting multi domain application. Working towards standardized libraries.
Goal: Moving toward standardization with agreed language and
Goal: SE theoretical foundations taught at

Stream Output

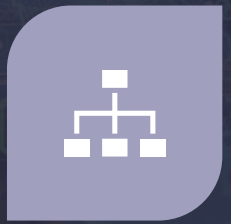
- An overview of initiatives that support the realization of the SE Application Extensions Roadmap.
  - Existing, e.g. Smart Cities Initiative
  - Potential new ones, e.g. Innovation
- Stimula and support to initiatives
  - Typically cross-WG, cross-organization
- Coordination and collaboration
  - products, papers, workshops, lobbying

How?

DEFINE TOPICS THAT CAN SUPPORT EXTENDING THE APPLICATION OF SE

DEFINE TARGET GROUPS AND THE MESSAGE REQUIRED

DEFINE HOW TO APPROACH THE TARGET GROUP



IDENTIFY THE RESOURCES REQUIRED, INTERNAL AND EXTERNAL TO INCOSE

STIMULATE AND SUPPORT JOINT INITIATIVES

Initial Selection of Topics.

Smart Cities

Innovation

Asset Management

Grand Challenges

Results IW2023

Key Insights SE Application Extensions

Topics

Validating the stream´s **purpose**, content and goals

Topics for extending SE applications proposed validated fit for purpose:

- Smart Cities
- Innovation
- SE and Asset Management
- Grand Challenges

Key Insights

SE Application Extensions stream **purpose and topics** have been **validated**. **MoE, risks and activities** have been **proposed** by the participants.

Smart Cities – good foundation exists for reaching out to internal & external groups. Next step is the validation by application together with mayors or alike.

Innovation – an innovation framework based on systems thinking identified to be a useful means to engage with new target groups. Good potential for collaboration between WGs.

Asset Management – Value and interest to cooperate with the Institute of Asset Management in order to align the forces. Identify the respective WGs within INCOSE.

Grand Challenges – Quite some Value Propositions identified that INCOSE could provide – Proposed next step set up a cross-WG initiative and to seek collaboration with complementary organizations with a joint message to target groups.

Saturday January 28th Session

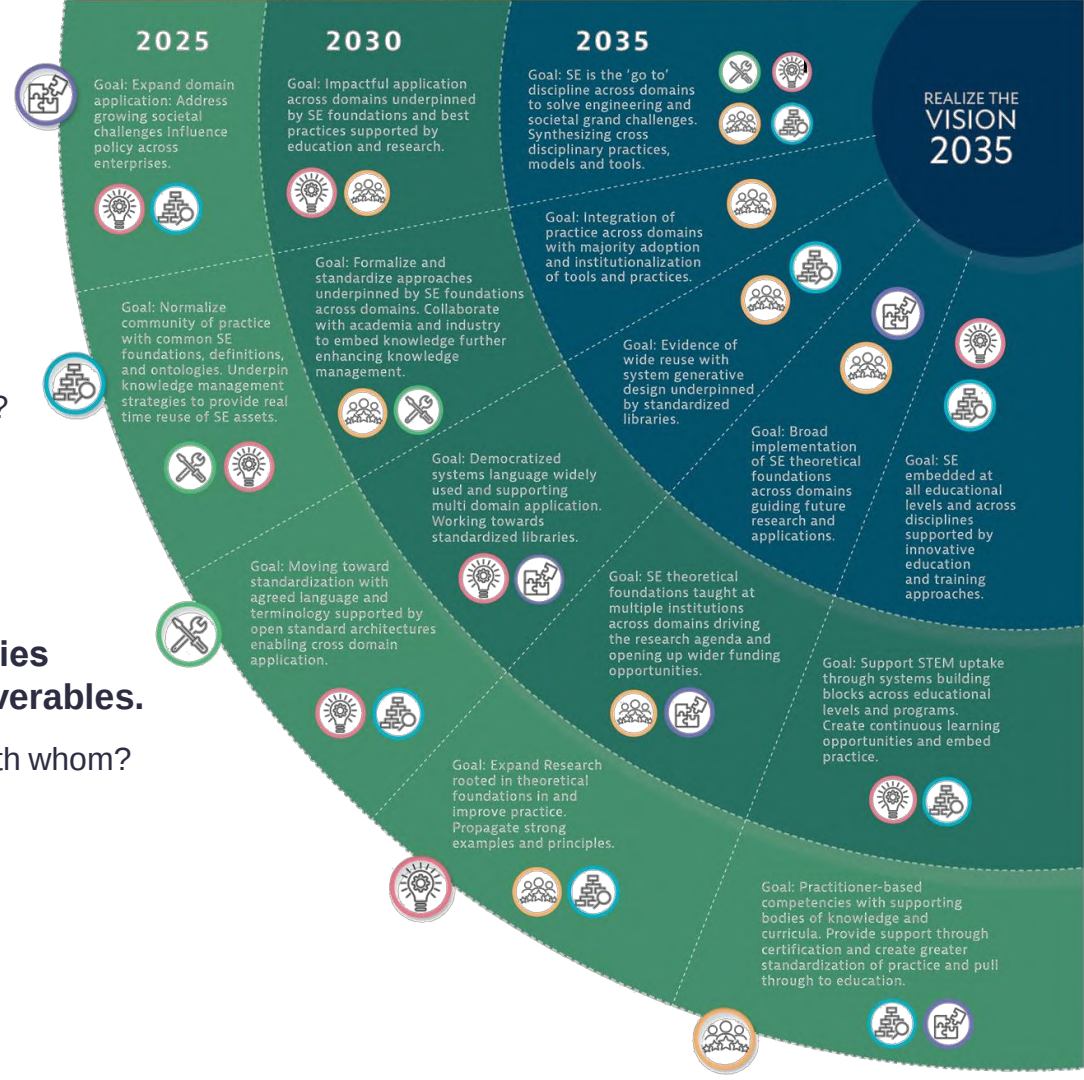
1) **Feedback on the stream's scope**
2) **Feedback on the stream's planned activities in order to accomplish our targets & deliverables.**

SE Vision 2035 roadmap

As focused on the Methodologies Stream

- **Feedback on the stream's scope.**
  - What questions do you have?
  - What measures of success would you propose?
  - What risks do you see?
  - What mitigations do you propose?

- **Feedback on the stream's planned activities in order to accomplish our targets & deliverables.**
  - What other activities should be considered? With whom?
  - What if any priority is there to the activities?



Feedback on the stream's scope.
What questions do you have?

- What would be the minimum Level of success in the stream?
- What is the focus? get a message that is clear!
- Are we answering the right questions in terms of societal needs?
- Are we addressing the right needs of stakeholders → survey stakeholder needs!
- How are the differences between the 3 sectors to approach societal needs?
- What can we as INCOSE produce as a group of volunteers ?
- What are the low hanging fruits to approach like SMART CITY?
- When will INCOSE establish lobbyists in national capitals?
- Are there SEs in the UN ? If not : measure of success = SE in the UN
- What do we mean by INNOVATION?

Feedback on the stream's scope.
What measures of success would you propose?

VISION as a general understandable language - 5 pager

INCOSE Known as a resource for policy creation in national capitals &U.N.

Need good representation in all of the different agencies

Show / Prove that INCOSE can do it

INCOSE recognized by agencies outside Defences Aerospace

We want to demonstrate that the SE approach has helped to cope with a certain challenge

Feedback on the stream's scope.
What risks do you see?

- **INCOSE is offered funding for projects but can't accept it.**
- **→ Mitigation: INCOSE to act as a broker for establishing consortia**
- **Innovation means novelty for novelty's sake**
- **Systems Engineering not recognized as a term/ discipline/ profession → System Engineer = Computer Engineer**
- **INCOSE as a name is not explicit .**
- **Why are there Systems Engineers that don't know of INCOSE?**

Feedback on the stream's scope.
What other activities should be considered?

- INCOSE needs a sister cooperation that can make profit as a think tank
- Offer free hours sessions --> MENTORSHIP PROGRAM
- Offer SE training in curricula / educational programs in "new" domains Educating non-graduate students in SE principles
- Review what we have as products that could be used (and what revisions maybe necessary ...)
- Ensure that our / WG products are brought out by ambassadors to the target groups
- Establish SE Primer for the "new" domains, written in the language of the domain .
- We have already good content --> we have to bring these product to the people that could use them !
- SE Ambassadors to UN, WEF, ...
- SE equivalent to US "land-grant" university - SE for sustainable/ resilient agriculture e.g., 1/3 of world's wheat from Ukraine ... but now ?'
- Electrification of Transportation ... - Lithium mining for batteries - SE planning / solution for long-term sustainability environmental reclamation
- Reach out to totally different target groups !
- For the different target groups, we need to adopt to their language
- Transformative Research & Innovation Policy (TRIP)
- Establish an initiative to find the synergy between standards, e.g. 15258 /55000, BiM
- Plain language! Illustrations !

Feedback on the stream's scope.
What other activities should be considered?

- Offer modelling of system problems / failures.
- For successful Acceptation Provide Proof of success in other Industries. => Extend Scope with Success stories.
- Open a chapter in UN - Establish a kind of network
- Apply SE to Financial Model
- Check if any INCOSE member is affiliated within Policy makers, UN & other influential org.
- Help someone to solve a problem and learn in the process .
- Offer training to other organizations like asset management organizations
- Approach organizations that are dealing with the societal needs -> Explore their needs !
- Student Chapters to engage in SE solving Grand Challenges
- Implement & provide a platform for the "daily Engineer success stories"
- Provide a list of all relationships INCOSE got with other organization .
- Get students involved via student chapters, connect them worldwide and let them work on grand challenges stuff
- Promote job exchanges between domains.
- Provide the Value Proposition for a Systems Engineer practicing SE.
- Ensure that we involve all 3 sectors. --> include cultural aspects.

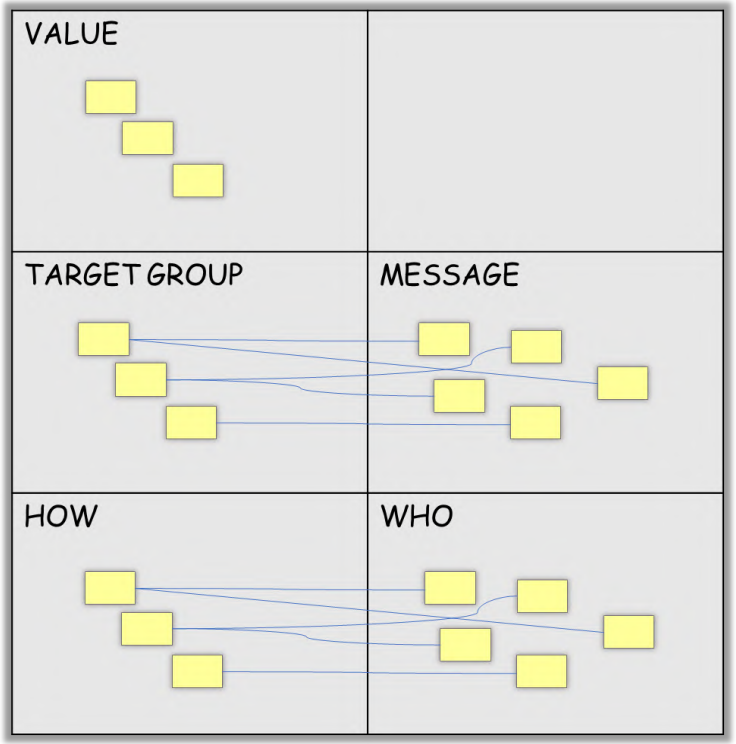
Sunday January 29th Session

1) **Innovation**
2) **Smart Cities**

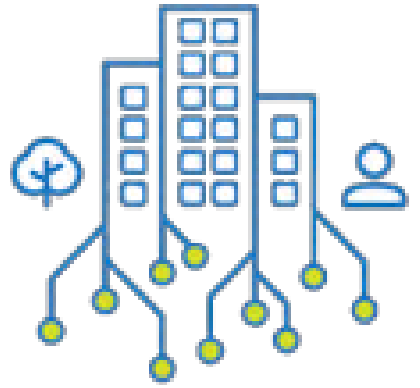
Breakout (50 min) - Approach for the 4 Topics

Round table hello

1) Feedback on topic and value SE could bring
2) The target groups to approach
3) The message to use when approaching the target group
4) How – what actions are in place or need to be taken?
5) What internal and external resources (collaborations) to engage



Smart Cities Initiative



Smart Cities Initiative

Chair: Jennifer Russell EISE, CSEP *Jennifer.Russell@incose.net*

Co-Chair: Marcel van de Ven, CSEP *marcel.vandeVen@incose.net*

Co-Chair: Rael Kopace *Rael.Kopace@incose.net*

INCOSE International Workshop

January 29, 2023

Smart Cities Initiative

Purpose

- Support communities
  - Concepts
  - Applications
  - Technology
  - Services (CATS)

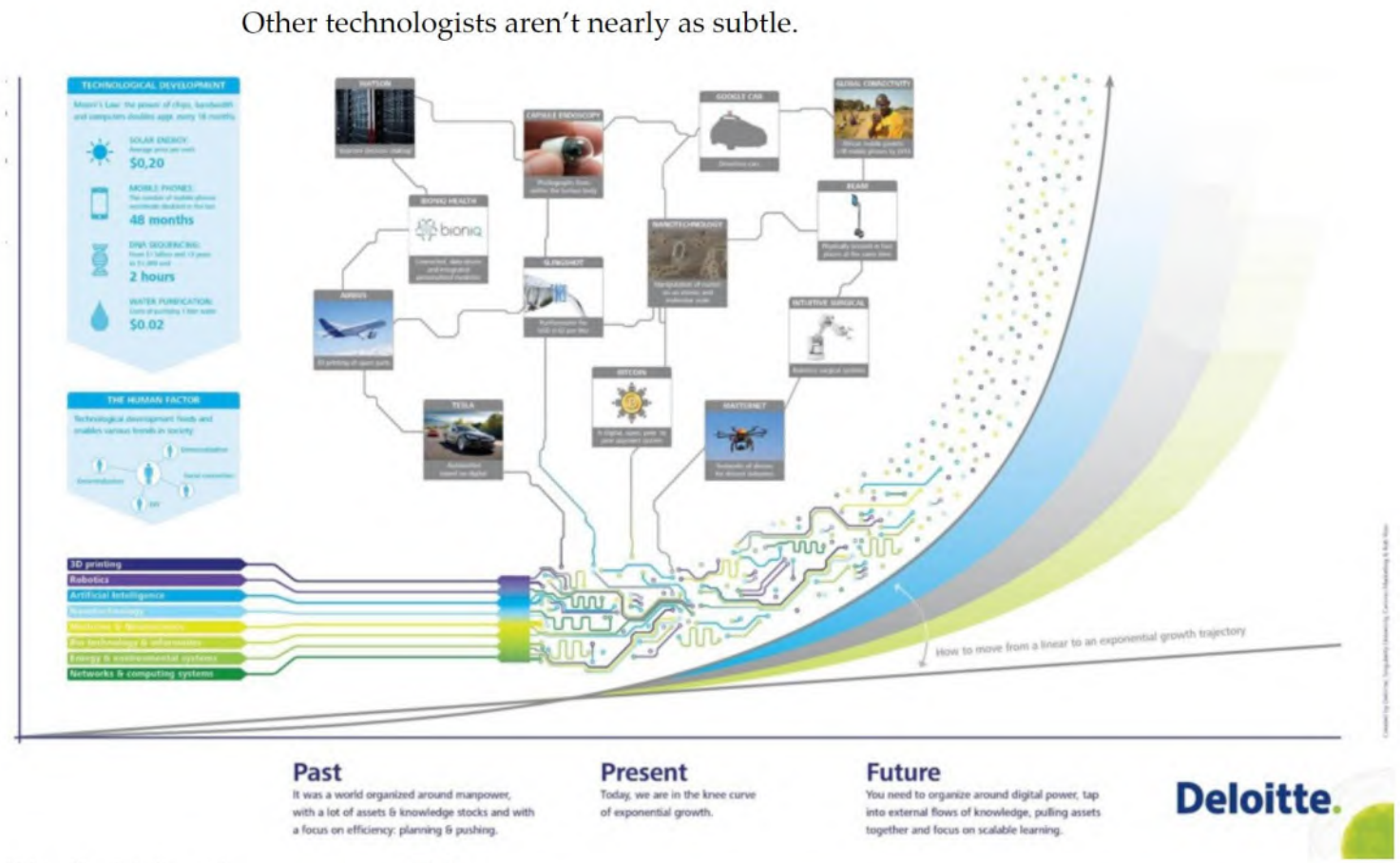
  by leveraging systems engineering tools and principles

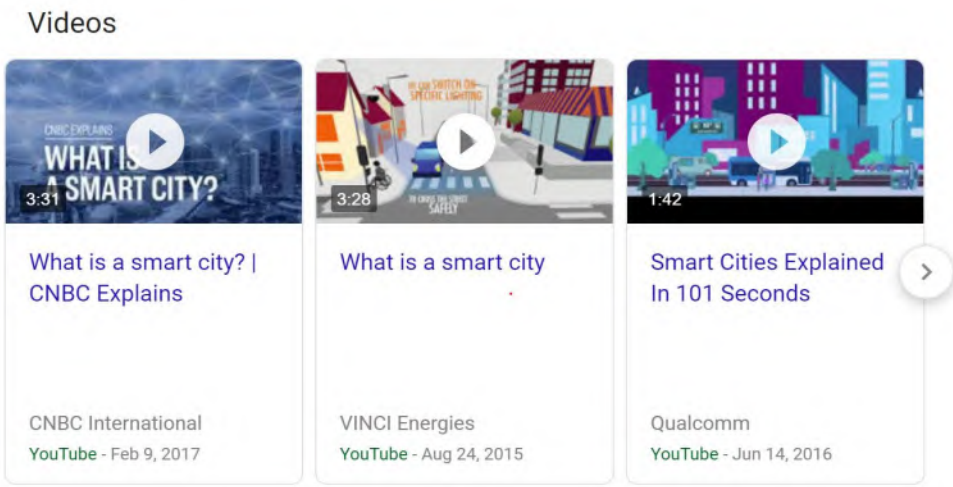
Goal

- Create a model that illustrates the resources
- Enabling
  - interconnectivity
  - reuse
  - consistency

Smart Cities are a moving target

And lack of success has diminished the concept and term





Smart Cities Initiative

INCOSE

Technology focused smart cities are rethinking their approach

Electronics

'Frankenstein' lunges to new life for Cisco and smart Carlsbad, California

by Matt Hamblen | Feb 5, 2021 5:12pm

Success in a smart city “has nothing to do with technology and has to do with people. We need to invite the public into co-creating these experiences with high degree of civic engagement. Cities need to be engaged with the public around connecting communities.”

- David Graham, Chief Innovator Officer for the City of Carlsbad, California.

Smart Cities Initiative

INCOSE

We need a common definition for a smart city

Smart Cities Initiative

Guiding the evolution of smart cities

By Calil Queiroz June 01, 2021

The idea of the "Smart City" is a fashionable one. However, there is no common definition of what a smart city should look like.

(Image credit: Image source: Shutterstock/ jamesteohart)

Smart Cities Products Plan

Smart Cities Initiative

complete

- ✓Definition of Smart City
- ✓Metrics
- ✓Reference model

started

- Case Studies
- Stakeholder List + Management Plan
- Architecture template for Smart Cities ~ MBSE model

future

- Input on other Smart Cities publications

People are at the center of the most complex challenges facing today's municipalities around the world. Economic development, homelessness, healthcare, racial equity, and many other issues are directly related to the humans in the city. Meanwhile, technology continues to provide new resources and opportunities. Smart Cities efforts often attempt to leverage technology to solve the human challenges, however the efforts can fall short. The INCOSE Smart Cities Initiative has developed an approach to focus on the humans in the city and identify solutions to best support their needs.

We propose a human-centric model to help cities make decisions with human needs in focus. This model helps identify and classify technological and other investments with the greatest positive impact for the residents. This document proposes a new framework, a definition of a smart city, and human-centric metrics to consider for evaluating a smart city.

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A better world through a systems approach

AUTHOR NAME | AUTHOR NAME | AUTHOR NAME

Smart Cities Initiative

INCOSE

International Council on Systems Engineering

A better world through a systems approach

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INCOSE Smart City Definition provides evaluation and comparison

A smart city is capable of

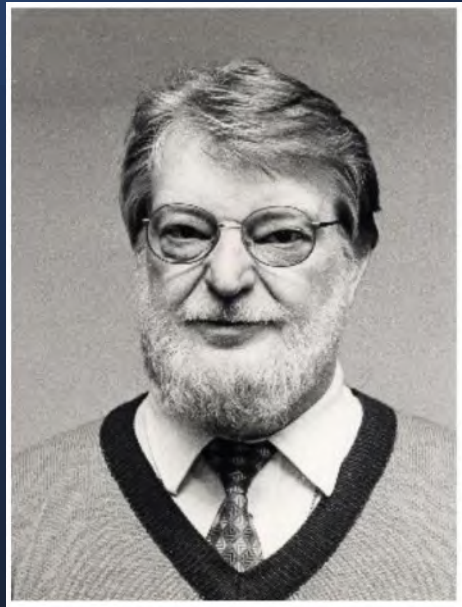
identifying its problems and

mitigating root causes

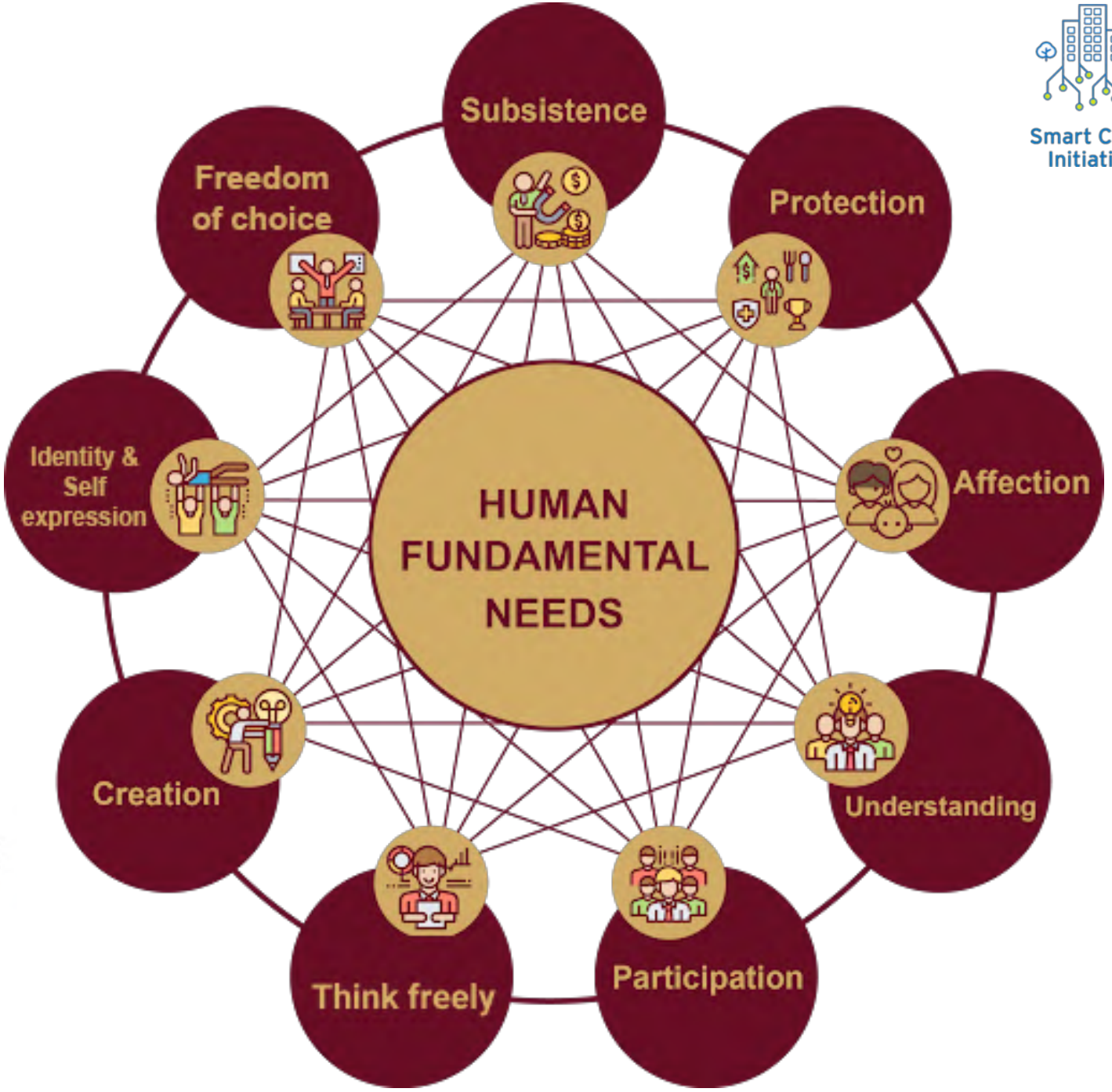
by generating and processing

engineered quality data in a continuous and inclusive manner.

Human Fundamental needs are the basis for a Smart City's goal



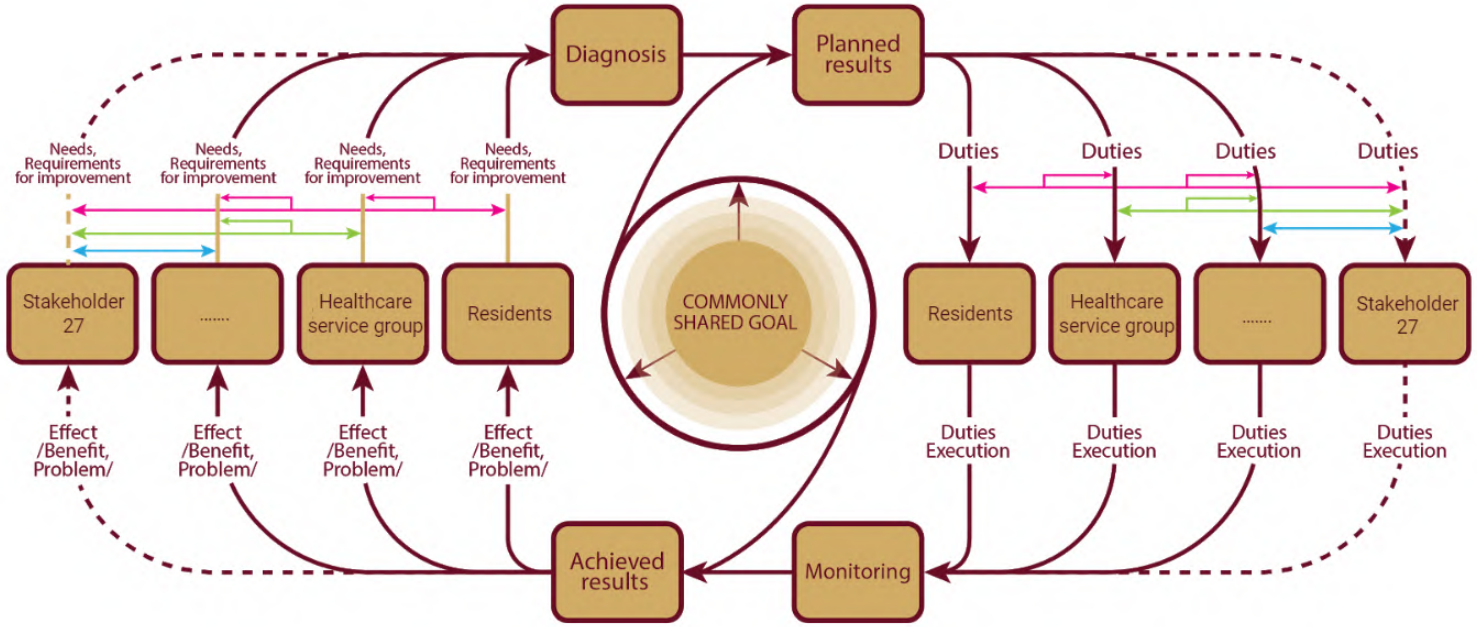
Economist
Artur Manfred Max Neef */1932-2019/*



Smart Cities Initiative

Smart Cities Initiative

The INCOSE-TUS Reference Model is a robust, tailorable, and systematic way to view and evaluate a smart city as an integrated complex social system



SCI Team Focus Areas

Framework & demonstration city

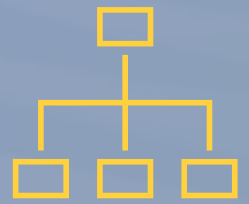
Human centric perspective
City goals – top level

Jennifer Russell + TUSS

IEC – INCOSE Smart City Reference Architecture

UAF modeling collaboration

Rael Kopace



Smart City Use Cases

Solution Architectures

Matthew Hause

Smart Cities Reference Architecture

SCRA Level 1 Capability Map (example)

IEC Collaboration

7.27.3 Smart Cities example

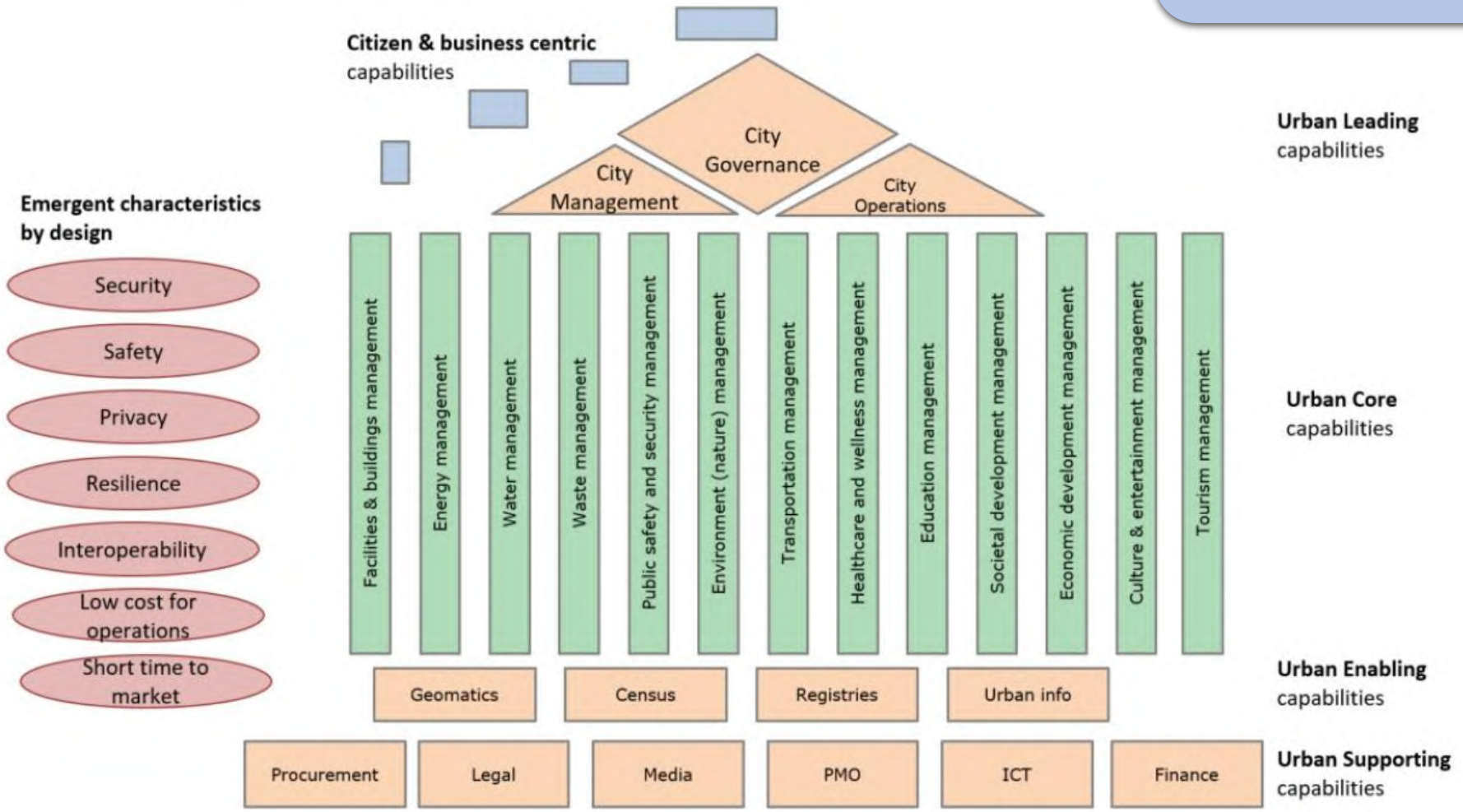
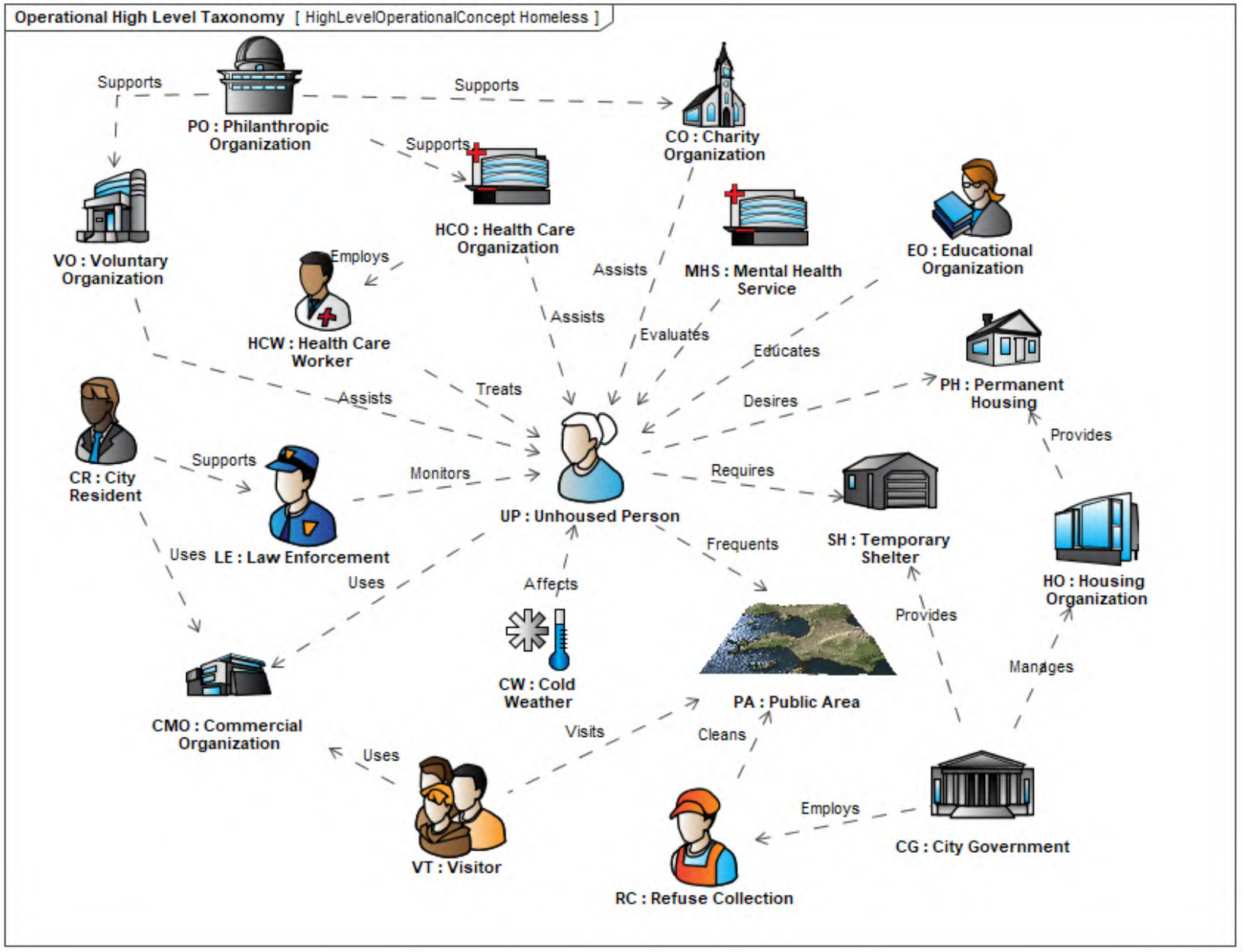


Figure 31 – Potential SCRA level 1 reference capability map

INCOSE

Autoville Unhoused Person Concept Diagram

- Unhoused people have interactions with multiple organizations and systems in Autoville.
- This helps to understand the positive and negative effects that homeless people have on city elements, and vice versa.
- Understanding this will help to frame solutions.



Questions?

Smart Cities Initiative

INCOSE:

The global professional association for systems engineers

International Council on Systems Engineering

A better world through a systems approach

INCOSE

Smart Cities

Value Proposition

DEFINE THE PROBLEMSPACE FIRST

TOOLS TO UNDERSTAND THE WHY FIRST

PRIORITIZATION OF RESSOURCES

FRAMEWORK TO DEFINE THEIR (CITY) GOAL

PROVIDE A TOOLSET THAT SUPPORTS THE DECISION MAKERS / RESPONSIBLES

PROVIDE A UNBIASED FRAMEWORK (VOLUNTEER ORGANISATION / NON PROFIT)

Out of Scope : Implementation

GOVERNANCE MODEL

A framework that gives you a way to understand & measure a City's situation.

Does not set the goals for the city

<-----

BARRIER / Challenge:
A city can't serve everyone's needs.
Spending on things people don't want / need

how does smart city demonstrate city is being a good steward of tax payer $

on resilience
Justify broader margin to be included in design @ beginning

Target Groups

Mayor

global professionals societies

Educational Institutions

Non- profits Foundations

Municipalities

municipalities city planners

Council of mayors

Leaders of critical verticals (power, water, comm, transport, emergency ..

Messages

SUPPORT IDENTIFYING THE SYSTEM PROBLEM

HELP / SUPPORT PRIORITIZE THE PRIORITIES

Mayors want to find next step forward to be best at ...
"Smartness"

For mayors + elected Officials:
Empower to quantify how performing

For mayors + elected officials
Leverage competition
Need / want headlines

Cities --> Communities?

Demonstrate how the framework can support managing variability (e.g. weather)

Holistic views beyond verticals. Interactions between disciplines Interdependencies!!

WHO

Attend Mayors' Meetings

Meetings of associate of critical system verticals e. g. National Association of City Transportation Officials

SIMPLE Diagrams + Pictures

HOW

Organizations
- regional, national
- for mayors, ...

Smart Cities. Feedback on topic and value SE could bring.

- Define the problem space first
- Prioritization of resources
- Tools to understand the why first
- Framework to define their (city) goal
- Provide a toolset that supports the decision makers / responsibles
- Provide an unbiased framework (volunteer organisation / non-profit)
- Governance model
- A framework that gives you a way to understand & measure a city's situation.
- Resilience - Justify broader margin to be included in design in the beginning
- How does smart city demonstrate city is being a good steward of taxpayer $?
- BARRIER / Challenge: A city can't serve everyone's needs. Spending on things people don't want / need
- Out of Scope: Implementation, setting the goals for the city

Smart Cities. The target groups to approach & message

- Mayors
- Global professionals' societies
- Educational Institutions
- Non-profit Foundations
- Municipalities
- City planners
- Council of mayors
- Leaders of critical verticals (power, water, comm, transport, emergency ..

- Support identifying the system problem
- Help / support prioritize the priorities
- Mayors want to find next step forward to be best at ... "Smartness"
- For mayors + elected officials: Empower to quantity how performing
- For mayors + elected officials: Leverage competition - Need / want headlines
- Demonstrate how the framework can support managing variability (e.g. weather)
- Holistic views beyond verticals. Interactions between disciplines - Interdependencies!!

Smart Cities. How – what actions are in place or need to be taken and who will be involved?

HOW?

HOW?

HOW?

HOW?

HOW?

- Attend Mayors' Meetings
- Meetings of associate critical systems verticals, e.g. National Association of City Transportation Officials
- SIMPLE Diagrams + Pictures

- Organizations - regional, national - for mayors, ...

WHO?

WHO?

WHO?

WHO?

WHO?

2023
Annual INCOSE
international workshop
HYBRID EVENT
Torrance, CA, USA
January 28 - 31, 2023

FuSE Implementation

How does Systems Engineering view Innovation?

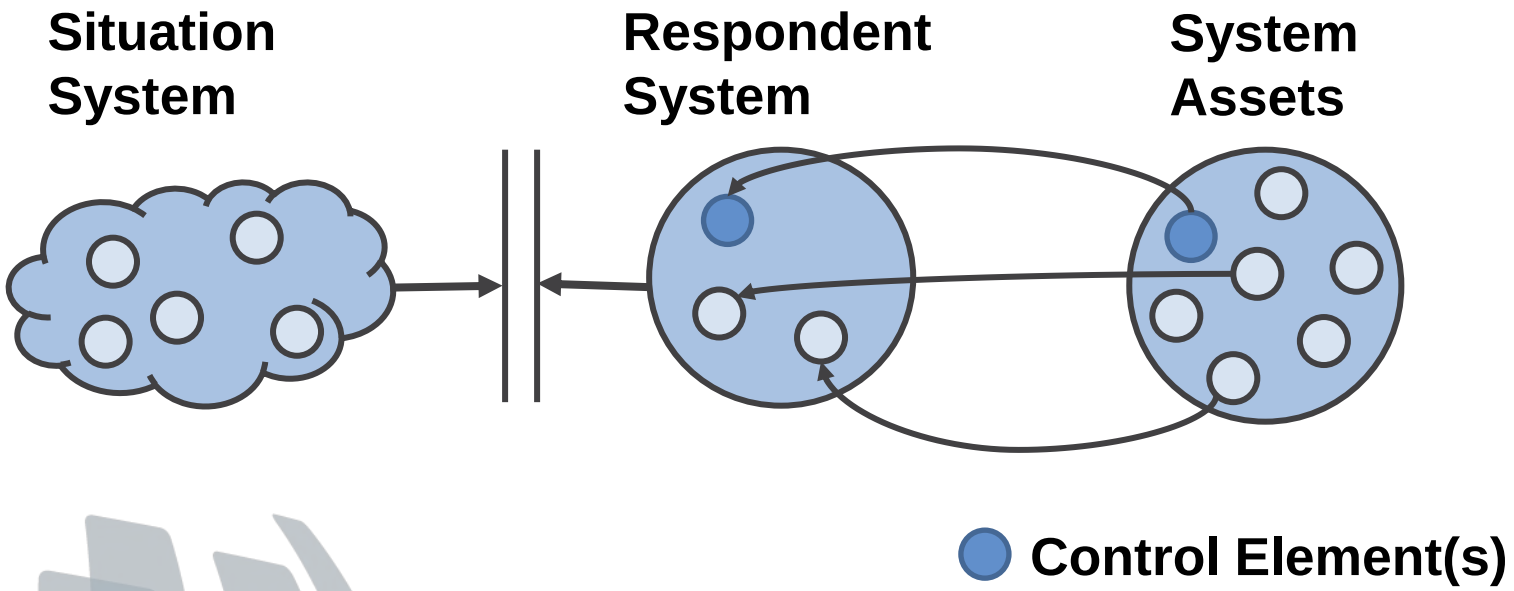
Context of FuSE

- The ability of Systems Engineering to find adoption in new applications and respond to societal situations is not about reinventing SE, it is about converging all the ways of doing SE (by other names) into a universal framework

Definitions:

- Innovation is simply “the introduction of something new” (Webster)
- ISO 56000:2020 Innovation management — Fundamentals and vocabulary defines innovation as "a new or changed entity realizing or redistributing value“.

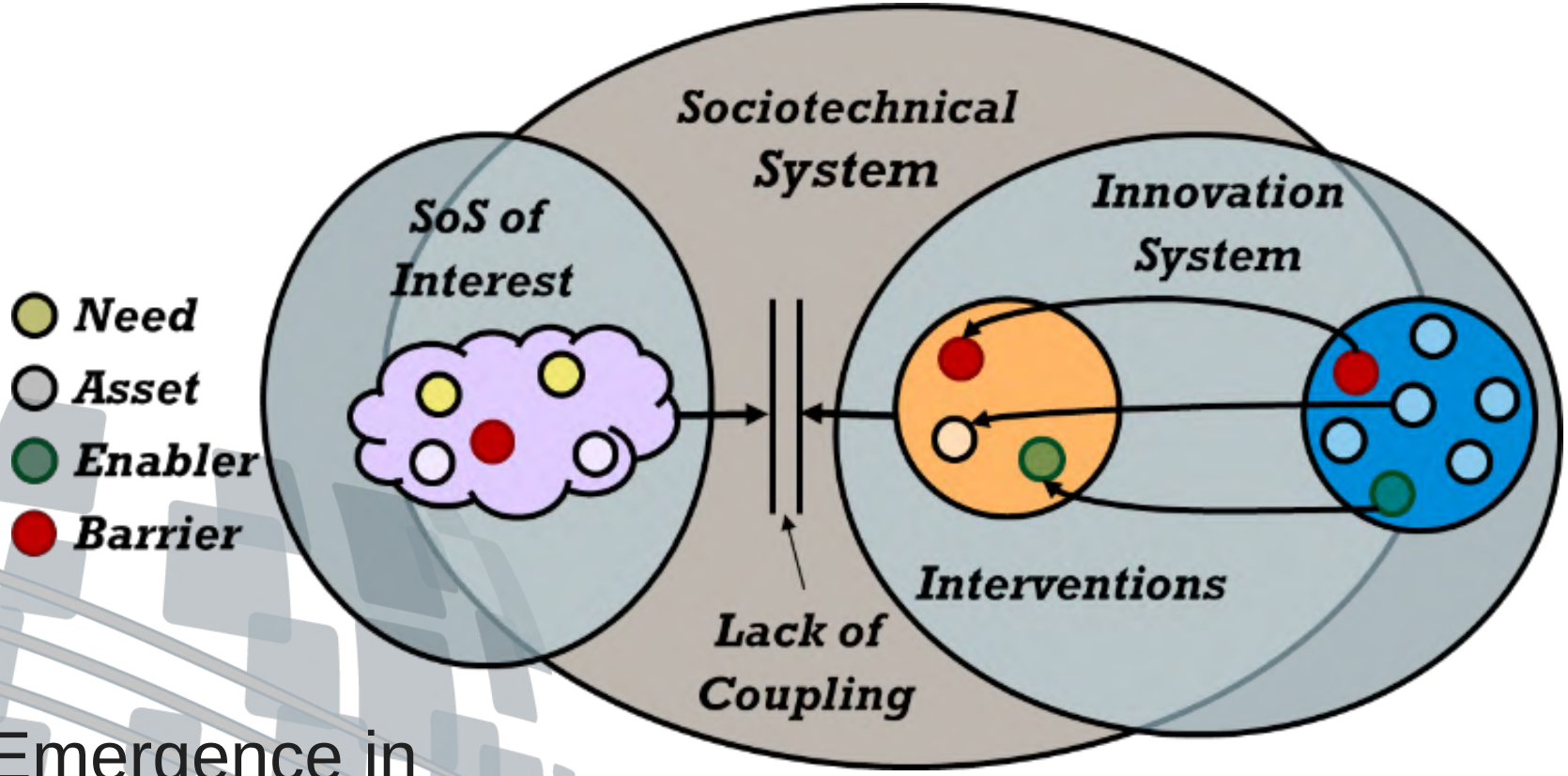
Lawson's Universal Mental Model of Systems



- Situation: problem or issue, event, opportunity
- Assets: available assets to bring to a situation
- Response: temporary system asset formed in response

From: Lawson, Harold, A Journey Through the Systems Landscape, College Publications, 2010

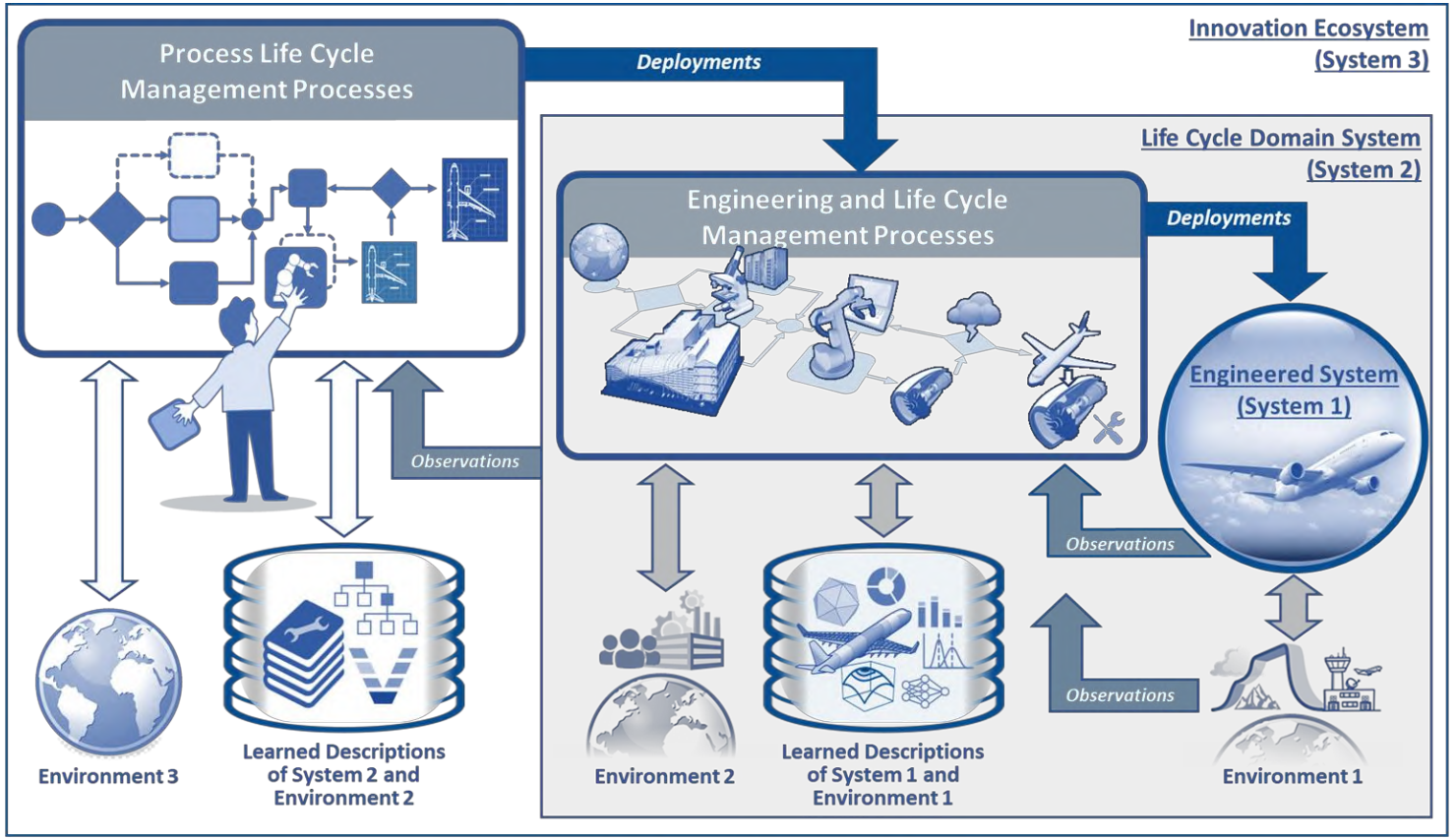
Innovation “Three System Model” (with inspiration from Bud Lawson)



Emergence in Systems-of-Systems

INCOSE Innovation Ecosystem Pattern

AKA--Agile Systems Engineering Life Cycle Management (ASELCM) Pattern



INCOSE ASELCM Level 0 Reference Model

System 3: Process definition, advancement | System 2: Engineering, production, support, science | System 1: Products

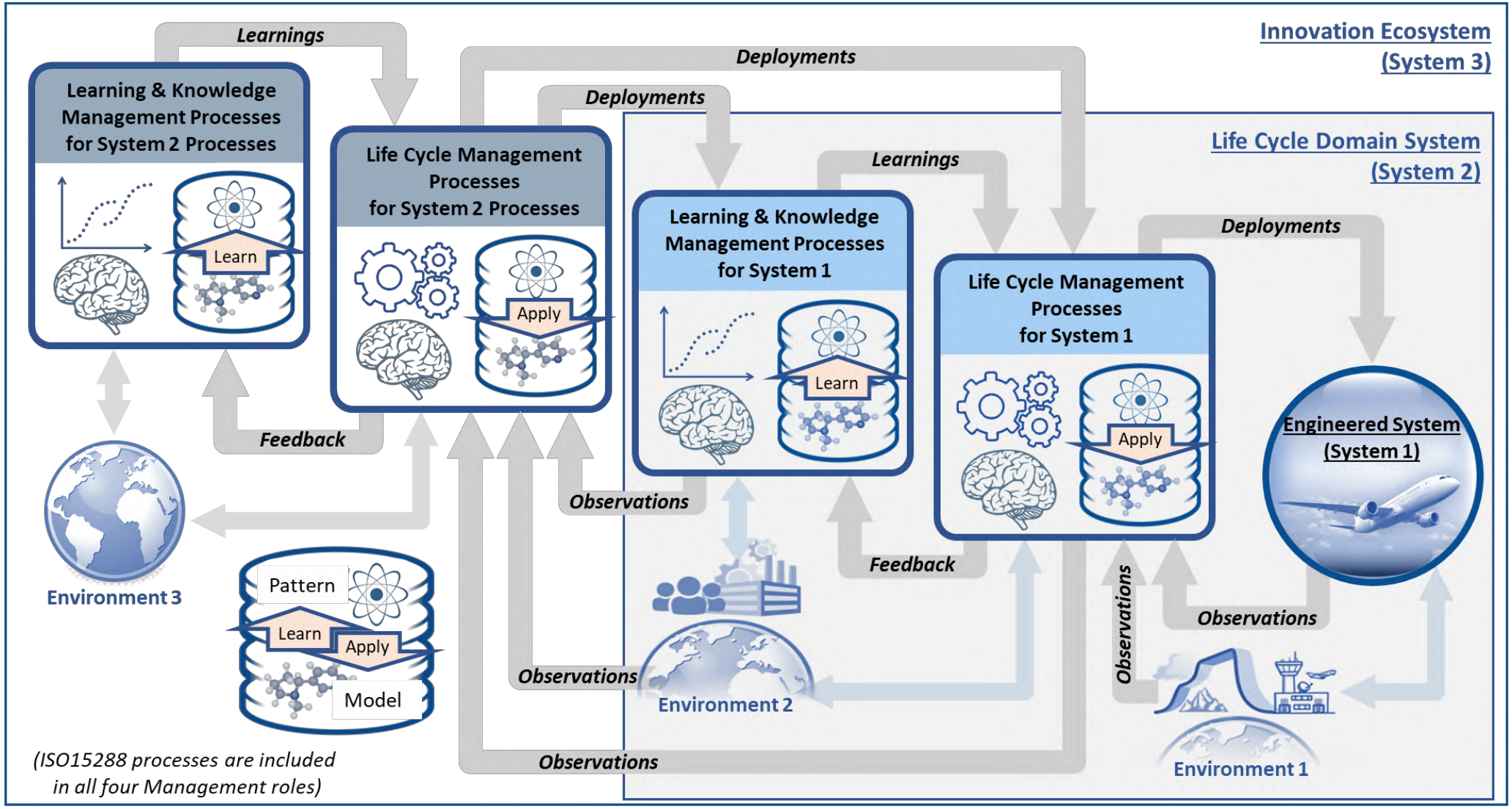
System 1: Engineered System

System 2: Life cycle environment of System 1, including its Life Cycle Management--its Engineering, Production, Distribution, Operations, Sustainment). *Learns about System 1 and its environment*.

System 3: The environment and life cycle management of System 2 (its design, implementation, deployment, support). *Learns about System 2 and its environment*.

INCOSE Innovation Ecosystem Pattern

AKA--Agile Systems Engineering Life Cycle Management (ASELCM) Pattern

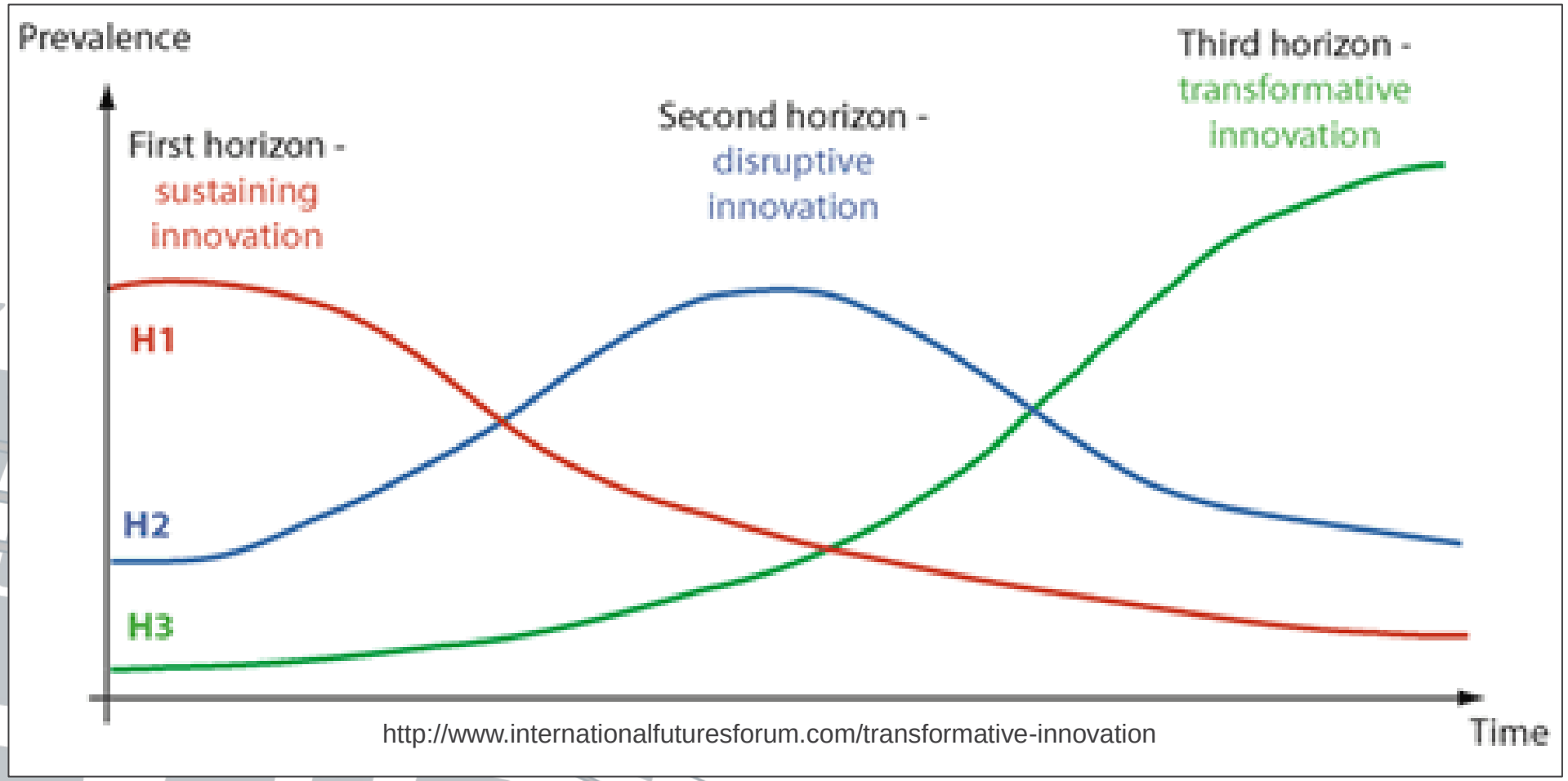


Pattern Description

AIAA Pattern Application

Especially for study of group learning and its effective application

The Three Horizons



http://www.internationalfuturesforum.com/transformative-innovation

Four Questions

1. (Value) What Innovation Systems Models should INCOSE adopt, then push out to potential target organizations?
   - Frameworks, competencies, case studies?
2. (Targets) Who would we target as potential users of our models/ products?
3. (Messaging) What messages (with regard to INCOSE's value) should we bring them?
4. (Resources) Who are the resources inside of and outside of INCOSE?

2023

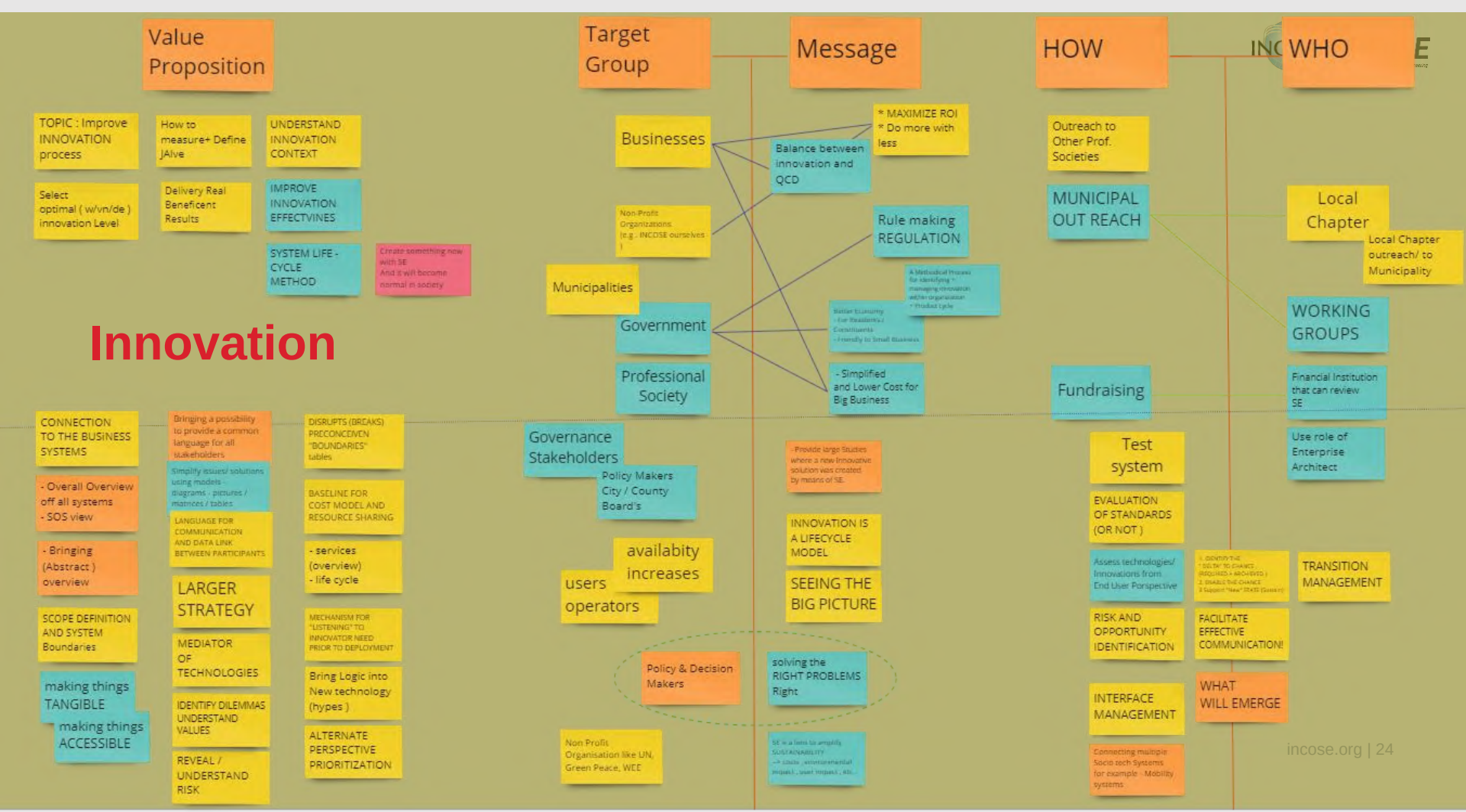
Annual INCOSE international workshop

HYBRID EVENT

Torrance, CA, USA

January 28 - 31, 2023

www.incose.org/IW2023


Value Proposition
Target Group
Message
HOW
WHO
TOPIC : Improve INNOVATION process
How to measure+ Define JAIve
UNDERSTAND INNOVATION CONTEXT
Select optimal (w/vn/de) innovation Level
Delivery Real Beneficent Results
IMPROVE INNOVATION EFFECTVINES
SYSTEM LIFE - CYCLE METHOD
Create something new with SE
And it will become normal in society
Innovation
Businesses
* MAXIMIZE ROI
* Do more with less
Balance between innovation and QCD
Non-Profit Organizations (e.g.- INCOSE ourselves)
Rule making REGULATION
Municipalities
Government
Professional Society
- Simplified and Lower Cost for Big Business
Outreach to Other Prof. Societies
MUNICIPAL OUT REACH
Local Chapter
Local Chapter outreach/ to Municipality
WORKING GROUPS
Fundraising
Financial Institution that can review SE
Use role of Enterprise Architect
CONNECTION TO THE BUSINESS SYSTEMS
- Overall Overview off all systems
- SOS view
- Bringing (Abstract) overview
SCOPE DEFINITION AND SYSTEM Boundaries
making things TANGIBLE
making things ACCESSIBLE
Bringing a possibility to provide a common language for all stakeholders
Simplify issues/ solutions using models - diagrams - pictures / matrices / tables
LANGUAGE FOR COMMUNICATION AND DATA LINK BETWEEN PARTICIPANTS
LARGER STRATEGY
MEDIATOR OF TECHNOLOGIES
IDENTIFY DILEMMAS UNDERSTAND VALUES
REVEAL / UNDERSTAND RISK
DISRUPTS (BREAKS) PRECONCEIVEN "BOUNDARIES" tables
BASELINE FOR COST MODEL AND RESOURCE SHARING
- services (overview)
- life cycle
MECHANISM FOR "LISTENING" TO INNOVATOR NEED PRIOR TO DEPLOYMENT
Bring Logic into New technology (hypes)
ALTERNATE PERSPECTIVE PRIORITIZATION
Governance Stakeholders
Policy Makers City / County Board's
availabity increases
users
operators
Policy & Decision Makers
Non Profit Organisation like UN, Green Peace, WEF
- Provide large Studies where a new Innovative solution was created by means of SE.
INNOVATION IS A LIFECYCLE MODEL
SEEING THE BIG PICTURE
solving the RIGHT PROBLEMS Right
Test system
EVALUATION OF STANDARDS (OR NOT)
Assess technologies/ Innovations from End User Perspective
RISK AND OPPORTUNITY IDENTIFICATION
INTERFACE MANAGEMENT
Connecting multiple Socio tech Systems for example - Mobility systems
FACILITATE EFFECTIVE COMMUNICATION!
WHAT WILL EMERGE
TRANSITION MANAGEMENT

Innovation. Feedback on topic and value SE could bring.

- How to measure
- Understand innovation context
- Improve innovation effectiveness
- Select optimal innovation level
- Delivery real beneficent results
- System life-cycle method
- Create something new with SE and it will become normal in society
- Connection to the business systems
- Bringing a possibility to provide a common language for all stakeholders
- Disrupts (breaks) preconceived "boundaries"
- Simplify issues/ solutions using models - diagrams - pictures / matrices / tables
- Overall overview off all systems - SOS view
- Baseline for cost model and resource sharing

Innovation. Feedback on topic and value SE could bring.

- Language for communication and data link between participants
- Bringing (abstract) overview
- Services (overview) - life cycle
- Larger strategy
- Mechanism for "listening" to innovator need prior to deployment
- Scope definition and system boundaries
- Mediator of technologies
- Bring logic into new technology (hypes)
- Making things TANGIBLE
- Identify dilemmas, understand values
- Making things ACCESSIBLE
- Alternate perspective prioritization
- Reveal / understand risk

Innovation. The target groups to approach & message

- Businesses
- Non-Profit Organizations (e.g. INCOSE ourselves)
- Municipalities, Government
- Professional Society
- Policy Makers City / County Board's
- Policy & Decision Makers
- Users / operators
- Non-Profit Organization like UN, Green Peace, WEE

- Maximize ROI - Do more with less
- Balance between innovation and QCD
- Rulemaking regulation
- A Methodical Process for identifying + managing innovation within organization + Product cycle
- Better Economy - For Residents / Constituents - Friendly to Small Business
- Simplified and Lower Cost for Big Business
- Provide large Studies where a new Innovative solution was created by means of SE.'
- Innovation is a lifecycle model
- Seeing the big picture
- Solving the RIGHT PROBLEMS right
- SE is a lens to amplify SUSTAINABILITY --> costs , environmental impact , user impact , etc .

Innovation. How – what actions are in place or need to be taken and who will be involved?

HOW?

HOW?

HOW?

HOW?

HOW?

- Outreach to other prof. Societies
- Municipal outreach
- Fundraising
- Test system
- Evaluation of standards
- Assess technologies/ innovations from end user perspective
- 1. Identify the " delta" to chance, (required + archieved); 2. Enable the chance; 3. support "new state (sustain)
- Risk and opportunity identification
- Facilitate effective communication!
- What will emerge
- Interface management
- Connecting multiple socio-tech systems for example - mobility systems

- Local chapter
- Local chapter outreach/ to municipality
- Working groups
- Financial institution that can review SE
- Use role of enterprise architect
- Transition management

WHO?

WHO?

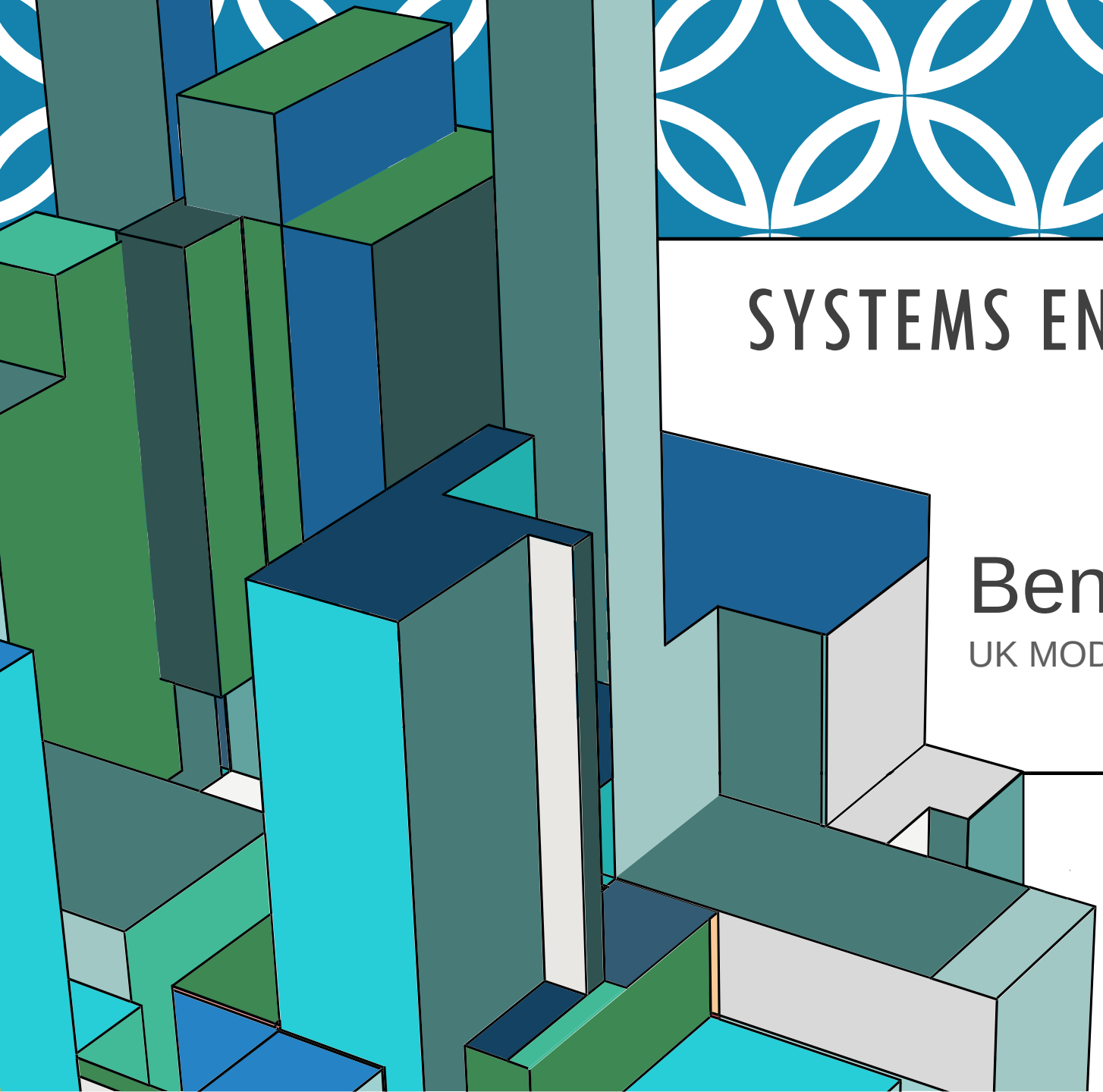
WHO?

WHO?

WHO?

Monday January 30th Session

1) **Asset Management**
2) **Grand Challenges**



SYSTEMS ENGINEERING & ASSET MANAGEMENT

Ben Mogridge
UK MOD

PRESENTATION COVERAGE

What is Asset Management

Where can we connect INCOSE with Asset Management

Aligning SE to AM

BEN'S BACKGROUND

- DE&S ITS SE Asset Management Domain Lead
- Leading the technical implementation of AM in multiple areas of UK MOD
- AMS/1 Deputy Chair
- TC251 Asset Management Leadership Committee
- Developing and supporting SSGs on behalf of the IAM

Ben Mogridge MSc CEng MIET MINCOSE
Asset Management Domain Lead
Internal Technical Support Systems Engineering Consultant
Engineering Group
Abbey Wood South, BS34 8JH
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ASSET MANAGEMENT – WHAT IS IT AND WHY?

Asset Management - “the coordinated activity of an organization to realise value from assets”
(Clause 3.3.1 of ISO 55000).

“Asset management is more than doing things to assets - it is about using assets to deliver value and achieve the organisation’s business objectives. It also brings a different approach and way of thinking and a transformation of organisational alignment and culture. Each organisation has to determine what it considers value to be and choose how to manage its assets to derive best total value.”

(The Institute of Asset Management - An Anatomy of Asset Management Ver.3 (2015, December) - p8)

The Institute of Asset Management https://theiam.org/

“What’s going to happen is equally as important as what is happening today…”

“We must balance our duty to commission our Assets as swiftly as reasonably practicable with the need to ensure through-life reliability and availability ”

ASSET MANAGEMENT – WHAT IS IT AND WHY?

Asset management is a strategic discipline which gives rigour and accountability to the way organisations decide:

- how, where and in what to invest
- what assets are most critical
- what risks need to be managed
- what demands must be served
- what needs to be known
- how this knowledge should be captured and disseminated how organisations should be structured and led
- what types and teams of people they need how activities should be carried out
- how actual performance should be measured
- that improvements are needed.

OVERALL GOALS OF AM

- spending where necessary
- leaving assets in the same state as you would wish to find them managing risks not resources
- thinking in whole systems not their parts
- applying a whole-life perspective
- everyone reading from the same page
- stakeholders understanding the choices made.

UN SDG'S

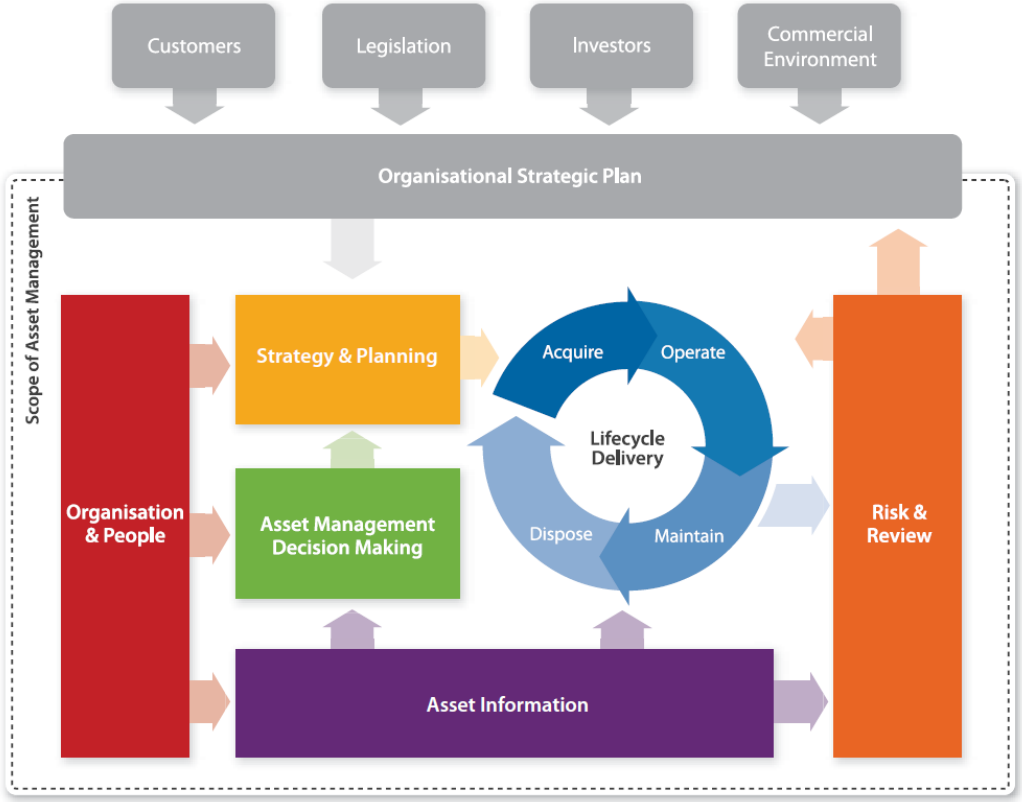
ISO/TC 251 sees its work contributing specifically to the SDG's under categories: 6, 7, 9, and 11

ASSET MANAGEMENT & MANAGING ASSETS – THEY'RE DIFFERENT!

	Managing Assets	Asset Management
Colleague Focus	Asset data, location and condition assessment	Information supported decision making (i.e. with strategic context and related to customer need)
	Current KPIs	Strategies to select and exploit assets over the lifecycles to support business aims
	Department budgets	Collaboration across departments to optimise resources allocated and activities
Stakeholder Focus	Current costs	Triple bottom line and value
	Current performance	Clarity of purpose of the organisation
	Response to failure/ maintain function	Focus on impact of activities of an organisation's objectives
Seniour Focus	Short term gain and loss	Long term value for the organisation
	Departmental/individual performance	Developing competence and capability across workforce
	Savings, especially OPEX	Business risks understood and mitigated
Supplier Focus	Short term contracts and performance	Long term contracts and/or partnering relationships in support of client value and objectives
	Service level agreements focussed on contract specifications	Understanding client strategy and needs in 5-10 years

Table adapted from ISO/TC 251 - Managing Assets in the context of Asset Management – First Edition dated May 2017

ASSET MANAGEMENT SUBJECT GROUPS



ASSET MANAGEMENT PUBLICATIONS

WHERE CAN WE CONNECT SE TO AM

2 Institutions…

ISO 55000 series

ISO 15288

2 ISO's

Common interests?

ALIGNMENT

Asset Management

"enable an organization to achieve its objectives through the effective and efficient management of its assets. The application of an asset management system provides assurance that those objectives can be achieved consistently and sustainably over time"

ISO 55000

System Engineering

"a structured and auditable approach to identifying requirements, managing interfaces and controlling risks throughout the project lifecycle"

Z1 - Guide

The Institute of Asset Management

INCOSE

ALIGNMENT

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System Engineering

"a structured and auditable approach to identifying requirements, managing interfaces and controlling risks throughout the project lifecycle"

Z1 - Guide

The Institute of Asset Management

INCOSE

ALIGNMENT

Asset

"An item, thing or entity that has potential or actual value to an organization. The value will vary between different organizations and their stakeholders, and can be tangible or intangible, financial or non-financial."

ISO 55000

System

"Combination of interacting elements organized to achieve one or more stated purposes"

ISO 15288

The Institute of Asset Management

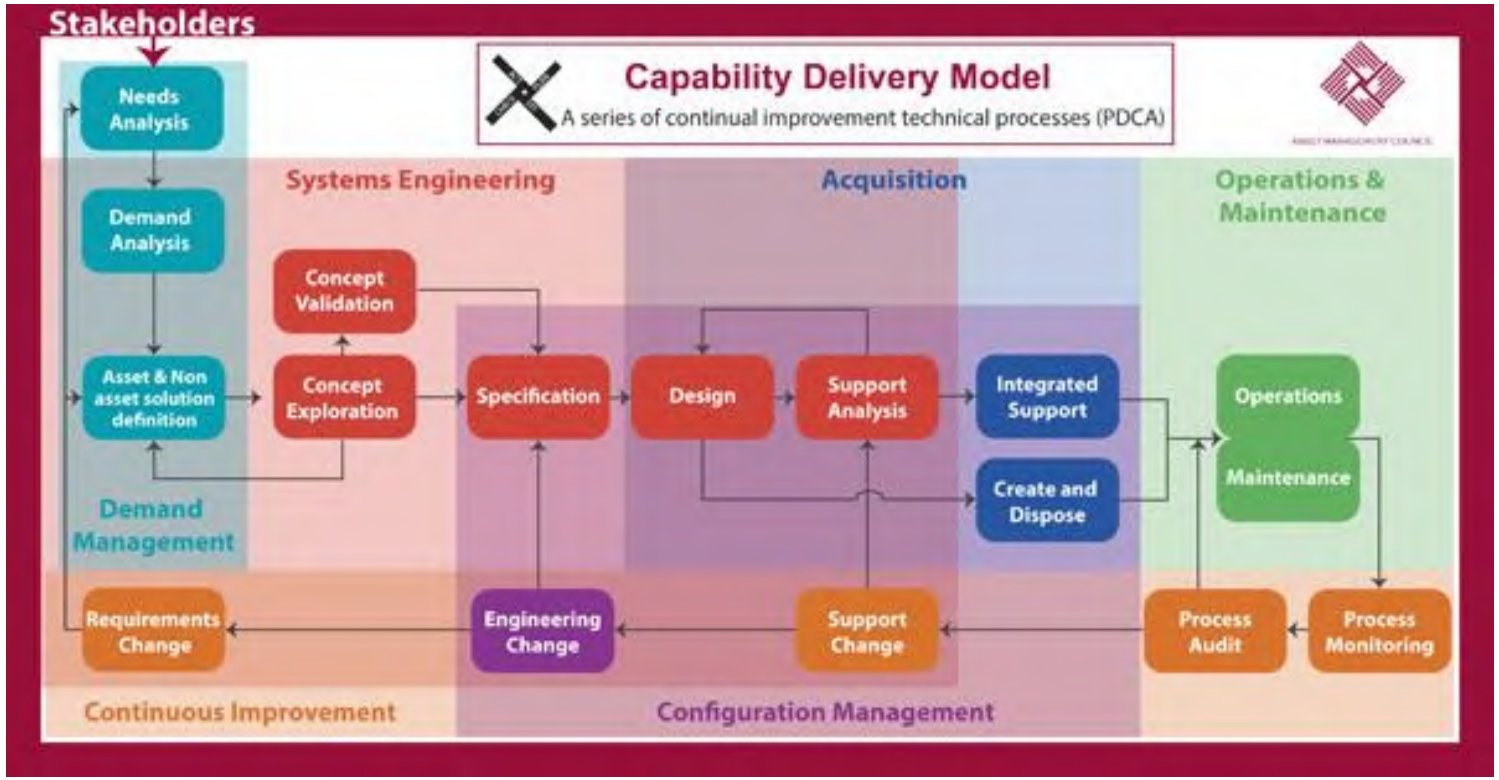
INCOSE

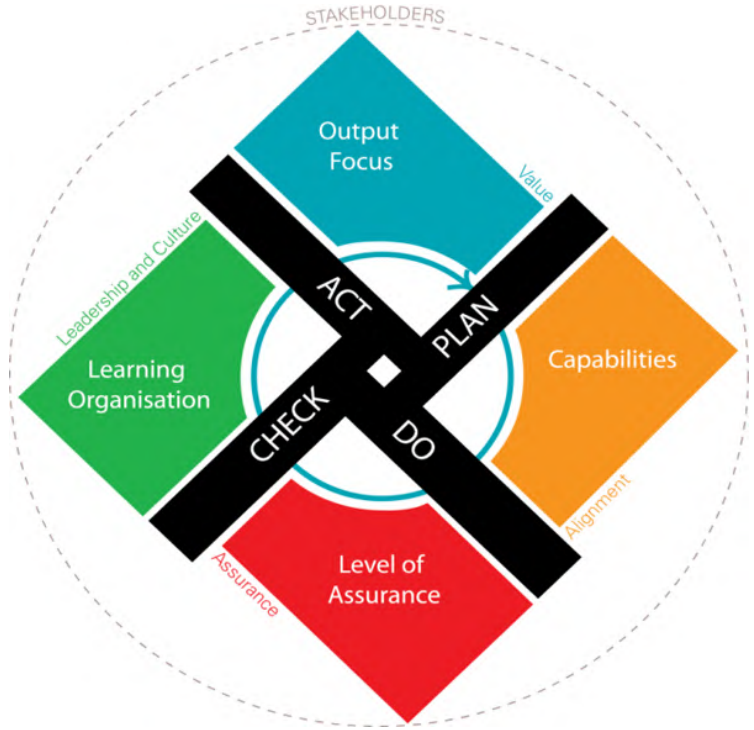
ASSET MANAGEMENT COUNCIL

- Technical society of Engineers Australia
- Founding member of Global Forum on Maintenance and Asset Management (GFMAM)

ASSET MANAGEMENT COUNCIL

Explicitly advises organizations to leverage Systems Engineering practices.





https://www.amcouncil.com.au/knowledge/asset-management-body-of-knowledge-ambok/ambok-models.html

LIFECYCLE EMPHASIS + OPTIMIZING TRADE-OFFS

The goal of asset lifecycle management is to achieve an optimal balance between risk, cost and performance.

Where SE practitioners can build bridges with AM:

- Balance lower capital costs with longer operating life costs (trade-offs)
- Strategies for end of life (retire/replace/renew); with technology migration and procurement strategies
- Provide tools to assess trade-offs to optimize systems performance, cost and risk

QUESTIONS?


Value Proposition
Target Groups
Messages
WHO
HOW
Asset Management is the what, SE is how !
asset = system
Thinking forward
standardization / uniform
Harmonize SE and Asset Management Processes and Standards
Looker to the bigger picture
predict failure of assets systems
Achiving "Line of Sight" through an org with SE, (People understand their value to the org)
IAM & 150
operators/ owners asset
owners /operators of public infrastructures
Communicate :
- Value
- Interest
- seeking alignment
Gain MoU between INCOSE and each AM Group
Best practices
Asset Management

Asset Management. Feedback on topic and value SE could bring.

- Harmonize SE and Asset Management Processes and Standards
- Asset Management is the what, SE is how !
- Value : integrated (SE/AM) methodology to apply scientific principles to support decision making
- asset = system
- Looker to the bigger picture
- Achieving "Line of Sight" through an org with SE, (People understand their value to the org)
- Thinking forward
- standardization / uniform
- predict failure of assets / systems
- Share methods for analyzing systems/assets for achieving missions in a cost-effective long-term manner
- long term aspects of AM & SE counters "Accountability Fade" in big infrastructure programs
- Define digital thread requirements: - Eng - Conflg. - Sustain - Finance - Procure

Asset Management. The target groups to approach & message

- IAM & 150
- asset owners
- owners /operators of public infrastructures

- Communicate :
  - Value
  - Interest
  - seeking alignment

Asset Management. How – what actions are in place or need to betaken and who will be involved?.

HOW?
HOW?
HOW?
HOW?
HOW?

- Gain MoU between INCOSE and each AM Group
- Working groups to harmonize languages - Use cases on how SE /AM work together
- Best practices

- INCOSE - Monthly Meetings:
  - IWG
  - TWG
  - CIPR
- Task force to organize INCOSE resources and define products
- Task force also to manage outreach

WHO?
WHO?
WHO?
WHO?
WHO?

2023 Annual INCOSE international workshop

HYBRID EVENT

Torrance, CA, USA

January 28 - 31, 2023

Michael Watson - SE Application Extensions

Monday 30 Jan 2023, 08:00-10:00 PST

FuSE: Systems Engineering Application Extensions

Topic: Grand Challenges

Systems Engineering Applications – Grand Challenges

- INCOSE Systems Engineering Vision 2035 sets the framework for Grand Challenges in Systems Engineering Applications
  - *SYSTEMS ENGINEERING AIMS TO ENSURE THE PIECES WORK TOGETHER TO ACHIEVE THE OBJECTIVES OF THE WHOLE*
- As society benefits from advancements in system capabilities, consumers and users continue to expect more from these systems.
  - This includes expectations that systems are more capable, dependable, sustainable, and affordable.
  - They expect systems to be more socially acceptable by considering their impact on society and the environment.
  - Users also expect systems to be more autonomous, enabling them to seamlessly interact, and understand and respond to their requests.

INCOSE Systems Engineering Vision 2035 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.

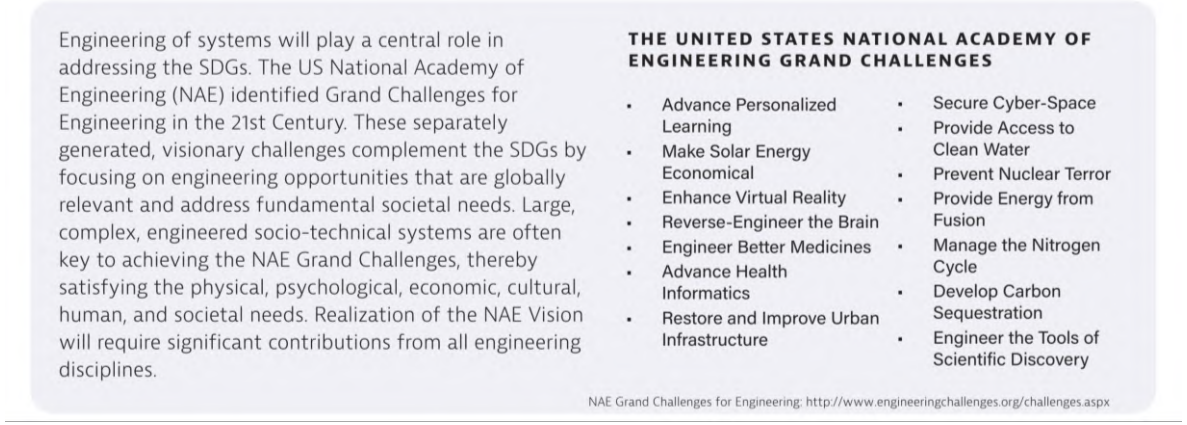
Social Grand Challenges from International Organizations

- The United Nations Sustainable Development Goals (SDG) focus on **Social Grand Challenges**
- Systems Engineering provides system solutions to support identified social needs
  - Require a system understanding and system engineering approach, in particular:
    - SDG 1 - Eliminate Poverty
    - SDG 2 - Eliminate Hunger (food supply chain)
    - SDG 3 - Good Health and Well-Being (medical systems)
    - SDG 6 - Clean Water and Sanitation Systems
    - SDG 7 - Affordable and Clean Energy
    - SDG 8 - Economic Growth (products and manufacturing)
    - SDG 9 - Industry, Innovation, and Infrastructure
    - SDG 12 - Responsible Consumption and Production
    - SDG 11 - Sustainable Cities and Communities
    - SDG 13 - Climate Action
    - SDG 14 - Aquatic Systems
    - SDG 15 - Agricultural Systems

United Nations Sustainable Development Goals: https://sdgs.un.org/goals

Grand Engineering Challenges from National Organizations

- **Engineering Grand Challenges** focus on engineering solutions which have a social benefit
- The United States National Academy of Engineering has established a set of **Engineering Grand Challenges**
  1. Advance Personalized Learning
  2. Make Solar Energy Economical
  3. Enhance Virtual Reality
  4. Reverse-Engineer the Brain
  5. Engineer Better Medicines
  6. Advance Health Informatics
  7. Restore and Improve Urban Infrastructure
  8. Secure Cyber-Space
  9. Provide Access to Clean Water
  10. Prevent Nuclear Terror
  11. Provide Energy from Fusion
  12. Manage the Nitrogen Cycle
  13. Develop Carbon Sequestration
  14. Engineer the Tools of Scientific Discovery



Other Grand Challenges

- **Societal and Engineering Grand Challenges**
  - Society 5.0
    - Reinforces the role and the contribution of industry to society
    - It places the wellbeing of the worker at the centre of the production process
    - Uses new technologies to provide prosperity beyond jobs and growth
    - Focus on sustainable, human-centric and resilient European industry
    - System solution needs in the areas of
      - Digital Transformation
      - Integration of Cyber-Space physical life
      - Green Transformation
  - Biological Economics
  - Establish sustained human presence on the Moon and Mars
  - Self Driving Automobiles
  - Electric air transportation

Society 5.0 explicitly looks to a future of socio-cyber-physical systems. That is, a human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyber-space and physical space. In Society 5.0, data from sensors in physical space are accumulated in cyber-space, analyzed by artificial intelligence (AI), and results are fed back to humans in physical space in various forms.

Together these trends respond to the sustainable goals of the UN, the recommendations of the World Economic Forum, and the changing values of the world's population, especially of younger generations.

SOCIETY 5.0

Japan has established Society 5.0 as a national strategic policy that will shape national priorities and investments. Society 5.0 is envisioned as society's next major transformation beyond the information age.

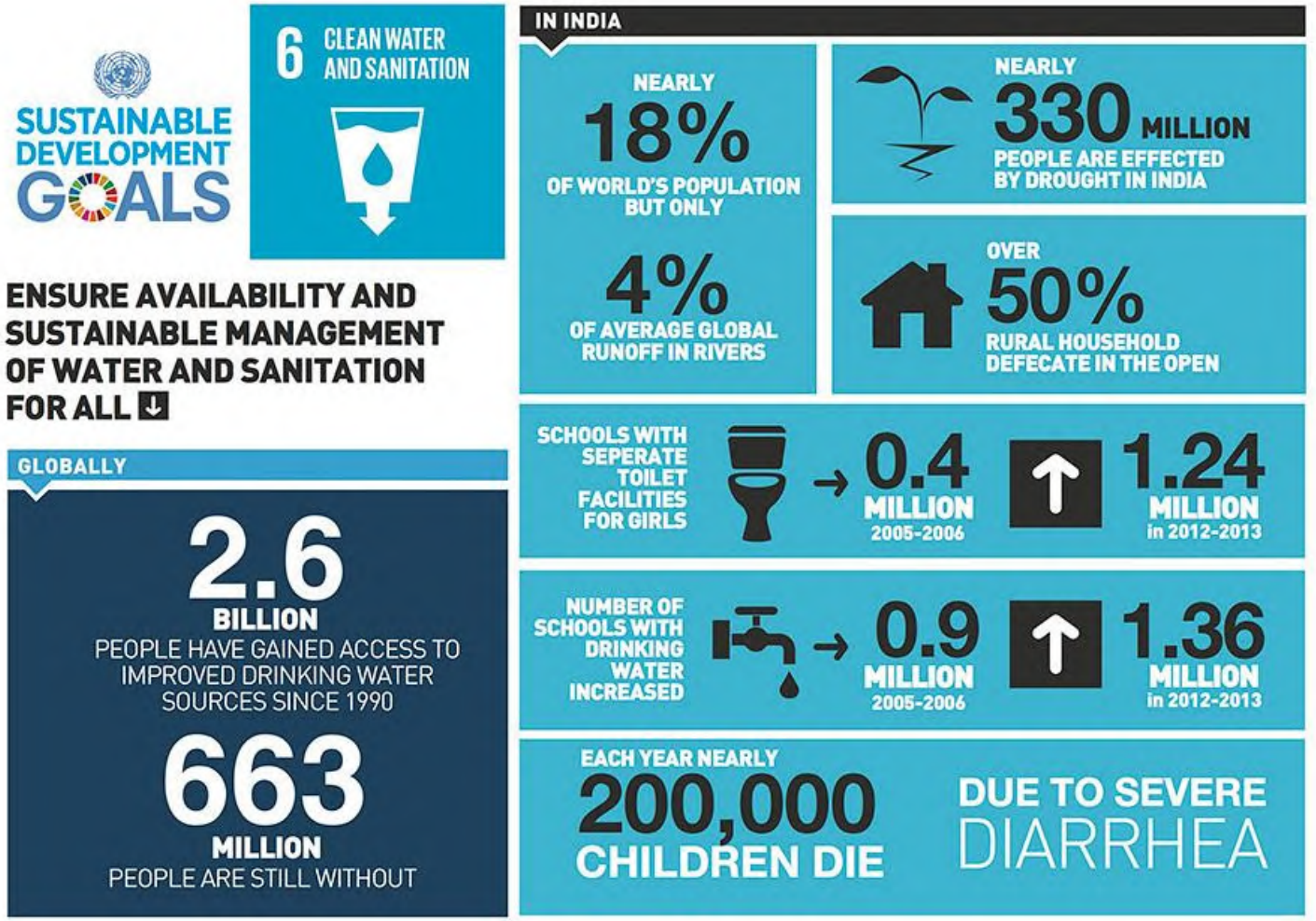
"Society 5.0 will be an Imagination Society, where digital transformation combines with the creativity of diverse people to bring about "problem solving" and "value creation" that lead us to sustainable development. It is a concept that can contribute to the achievement of the Sustainable Development Goals (SDGs) adopted by the United Nations."

– Nakanishi, H., World Economic Forum Annual Meeting, 2019

Society 5.0: https://www8.cao.go.jp/cstp/english/society5_0/index.html

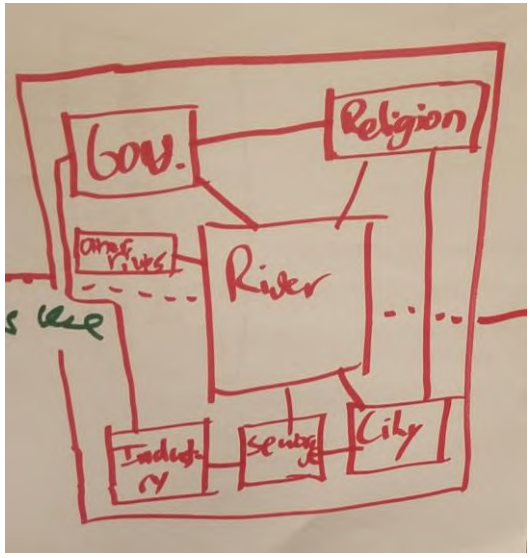
IS 2019 Practitioners Challenge
Clean Water, the Ganges River

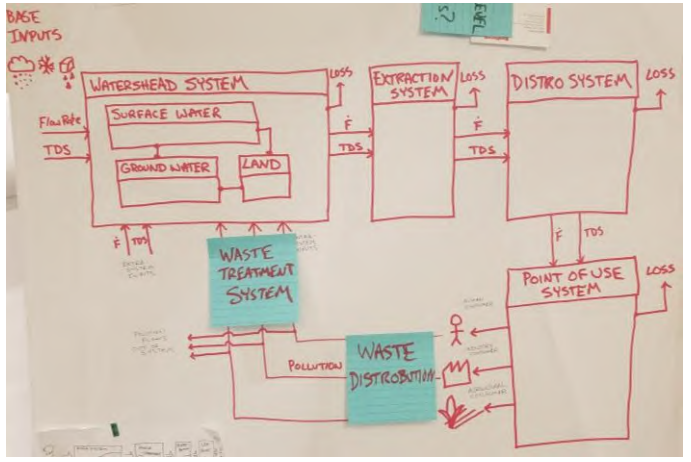
The ultimate aim….to close the gap between water demand and supply by the year 2030

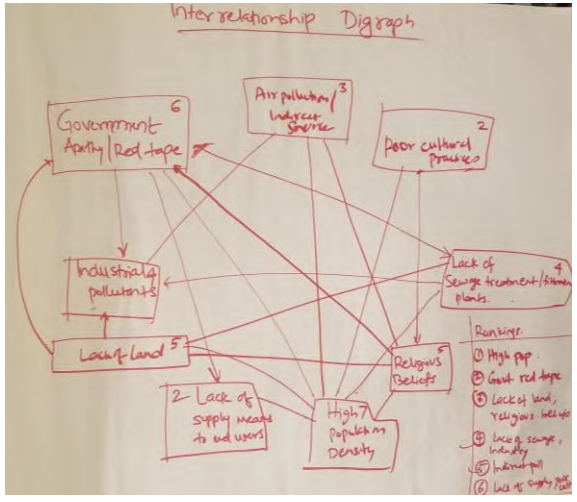


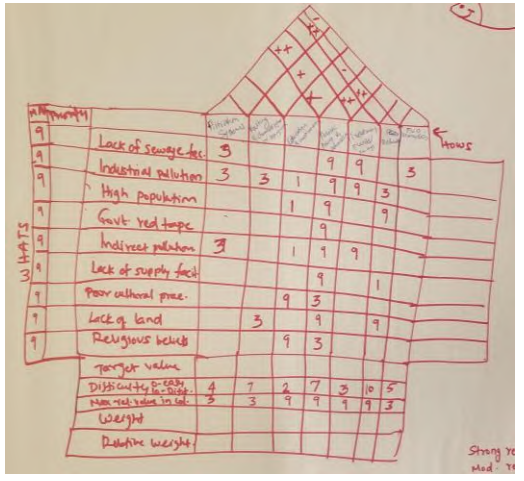
Clean Water and Sanitation Case Study

- Understood problem
  - Met with Subject Matter Experts (SMEs)
    - Clean Water and Sustainability
    - Socio-Technical Framework
    - Biomimicry
- Defined System Solution
  - Identified layered approach (SOS, Govt, Individuals)
  - Ontology
  - System Definition
  - Functional analysis of system elements
  - etc…
- Planned Next Steps
  - Communicate
    - Deliver work (Connect)
    - Write paper for Insight
  - Collaborate with those working problem









Working Sessions

- Select a Grand Challenge Topic with the group at your table
- Discuss how systems engineering can contribute to solutions to the challenge
- Discuss how INCOSE can foster solutions for the challenge, *including:*
  - *The target group(s) and the message to be delivered*
  - *Resource within and external to INCOSE that we should engage*


Value Proposition
Target Groups
Messages
WHO
HOW
Modelling of complex Systems and Interactions
Strengthen the Systems Thinking & integration of concerns
SE could bring methodologies with better rigor to support sustainable solutions
Design Space exploration and trade-off studies
SE could bring better choice of solutions and ways to select "best" solution
Systems dynamics modeling
Decision Support tools
ICC / State / courts local building codes
European Commission
Individual Goverments
Insurance Companies
INSIGHT AT A BROADER SCALE
We can help you understand your problems
We can help you solve your problems
Set up an initiative cross - WG
Identify Who within INCOSE has connections to relevant organizations
American Planning Association
American Urban Planning Association
NGOS
charities
Greenpeace
Carbon Leadership Foundation
we can bring systems engineering rigor
U. N. organisations
Grand Challenges

Grand Challenges. Feedback on topic and value SE could bring.

- Modelling of complex Systems and Interactions
- Strengthen the Systems Thinking & integration of concerns.
- SE could bring methodologies with better rigor to support sustainable solutions
- SE could bring better choice of solutions and ways to select "best" solution
- Design Space exploration and trade-off studies
- INOSE can bring many different engineering domain experts to work on solutions .
- Decision Support tools
- Systems dynamics modeling

Grand Challenges. The target groups to approach & message

- ICC / State / courts local building code
- IPCC informed group of scientist (present @ EMEA AOSEC)
- European Commission
- Individual Governments
- Insurance Companies

- INSIGHT AT A BROADER SCALE
  - We can help you understand your problems
  - We can help you solve your problems

Grand Challenges. How – what actions are in place or need to betaken and who will be involved?.

HOW?

HOW?

HOW?

HOW?

HOW?

- Set up an initiative cross - WG
- Identify Who within INCOSE has connections to relevant organizations

- INCOSE WG:
  - Natural Systems WG
  - Social Systems WG
  - infrastructure WG
  - Smart Cities
  - Safety
- American Planning Association American Urban Planning Association
- NGOs, charities, Greenpeace ...
- Carbon Leadership Foundation we can bring systems engineering rigor
- U. N. organisations

WHO?

WHO?

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WHO?

WHO?

Next Steps

FuSE Targeted Events in 2023

Where to engage

Let's connect.

Or find us on
www.incose.org/fuse

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INCOSE

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FuSE

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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