INCOSE Initiatives, Projects, and Collaboration Opportunities

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IEEE-CS Golden Core,

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Engineering Outreach Program Manager

INCOSE NDIA SE Division Meeting
6 June 2019

Agenda

- INCOSE Organization Overview
- INCOSE Technical Program
- SE Evolution / Future of Systems Engineering
- Digital Engineering and MBSE Focus
- SoS / Interconnected Systems Focus
- SE Professional Development
- INCOSE Events
- Other Opportunities

INCOSE Overview

Who We Are – Vision, Mission, and More

INCOSE Vision
A better world through a systems approach

INCOSE Mission
To address complex societal and technical challenges by enabling, promoting, and advancing Systems Engineering and systems approaches

Values
- Systems Thinking
- Pioneering and Innovation
- Learning and Development
- Respect, Diversity, Collaboration
- Individuals
- Volunteerism

Principles
- Impact
- Partnership
- Holism
- Differentiation
- Volunteers

A Global Organization

**Nearly 18000 Individual members worldwide
70 Chapters & 5 Emerging over 35 Countries**

Corporate Members (CAB/AC)

Individual Members

Chapters/Sectors

CAB/AC Employees, Faculty

Working Groups

Board and Committees

Partner Organizations

Professional Support

Over 112 Corporate + Academic Members

Honeywell, Boeing, Airbus, FAA, BAE, GE, JPL, Lockheed Martin, Medtronic, NASA, Thales, Siemens, United Technologies, Shell, Rockwell Collins, Rolls Royce, MIT, CMU-SIE, General Motors, IBM…
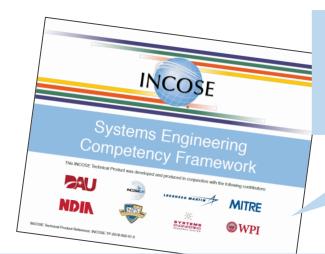
Diversity in CAB Organizations

Many Alliances Across the Globe

Learn more at: www.incose.org

Our Value Streams

portfolio of books, papers, videos, standards, tools, and other tangible high-value outputs created and distributed by INCOSE and/or its alliances

portfolio of offerings by INCOSE and/or its alliances of both in-person and on-line courses to enhance a professional's specific knowledge, skills, and abilities in a topic relevant to systems engineers

Products/

portfolio of conferences, workshops, seminars, and other physical and virtual gatherings offered by INCOSE alone or with its alliances

Mem

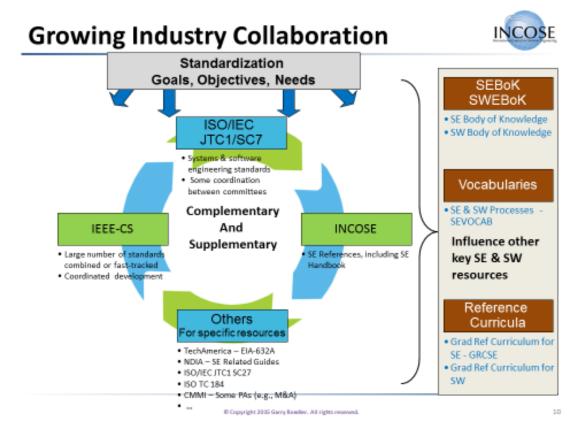portfolio of offerings through which INCOSE confirms a member's competency in systems engineering

portfolio of the aggregated intellectual capital provided by INCOSE members of all types (full, student, associate, corporate, …) and the services through which INCOSE recruits, engages, influences, and retains members

Certification

Our Industry Outreach – Greater Collaboration across Industry on Targeted Objectives

Growing Industry Collaboration

Some of the Industry Associations with which INCOSE Collaborates

- SAE International
- Project Management Institute (PMI)
- Object Management Group (OMG)
- IEEE System, Man, and Cybernetics Society (SMCS)
- IEEE Systems Council
- SoSE Conference
- NAFEMS (the International Association for the Engineering Modelling, Analysis and Simulation)
- Association for Computing Machinery (ACM)
- Military Operations Research Society (MORS)
- Institute for Industrial and Systems Engineering (IISE)
- Practical Software and Systems Measurement (PSM)
- National Defense Industrial Association (NDIA) SE Division (SED)

- Build/refine an effective outreach strate
- Focus needs to be on mutual value and

INCOSE Technical Program

Our Technical Program: Technical Working Groups

- Over 50 different working groups and initiatives in our Technical Operations organization

- The technical heart of INCOSE supported by many national and local working groups

- Focused on solving providing relevant problems and creating products for global use

- Sponsors multiple monthly webinar series that are archived and available after the online event

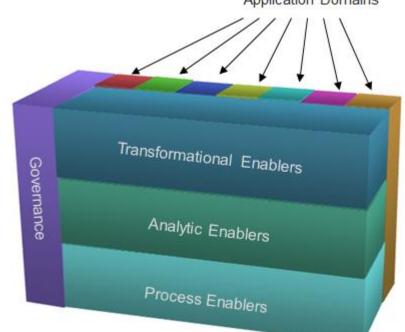- Also, includes a very influential Standards Initiative & MBSE Initiative

Individual Members Can Join – Chapters and Industry Associations Can Collaborate

INCOSE Working Groups

- INCOSE has about [50 Working Groups](#)
  - Analytic Enablers
  - Application Domains
  - Process Enablers
  - Transformational Enablers
- Working Groups are creating impactful products and are supporting various activities, e.g.
  - INCOSE Strategic Objectives
  - INCOSE Value Streams
- Current status of Working Groups: [Working Group Information Sheets](#)
- For more information, contact INCOSE's [Technical Director](#)
- Opportunity for seasoned subject matter experts to volunteer for technical reviews:
  - POC: Lin Yi, Ph. D
  - Assistant Director for Technical Review, INCOSE
  - Team Lead/Physicist, NASA JPL/Caltech
  - Email: lin.yi.dr@ieee.org

Application Domains

Transformational Enablers

Analytic Enablers

Process Enablers

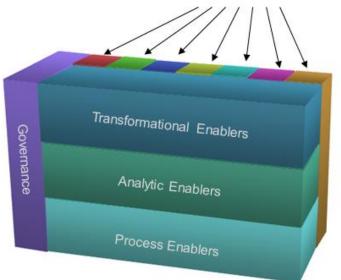Governance

INCOSE Technical Program: Working Groups & Initiatives

- Agile Systems and Systems Engineering
- Anti-terrorism International
- Architecture
- Automotive
- Autonomous Systems Test & Evaluation
- Competency
- Complex Systems
- Configuration Management
- Cost Engineering
- *Critical Infrastructure*
- Decision Analysis
- Defense Systems
- Enterprise Systems
- Future of SE Initiative
- Global Earth Observation SoS
- Healthcare
- Human Systems Integration

- Infrastructure
- Joint INCOSE-NAFEMS M&S
- Knowledge Management
- Lean Systems Engineering
- Life Cycle Management
- MBSE Initiative
- Measurement
- Model-Based Conceptual Design
- Natural Systems
- Object Oriented SE Method
- Oil & Gas
- Ontologies
- Patterns
- PM-SE Integration
- Power & Energy Systems
- Process Improvement
- Product Lines
- Quality Management

- Reliability Engineering
- Requirements
- Resilient Systems
- Risk Management
- SE in VSE
- SE Management
- Software – Incremental Dev
- *Space Systems*
- Standards Initiative
- Systems of Systems
- Systems Science
- System-Software Interface
- Systems Safety Integration
- Systems Security Engineering
- *Telecommunications*
- Tools Integration & Model Life Cycle Management
- Training
- Transportation

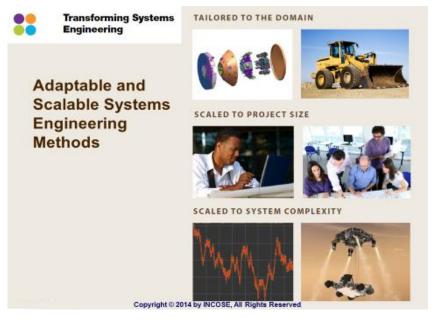For more information or the complete list, visit http://www.incose.org and click "Find a Working Group"

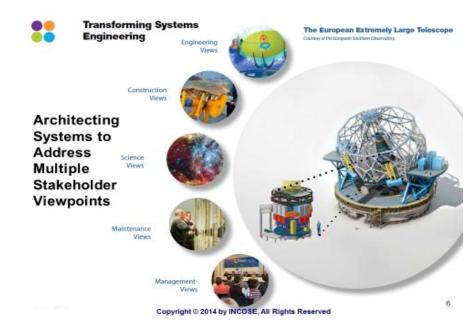# SE Evolution / Future of Systems Engineering

INCOSE Focus on Evolving the Discipline

Transforming Systems Engineering — Adaptable and Scalable Systems Engineering Methods

- TAILORED TO THE DOMAIN
- SCALED TO PROJECT SIZE
- SCALED TO SYSTEM COMPLEXITY

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Transforming Systems Engineering — Architecting Systems to Address Multiple Stakeholder Viewpoints

The European Extremely Large Telescope
Courtesy of the European Southern Observatory

- Engineering Views
- Construction Views
- Science Views
- Maintenance Views
- Management Views

Copyright © 2014 by INCOSE, All Rights Reserved

- Systems Engineering needs to evolve practices to address:
  - Faster pace of change
  - Increasing complexity
  - Affordable solutions
  - Agile, adaptable, and resilient solutions
  - Challenges of tomorrow
- Move SE to a cohesive discipline

- Need to place emphasis on transforming our SE practices
  - Model Based Systems Engineering / Digital Systems Models
  - System of Systems / Complex Systems
  - Agile Systems Engineering
  - Product Line Engineering
  - Composable Architectures and Designs
  - Resilient and Adaptable Systems
  - …

Charter

Purpose: Evolve the practice, instruction and perception of SE to:

1) Position SE to leverage new technologies

2) Enhance SE's ability to solve the emerging challenges

3) Promote SE as essential for achieving success and delivering value

Goal: Create a road map that drives the evolution of SE to:

1) be increasingly *adaptable, evolvable and fit for purpose*

2) account for human abilities, needs and their interactions with a system

3) be more responsive in resolving increasingly challenging societal needs

4) realize and enhance INCOSE SE Vision 2025 and other visionary inputs

Scope: Identify the needs, priorities and means for transforming SE including:

1) underlying foundations, systems theory and principles

2) people, methods, tools, processes, education and training

3) the future social and ethical duties, contributions, and responsibilities of future systems engineers

Collaborating Organizations

Initiative Lead and Primary POC Bill Miller (wdmiller220@gmail.com)

FuSE Way Forward

- Get involved!
  - Public facing website
  - Collaboration portal
  - Wiki
  - Mini-workshops with other events
- Priority projects
  - *SE4AI and AI4SE*
  - *SE Foundations*
  - Engagement of the SE Community
  - Characterizing impacts on SE
- Intended Outcomes
  - Realization of SE Vision 2025 aligned with goals of FuSE
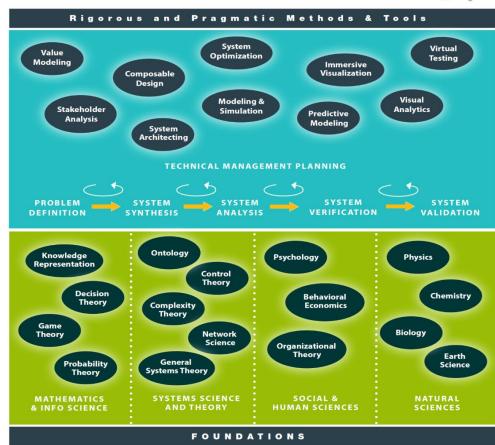 - Shape the evolution of SE using FuSE Roadmap

Participate in the collaboration to welcome the future!

Systems Engineering Foundations

Systems Engineering Principles

- SE Principles Action Team formed (IW2018)
  - Input from the NASA SE Research Consortium
  - Collaboration with International Systems Science Society (ISSS)
- Developed Criteria for INCOSE SE Principles
- Defined 15 SE Principles, 3 SE Hypotheses
- Developing Articles for Input in Systems Engineering Body of Knowledge (SEBoK)

SE Foundations – System and SE Definitions

Problem (2016) –

- Existing definition considered too limiting given the aspirations of SE Vision 2025

Objective –

- Review INCOSE definitions of Systems and SE and recommend any changes

Approach –

- 2.5 years project led by INCOSE Fellows

- Series of many briefings, working papers, research, 50 team webexes and wider stakeholder engagement

- 2 surveys, 6 published papers

Results –

- IS2018 – panel & 4 papers (incl Best Paper Award)

- Sep-Nov 2018 – review open to all INCOSE members receiving over 300 comments

- Jan 2019 – finalised and approved by BoD

- Q2/Q3 2019 – Formal and full publication

Definitions -

- Systems Engineering is a transdisciplinary and integrative approach to enable the successful realization, use and retirement of engineered systems, using systems principles and concepts, and scientific, technological and management methods.

- An engineered system is a system designed or adapted to interact with an anticipated operational environment to achieve one or more intended purposes while complying with applicable constraints.

- A system is an arrangement of parts or elements that together exhibit behaviour or meaning that the individual constituents do not.

Digital Engineering / MBSE Focus

Challenges of Digital Engineering

Transform Practice	Data & Artifacts	Integration	Response to change
Embrace models as primary basis of SE; Culture change	Manage data as an asset; Models rely on valid data	Integration across models	Ability to V&V models as changes are introduced
Meet expectations from traditional approaches	Provide a consistent set of artifacts that facilitate communication	Integration across disciplines	Potential changes to stakeholder interactions
Implement new or modified standards	Improve tool interoperability and information exchange	Interactions between systems – application for SoSE	Potential changes to systems from self learning/ adaptation
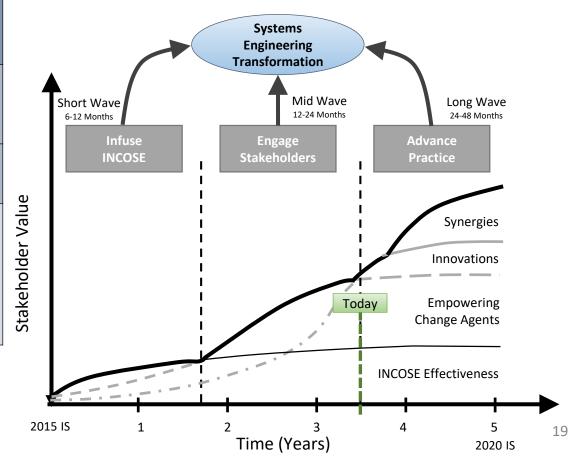
Trust of models

SE Transformation Strategy, Objectives and Path Forward

Systems Engineering:
The central cohesive discipline
essential for Digital Transformation

Vision	SE is known as a model-based discipline		
Mission	INCOSE accelerates the transformation of systems engineering to a model-based discipline		
Mission Area	**Infuse INCOSE**	**Engage Stakeholders**	**Advance Practice**
Mission Area	*What can INCOSE Do?*	*What is practiced and needed?*	*What is possible?*
Goals	Infuse model-based methods throughout INCOSE products, activities and WGs	Engage stakeholders to assess the current state of practice, determine needs and values of model-based methods	Advance stakeholder community model-based application and advance model-based methods.

Systems Engineering Transformation

Short Wave 6-12 Months

Mid Wave 12-24 Months

Long Wave 24-48 Months

Infuse INCOSE

Engage Stakeholders

Advance Practice

Stakeholder Value

Synergies

Innovations

Today

Empowering Change Agents

INCOSE Effectiveness

2015 IS   1   2   3   4   5   2020 IS

Time (Years)

Transformation Developments and Outcomes

Outcomes Achieved
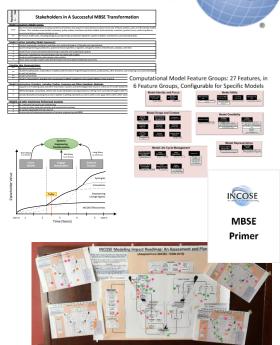
- Supported incubation of >7 Challenge Teams and WGs and more coming
- Provided >35 INCOSE Transformation briefings across multiple venues
- INCOSE IS and IW MBSE Lightening Rounds
- Expanding aperture of what Systems Modeling includes

New/Related Developments

- Supporting OCM effort within INCOSE
- *Expanding modeling collaborations across professional societies and Developing new MOUs and supporting standards modification*
- 5+ products in under development
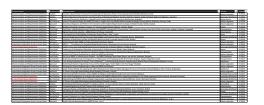
Next Steps

- *Collaborate with FuSE and Vision.*
- Semantic Technologies for SE (ST4SE) – Collaboration with JPL & SERC
- Transformation and Change Management for INCOSE Leaders/WGs
- Augmented Intelligence in SE
- Production and Logistics Systems Modeling

2018 MBSE Survey

- **Survey ran from Dec. 6 – Dec 29**

- **Total of 661 responses, with 100% completion rate – from 27 countries**

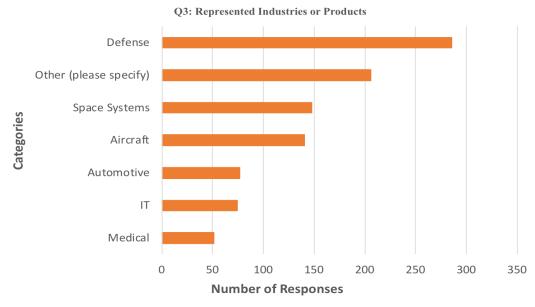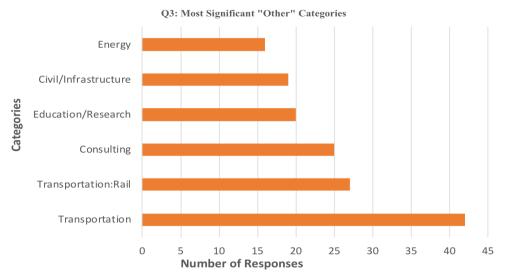- **Average time to complete survey: 08m:07s**

Architecture modeling

Requirements flowdown and traceability

Q3: Represented Industries or Products
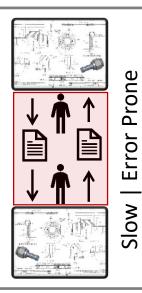

Q3: Most Significant "Other" Categories

Digital Engineering Information Exchange WG Overview

Problem Statement:

Despite advances in the digital era, there are significant inefficiencies when suppliers, acquirers, and internal team members exchange engineering information following a traditional document-based approach

Ambiguity | Risk | Rework | Error Prone

Slow | Error Prone

Primary Goal:

To establish a finite set of digital artifacts which stakeholders (acquirers, suppliers, internal teams etc. should use to exchange digital engineering information

Efforts:
- Define a Finite Set of Digital Artifacts
- Develop Constructs for assembling of Digital Artifacts
- Leverage and Influence Standards to Improve DEIX
- Adopt a Common Lexicon

ISO 15288

Opportunity:

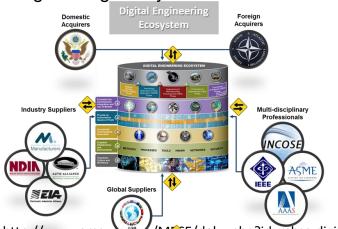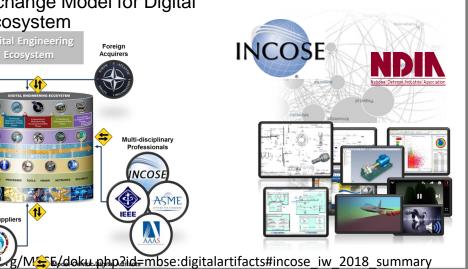Leverage new digital technologies, forms of media, and means of interaction to provide enriched system representations. Shared information, knowledge and understanding

Understanding | Speed | Efficiency | Consistent

Fast | Accurate | Complete

Information Exchange Model for Digital Engineering Ecosystem

http://www.omgwiki.org/MBSE/doku.php?id=mbse:digitalartifacts#incose_iw_2018_summary

DEIX Working Group Needs Projects

DEIX Primer

A narrative that describes the concepts and interrelationships between digital artifacts, enabling systems, and exchange transactions

DEIX Model

A prescriptive system model for exchanging digital artifacts in an engineering ecosystem

Digital Viewpoint Model

Descriptive information models of digital views that form content for IEEE 15288.2 reviews

DEIX Standards Framework

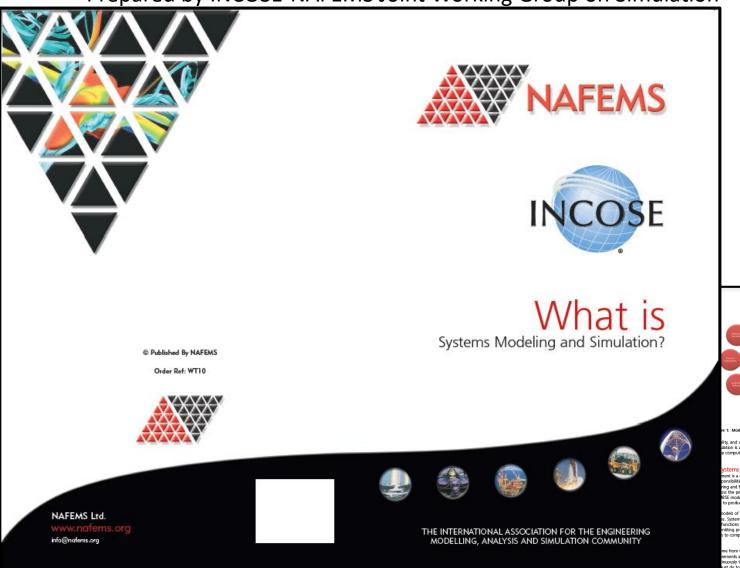A framework for official standards related to MBE Information Exchanges

Leveraging Standards for Global Application

Leveraging standards and other authoritative sources to identify essential digital artifacts and DEIX practices

ISO 15288   ISO 15289   ISO 15504-6

ISO 12207   ISO 26531   ISO 24748

Prepared by INCOSE-NAFEMS Joint Working Group on Simulation

INCOSE MBSE Patterns Working Group: Reconceptualizing SE

- **Problem/Opportunity**: Many advantages (financial, technical, schedule, risk, capability) by better exploiting "group learning" in <u>reconceptualized SE</u>:
  - Using history of <u>physical sciences and their engineering disciplines</u>.
  - About <u>trusted shared model-based patterns</u>.

- **WG Objectives:**
  - Making systems engineering, other life cycle management 10:1 simpler to use by a 10:1 larger population for 10:1 larger and more complex systems.

- **WG Focus and Approach:**
  - <u>Re-usable, model-based "patterns", configurable to specific project models</u>.
  - For whole systems, not just small parts of them.
  - For all information types needed across the entire system life cycle.
  - Based on the smallest model needed to support the full system life cycle.

Standardization - SysML V2
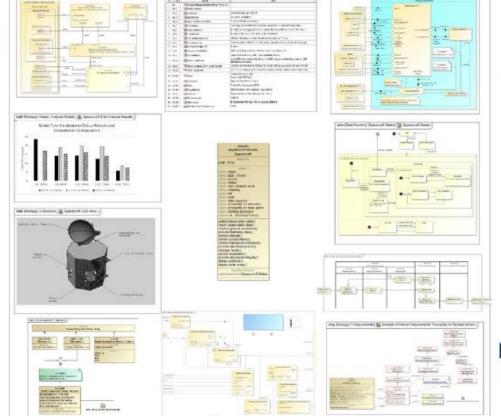
Improve:

- Interoperability with other tools

- Support for flexible visualization

- Precision

- Usability

Source: Friedenthal briefing on SysML V2, 11 Dec 2018
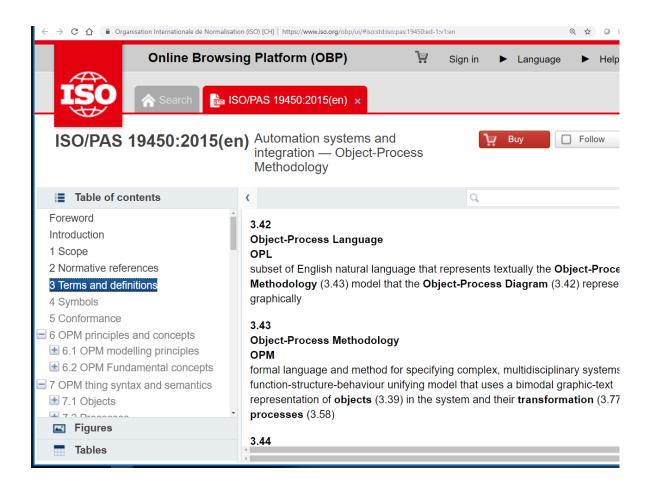
Standardization - OPM - Object-Process Methodology

- Language and methodology for modeling complex systems of any kind
- Useful for Industry 4.0 and agile MBSE
- Based on minimal universal ontology
  - stateful objects
  - processes that transform them (create, consume, change state)
- Objects and processes can be refined to any desired level of detail
- Executable, can be simulated by animation
- Bi-modal visual-textual presentation:
  - OPD – Object-Process Diagram
  - OPL – Object-Process Language

Digital Engineering Way Ahead
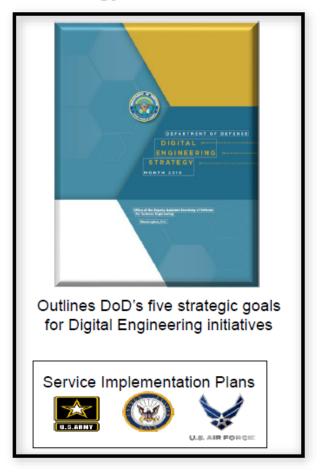
Collaborators/Partnerships

- Armed Services
- DoD Components
- Interagency
- Industry/OEMs/ Industrial Orgs
  - NDIA, INCOSE, AIA, AIAA
  - LOCKHEED MARTIN, GE, Rolls-Royce, NORTHROP GRUMMAN, BOEING
- Academic
  - SYSTEMS ENGINEERING RESEARCH CENTER, DAU

Strategy & Service Plans

DEPARTMENT OF DEFENSE DIGITAL ENGINEERING STRATEGY

Outlines DoD's five strategic goals for Digital Engineering initiatives

Service Implementation Plans

Next Steps

- ☐ Service Delivery and Execution of Implementation Plans

- ☐ Foundational & Cross-Cutting Challenges
  - o Data Patterns/Digital Artifacts
  - o Data Rights/Access and Intellectual Property
  - o Model Trust / Curation
  - o Model Improvement (e.g., from test data)
  - o Critical Technology Protection
  - o Determine Additional Efficiencies / Measurement
  - o Tool Characterization
  - o Workforce Development

Implementing Digital Engineering Across the Services

SoS / Interconnected Systems Focus

Challenges of Highly Interconnected Systems

Security
- Control of interfaces
- Emergent vulnerabilities
- Vulnerabilities growing faster than solutions

Data
- Privacy – e.g., conflict of surveillance vs civil rights or use of data
- Data capture, analysis, and access/exchange issues
- Data adequacy and accuracy

Regulations and Standards
- Policy lags technology
- Who? Spans government jurisdictions – users from any locations
- Lack of Standards – enables poor behavior - develop w/o regard to impact
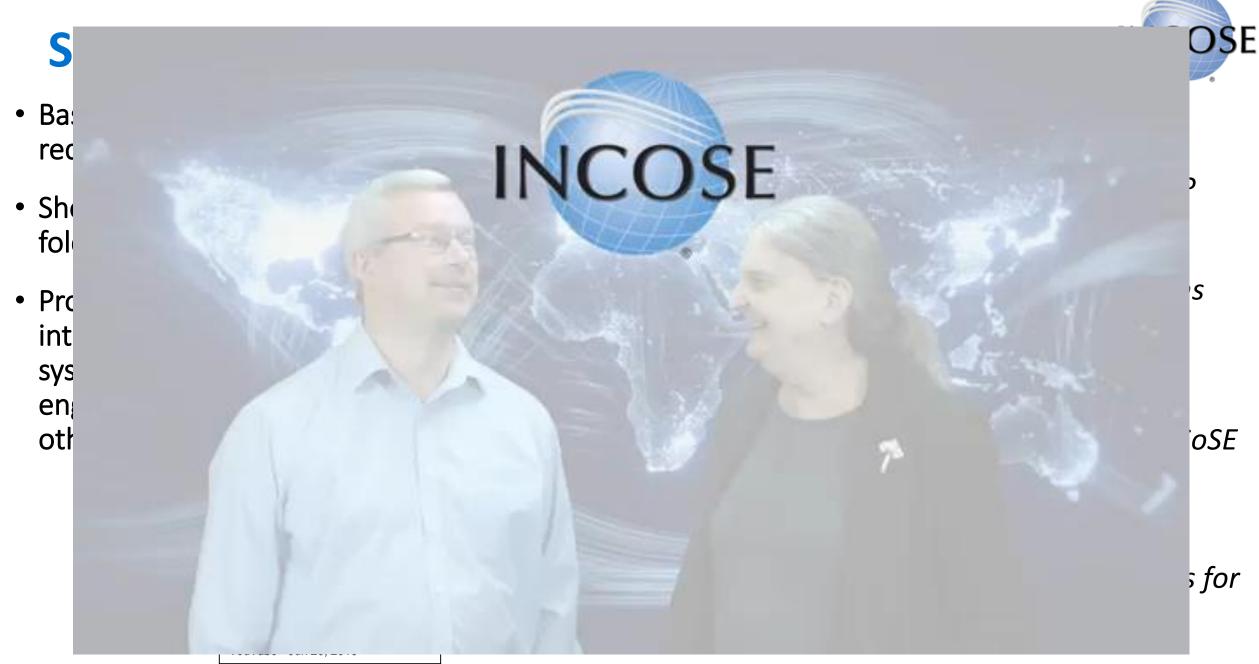
Life Cycle Sustainment
- Ability continue to meet evolving expectations and deliver value
- V&V for continually evolving set of connected systems – who is responsible?
- Who is responsible for sustainment of interconnections and shared functions?

Applies to IoT, Smart Anything, and Other Highly Interconnected Systems

S

- Bas
  rec

- Sho
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- Pro
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  sys
  eng
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SE and SoSE Standards

Number	Title
ISO/IEC/IEEE 15288:2015	*System life cycle processes*
IEEE 15288.1: 2014	*Application of Systems Engineering on Defense Programs*
IEEE 15288.2: 2014	*Technical Reviews and Audits on Defense Programs*
ISO/IEC/IEEE 21839	*System of Systems (SoS) Considerations in Life Cycle Stages of a System*
ISO/IEC/IEEE 21840	*Guidelines for the utilization of ISO/IEC/IEEE 15288 in the context of System of Systems (SoS) Engineering*
ISO/IEC/IEEE 21841	*Taxonomies of Systems of Systems*

Purpose of ISO/IEC/IEEE 21839

System of Systems (SoS) Considerations in Life Cycle Stages of a System

- Provides a set of critical considerations for the SOI to be addressed at key points in the life cycle of systems created by humans.

- Refers to a constituent system that will interact in a system of systems as the system of interest (SOI).

- Considerations are aligned with ISO/IEC/IEEE 15288 and the ISO/IEC/IEEE 24748 framework for system life cycle stages and associated terminology.

- Selected subsets of these considerations may be applied throughout the life of systems.

- Editor: Dr. Judith Dahmann (US)

- Co-editor: Garry Roedler (US)

Purpose of ISO/IEC/IEEE 21840

Guidelines for the utilization of ISO/IEC/IEEE 15288 in the context of System of Systems (SoS) Engineering

- Addresses systems of systems (SoS) considerations that apply to the set of systems at key stages in the life cycle of systems.
- Describes the systems of systems considerations when developing an SoS.

- It does not
  - Detail the approach to addressing systems of systems considerations in terms of methods or procedures.
  - Detail the described documentation in terms of name, format, explicit content, and recording media of documentation.

- Editor: Dr. Mike Yokell (US)
- Co-editor: Dr. Alejandro Salado (US)

Purpose of ISO/IEC/IEEE 21841
Taxonomies of Systems of Systems

- The purpose of this standard is to define normalized taxonomies for systems of systems (SoS) to facilitate communications among stakeholders.

- It also briefly explains what a taxonomy is and how it applies to the SoS to aid in understanding and communication.

- Editor: Dr. Mike Yokell (US)

- Co-editor: Dr. François Coallier (Canada)

INCOSE SoS Working Group Research Roundtable
International Workshop 2018

- Bridging the Performance Gap: Model-Based SoS Engineering and the Learning Digital Twin
- Agent-based simulation framework and decentralized planning algorithm for opportunistic coalition formation in Earth observing systems of systems
- Mission Engineering Competencies
- A Cyber-Physical Systems Approach to Optimizing Internet of Vehicles Architecture with Rapidly Evolving Technology
  - Complex System Governance Research: Advancing System of Systems Engineering
- SoS Analytic Workbench – Reflections on a Successful SERC Project and Directions for Future Projects
- SoS Solutions in Driverless Vehicles
- Lessons Learned from Engineering Emergence Research

Research Priorities on SoS

Transatlantic AREA-SOS Research Agenda

Table 1: Priority research themes

Rank	Research Area
1.	Engineering for emergence
2.	Architecture patterns for SoS
3.	Multi-heterogeneous modelling and multi-notation approaches
4.	Enterprise SoS, governance and policy
5.	Trade-off techniques for integration of legacy and managing evolution
6.	Metric identification/validation
7.	How to prototype SoS?
8.	Scenario-based simulation and analysis
9.	Dynamic SoS
10.	Security of SoS implementation
11.	Capabilities, processes and competencies
12.	Techniques for validation of interoperability
13.	Qualification of safety or security critical SoS
14.	Multi-level infrastructure consistency
15.	Technological issues
16.	Economic effects
17.	Political and social user acceptance and legal: mixing criticality – security an
18.	Need for case studies and identification of commonalities across case studies
19.	Identify and build the constituency and stakeholders in a SoS

My Personal Priorities
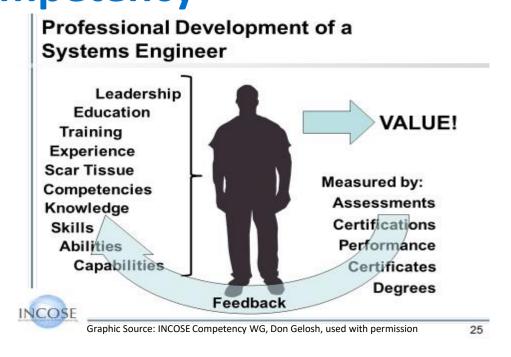
- **SoS Analysis** (including **trade-offs**)
  - Need to accelerate
  - Current research by SERC and others – SoS Workbench – SoS Modeling and Analysis

- **SoS Emergence and Dynamics** - highly interconnected systems with dynamic changes

- **SoS Architecture**

- **SoS Governance and Policy**

- **SoS Cybersecurity**, Cyber Resilience, and Security Engineering
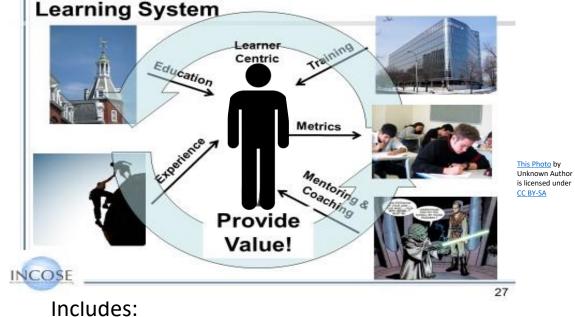
SE Professional Development

INCOSE Focus on Professional Development and Competency

Professional Development of a Systems Engineer

- Leadership
- Education
- Training
- Experience
- Scar Tissue
- Competencies
- Knowledge
- Skills
- Abilities
- Capabilities

VALUE!

Measured by:
- Assessments
- Certifications
- Performance
- Certificates
- Degrees

Feedback

Graphic Source: INCOSE Competency WG, Don Gelosh, used with permission

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The Professional Development Learning System

Learner Centric

Education / Training / Metrics / Mentoring & Coaching / Experience

Provide Value!

27

Graduate Reference Curriculum for Systems Engineering

Includes:

- Understand the characteristics of Systems Engineers
- Evolving the existing INCOSE SE Competency Framework
- Ensure the right enablers are in place
- Take a holistic approach to Professional Development
- Work collaboratively with others to get wide community consensus
- Academic Council – nearly 30 universities
- Establishment of SE Criteria and Cybersecurity Criteria for University program accreditation via ABET
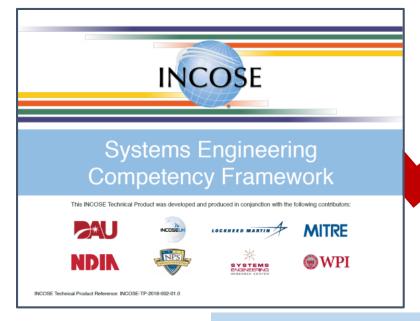
Systems Engineering Competency Framework

Represents a world view of 5 competency groupings with 36 competencies central to the profession of Systems Engineering, including indicators of knowledge, skills, abilities and behaviors across 5 levels of proficiency.

Aligns with major ongoing INCOSE initiatives.

Supports a wide variety of usage scenarios including individual and organizational capability assessments.

Enables organizations to tailor and derive their own competency models that address their unique challenges.

Systems Engineering Competency Framework

This INCOSE Technical Product was developed and produced in conjunction with the following contributors:

DAU   INCOSEUK   LOCKHEED MARTIN   MITRE

NDIA   NPS   SYSTEMS ENGINEERING RESEARCH CENTER   WPI

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The complete Competency Framework can be accessed at:
https://www.incose.org/CompetencyFramework

Collaboration by many – Free access to all

2019 Professional Development Portal Plan

1st Quarter Milestones

- 3-4 Iterations of Development Completed
- Roll-out minimum Viable Product for initial test and review
  - User Interface
  - INCOSE training and other assets
  - Browse and Search capability by Competency Framework topics
  - Web Data Analytics to support future decision-making
- Provide a briefing at the 2Q Board meeting on decisions to be made for future feature development and recommendations

2nd-4th Quarter Milestones
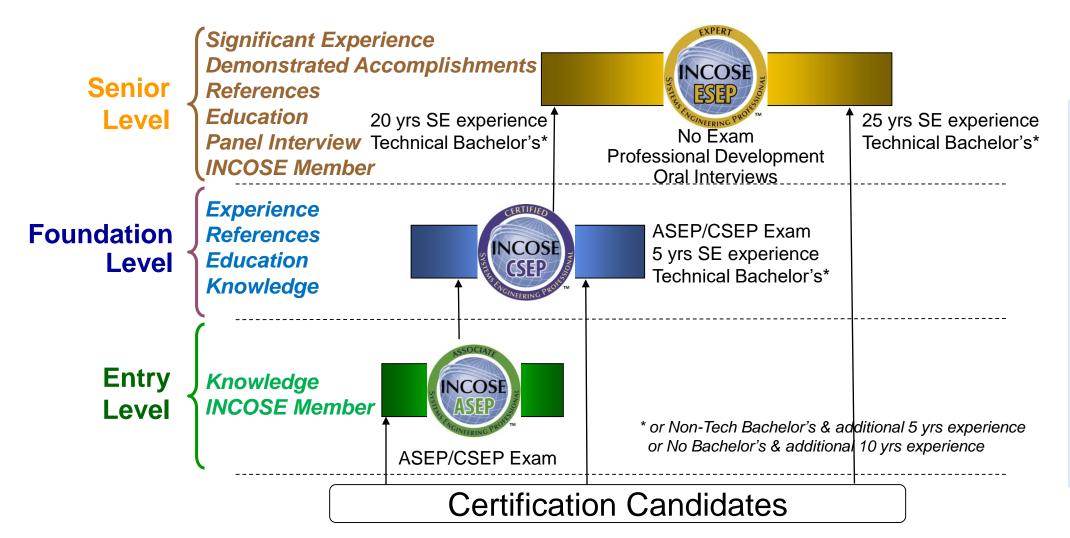
- 2nd Quarter milestones
  - Finalize populating the PD Portal with INCOSE content.
  - Review content against competency framework and define content gaps
  - Begin Turnover to Operations mid-year
- 3rd – 4th Quarter milestones
  - Develop new content to fill gaps
  - Continue feature development, test and delivery of content as planned out in the 2nd quarter for subsequent iterations.

Multi-Level SE Certification Concept

Senior Level
- *Significant Experience*
- *Demonstrated Accomplishments*
- *References*
- *Education*
- *Panel Interview*
- *INCOSE Member*

Foundation Level
- *Experience*
- *References*
- *Education*
- *Knowledge*

Entry Level
- *Knowledge*
- *INCOSE Member*

20 yrs SE experience
Technical Bachelor's*

No Exam
Professional Development
Oral Interviews

25 yrs SE experience
Technical Bachelor's*

ASEP/CSEP Exam
5 yrs SE experience
Technical Bachelor's*

ASEP/CSEP Exam

** or Non-Tech Bachelor's & additional 5 yrs experience
or No Bachelor's & additional 10 yrs experience*
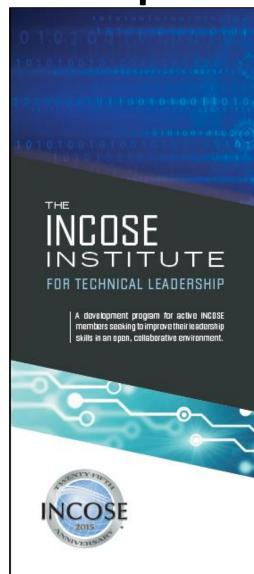
Certification Candidates

Established a set of agreements and/or equivalency programs with national engineering chartering programs, academic institutions, and government agencies

Uses INCOSE SE Handbook as Basis for Exam; Knowledge and Experience aligned with SEH

Expert Systems Engineering Professional
Certified Systems Engineering Professional
Associate Systems Engineering Professional

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SEs as Leaders: The INCOSE Institute for Technical Leadership

- Purpose
  - *Accelerate the development of systems engineering leaders who will exemplify the best of our organization and our profession*

- Benefits
  - *Individual members become more capable leaders*
  - *INCOSE has a growing pool of leaders to draw on*
  - INCOSE's international reputation will be enhanced

- Program Overview
  - Two-year program; new cohort formed annually
  - Four events per year: two face-to-face, two webcast
  - Individual project work between events
  - Each cohort will mentors the following one
  - Candidates must apply and be recommended by their organization and an INCOSE Leader

THE
INCOSE
INSTITUTE
FOR TECHNICAL LEADERSHIP

A development program for active INCOSE members seeking to improve their leadership skills in an open, collaborative environment.

INCOSE
2015
TWENTY-FIFTH ANNIVERSARY

Atlas Proficiency Model

Proficiency of a Systems Engineer

6. Technical Leadership

- Building & Orchestrating a Diverse Team
- Balanced Decision Making & Risk Taking
- Guiding Stakeholders with Diverse/ Conflicting Needs
- Conflict Resolution & Barrier Breaking
- Business & Project Management Skills
- Establishing Technical Strategies
- Enabling Broad Portfolio-Level Outcomes

1. Math / Science / General Engineering

- Natural Science Foundations
- Engineering Fundamentals
- Probability & Statistics
- Calculus & Analytical Geometry
- Computing Fundamentals

5. Interpersonal Skills

- Communication
- Listening & Comprehension
- Working in a Team
- Influence, Persuasion, & Negotiation
- Building a Social Network

2. System's Domain & Operational Context

- Principle and Relevant Domains
- Familiarity with System's Concept of Operations (ConOps)
- Relevant Domains
- Relevant Technologies
- Relevant Disciplines and Specialties
- System Characteristics

4. SE Mindset

- 'Big Picture' Thinking
- Paradoxical Mindset
- Flexible Comfort Zone
- Multi-Scale Abstraction
- Foresight & Vision

3. SE Discipline

- Lifecycle
- Systems Engineering Management
- Systems Engineering Methods, Processes, & Tools
- Systems Engineering Trends

An Example Systems Engineer's Proficiency

Radar chart axes: Math/Science/General Engineering, System's Domain & Operational Context, Systems Engineering Discipline, Systems Engineering Mindset, Interpersonal Skills, Technical Leadership

Other SE Professional Development Activities

- SE Certification
  - Program based on knowledge, experience, and demonstrated competencies
  - Three levels of certification

- SE Professional Development Portal
  - Open platform environment for professional develop
  - In development – expected to release in Jan 2019 and evolve thereafter

- Helix study (a SERC project – supported by INCOSE)
  - Understand what makes effective systems engineers
  - Understand how *systems engineers'* effectiveness impacts the organization's SE effectiveness
  - Understand other factors that impact SE effectiveness – culture, governance, structure

- Technical Leadership Institute
  - Accelerate development of systems engineering leaders to improve their leadership skills in an open, collaborative environment

- Webinars
  - Over 150 webinars

- Linkage to products, papers and other resources

INCOSE Events

INCOSE Events (2019, 2020, and Beyond)

- Events Web Page - https://www.incose.org/events-and-news
- INCOSE International Symposium
  - 2019: Orlando, FL – 22-25 July – Hyatt Regency Grand Cypress
  - 2020: Cape Town, South Africa – 20-23 July – Cape Town Convention Center
  - 2021: Honolulu, HI – 19-22 July – details in progress
- INCOSE International Workshop
  - 2020: Torrance, CA - 25-28 January – Torrance Marriott
  - 2021: Seville, Spain – 29-31 January – Barcelo Convention Center
  - 2022: Torrance, CA - 23-26 January (TBR) – Torrance Marriott
- INCOSE Regional Conferences
  - Western States Regional Conference – Los Angeles, CA – 13-1 September – Loyola Marymount University
  - Great Lakes Regional Conference – Cleveland, OH – 22-25 October – in conjunction with Energy Tech 2019
  - EMEA Workshop – Utrecht, Netherlands – 10-11 October
  - Asia Oceania Sector (AOSEC) Conference – Bangalore, India – 17-19 October
- Human Systems Integration (HSI) Conference
  - 11-13 September 2019 – Biarritz, France (HSI2019)
- IEEE/INCOSE/NDIA System Security Symposium
  - 2020: Crystal City, VA – 6-9 April – Crystal Gateway Marriott
- System of Systems Engineering (SoSE) Conference
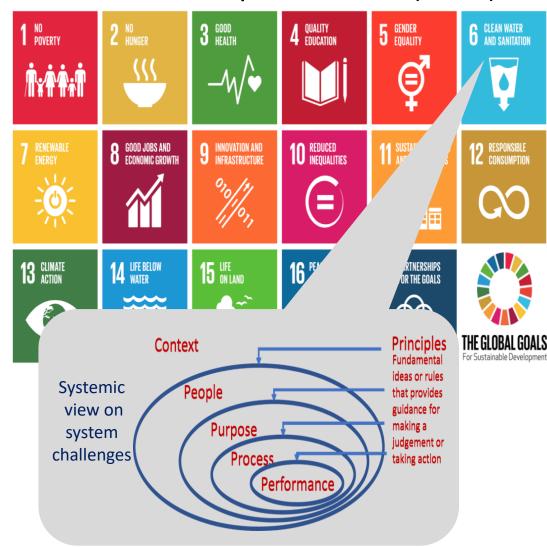 - 2020: Budapest, Hungary – 1-3 June – Obuda University
- Additional events on Website, including joint or co-sponsored events

Other Opportunities

Initiatives – Grand Challenges (GCs)

Sustainable Development Goals (SDGs)

SDGs -

- SDGs address global challenges related to poverty, inequality, climate, environmental degradation, prosperity, and peace and justice

- SDGs interconnect with targets to achieve by 2030

INCOSE can get involved -

- GCs do not occur in isolation

- They are complex system problems

- Participation supports our Vision

- We can apply a systems approach, engaging with a variety of stakeholder groups with a similar purpose

- It will be a collaborative, learning journey

Activities to date –

- Approach discussed

- Strategy session held

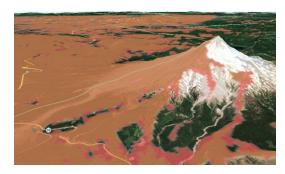- Selected– *CLEAN WATER & SANITISATION*

Next steps –

- Initiating discussions with 2 possible projects/ organisations to join.

- Looking for volunteers to join the team.

INCOSE Telecommunications Working Group – Critical Networks Project

- Technical Working Group officially formed Feb 2019 (preliminary work in Australia since Jan 2018)

- Two initial projects: **Critical Networks** and **Commercial Networks**

- Critical Networks Project will examine ways to employ Systems Engineering (SE) concepts in the design of critical communications networks.

- **Critical Infrastructure**:
  - "*Systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters.*" (US Patriot Act 2001)
  - "*This directive also identifies energy and <u>communications systems</u> as uniquely critical due to the enabling functions they provide across all critical infrastructure sectors*" (US Presidential Policy Directive/PPD-21)

- **[Mission] Critical Communications Networks** are those networks that are themselves considered 'critical infrastructure' in their own right (e.g. networks used by public safety or the military); or that other 'critical systems' depend on for communications services (e.g. air traffic control, NY Stock Exchange, utilities and transportation systems); as well as networks used during emergencies, crises or disasters.

INCOSE Telecommunications Working Group – Critical Networks Project

- **Challenge**: How can we best leverage systems engineering processes in order to develop and maintain 'communication networks' within the greater systems-of-systems?

- **Outcome**: Guidance on applying systems engineering principles, techniques and approaches that can be used to aid in the capture of requirements and design of critical wireless and wireline communications networks for normal day-to-day operations; and for the protection and recovery of those networks during service disruptions caused by manmade and natural events.

- **Timeframe**: Workshop at INCOSE International Symposium (Orlando, July 2019); article in INCOSE Insight Magazine (Critical Infrastructure Protection and Recovery theme, March 2020); session at IWCE (Las Vegas, March 2020)

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Formal Agreements

- INCOSE recommends the establishment of formal agreements between our organizations in order to strengthen our bonds and work to achieve common objectives.

- Types of Agreements
  - A Memorandum of Understanding (MOU) is a <u>non-binding</u> agreement between two or more parties outlining very broad concepts of mutual understanding, goals, and general plans. An MOU is often the first stage in the formation of a Memorandum of Agreement (MOA) or more formal contract.
  - A Memorandum of Agreement (MOA) is a <u>non-binding</u> agreement between two or more parties describing the terms, conditions, and specific details of an agreement, including each party's requirements, roles, responsibilities, and actions so that their goals may be accomplished. An MOA may lead to the formation of a formal contract among the parties.

- INCOSE Director for Outreach
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Example Common Objectives and Goals

- Formation and implementation of joint, cross-organizational working groups.

- Hosting joint events.

- Provide mutual assistance and support for development of international standards.

- Mutually support specific, non-funded events of each organization.

- Jointly develop new processes, methods, guidance, and/or tools in the applicable fields of interest.

- Jointly develop a series of articles, papers, and presentations for respective membership publications and events.

Thank you!

For More Information or To Share Ideas contact:

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Questions?

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