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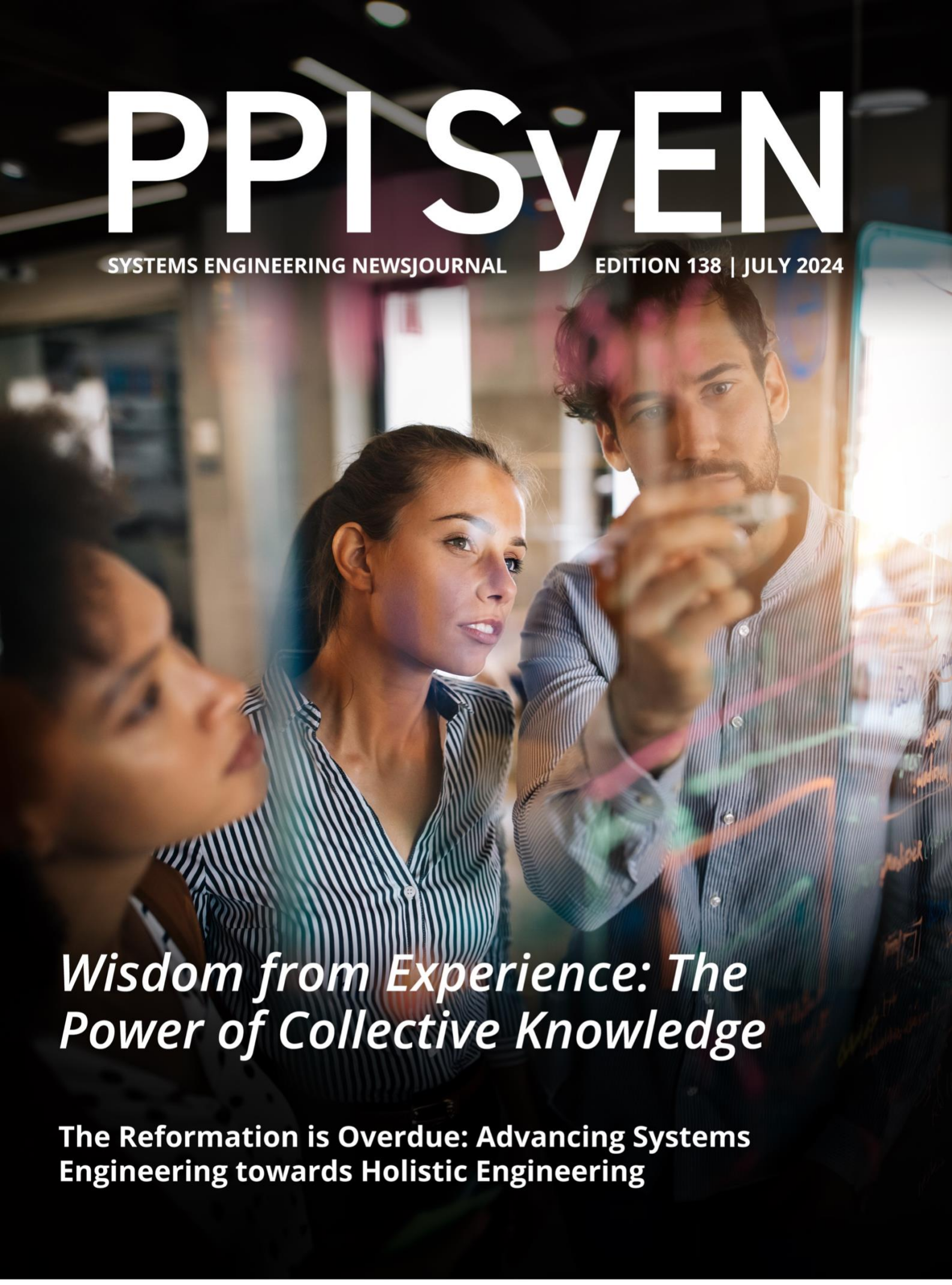

Wisdom from Experience: The Power of Collective Knowledge

The Reformation is Overdue: Advancing Systems Engineering towards Holistic Engineering

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PPI SyEN

EMAIL: PPISyEN@PPI-Int.com

EDITORIAL STAFF

Editor
John Fitch

Editor-in-Chief
Robert Halligan

Managing Editor
René King

PRODUCTION STAFF

Marketing Manager
Benjamin Bryant

Graphic Designer
Matthew Wong

Marketing Coordinator
Rebeca Carneiro

Publishing Assistants
Trudy King
Shalani De Silva

PUBLISHER

PROJECT PERFORMANCE INTERNATIONAL

Project Performance International
2 Parkgate Drive
Ringwood, Vic 3134 Australia
Tel: +61 3 9876 7345

Tel UK: +44 20 3608 6754
Tel USA: +1 888 772 5174
Tel China: +86 188 5117 2867

www.ppi-int.com

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WELCOME

Dear PPI SyEN Readers,

Welcome to another edition of PPI SyEN! This edition delves into the ongoing discussion about evolving systems engineering practices to embrace a more robust approach to solving engineering problems.

We begin with essential SE news, highlighting the expanded partnership between the Digital Twin Consortium and Smart Cities Council, which promises to accelerate the adoption of digital twin technology in urban environments. We also provide updates on the Systems Engineering Research Center (SERC), a hub for cutting-edge research and innovation in systems engineering.

Our conferences, meetings, and webinars section is brimming with professional development opportunities. From Smart Cities Week APAC to webinars exploring the intersection of project management and systems engineering, each event offers valuable insights and networking prospects.

Our feature article by Roger McCowan, titled "The Reformation is Overdue: Advancing Systems Engineering," proposes expanding our perspective of systems engineering to address the United Nations Sustainability Goals more effectively and thoroughly. This article offers much food for thought for us as systems engineering practitioners.

This edition also features an insightful interview with Juan Navas on deploying modeling in the field, showcasing real-world applications of systems engineering principles.

Additionally, we spotlight the INCOSE INSIGHT Practitioners Magazine, a valuable resource for systems engineering technical leadership. To support your professional journey, we've included resources such as recommended system dynamics materials and e-learning courses on systems modeling and simulation.

Finally, Syenna shares some insights into why systems engineering hasn't been as widely applied and successful as expected, along with some initial thoughts on how we can overcome these barriers.
.
Happy reading and thank you for your continued support.

Warm regards,

René

Managing Editor (on behalf of the PPI SyEN team)

"

Engineering process is useless in the absence of knowledge of solution technologies relevant to the problem, and creativity in applying that knowledge.

Robert Halligan

PPI Systems Engineering Newsjournal (PPI SyEN) seeks:

- To advance the practice and perceived value of systems engineering across a broad range of activities, responsibilities, and job-descriptions
- To influence the field of systems engineering from an independent perspective
- To provide information, tools, techniques, and other value to a wide spectrum of practitioners, from the experienced, to the newcomer, to the curious
- To emphasize that systems engineering exists within the context of (and should be contributory toward) larger social/enterprise systems, not just an end within itself
- To give back to the Systems Engineering community

PPI defines systems engineering as:
an approach to the engineering of systems, based on systems thinking, that aims to transform a need for a solution into an actual solution that meets imperatives and maximizes effectiveness on a whole-of-life basis, in accordance with the values of the stakeholders whom the solution is to serve. Systems engineering embraces both technical and management dimensions of problem definition and problem solving.

SYSTEMS ENGINEERING NEWS

Recent events and updates in the field of systems engineering

Expanded Partnership: Digital Twin Consortium and Smart Cities Council

The Digital Twin Consortium (DTC) and the Smart Cities Council (SCC) have announced an expanded global partnership to enhance the capabilities and capacity being brought to their common domains, including:

- Smart Airports & Intelligent Transportation Hubs
- Smart Tourism
- Regional Communities
- Indigenous Communities
- Healthcare & Aged Care
- Intelligent Buildings & Infrastructure

Aspects of this strengthened relationship include:

- An address by Corey Gray, SCC President, to the DTC membership at its quarterly members meeting in June.
- The appointment of Dan Isaacs, DTC CTO and digital twin expert, as the SCC Thought Leader for Digital Twins.
- The incorporation of a Digital Twin Day and related conference tracks at the Smart Cities Week APAC to be held in Adelaide, South Australia from 5-9 August.

See more about Smart Cities Week APAC in the Conferences section of this edition of PPI SyEN.

Systems Engineering Research Center (SERC) Updates

The June 2024 update from the Systems Engineering Research Center (SERC) highlights this organization's research-driven contributions to systems engineering practices.

Archimedes Initiative Summer Workshop

SERC hosted the third annual Archimedes Initiative summer workshop that gathered leaders from four prominent systems engineering organizations to discuss trustworthy AI, systems thinking, and other dynamic topics. SERC partners in this four-day event included:

- German Aerospace Center (DLR) Institute of Systems Engineering for Future Mobility
- Netherlands Organization for Applied Scientific Research (TNO-ESI) Embedded Systems Innovation Center
- Center for Trustworthy Edge Computing Systems and Applications (TECoSA) at the Royal Institute of Technology in Sweden.

Presentation topics included:

- Trustworthy Vehicles: Let's Learn from Live
- Trustworthy AI as a Requirement in Applied Research Prototypes
- Trustworthy AI Based Cyber-Physical Systems – the Good, the Bad and the Real Challenge
- Trustworthy Automation of Urban Transportation Systems

The 2025 edition of the summer workshop will be hosted by DLR in Oldenburg, Germany with a theme of "*Systems Engineering for the System Lifecycle – Rapid and Efficient System Evolution with Humans in the Loop*".

Capstone Marketplace Projects
The Capstone Marketplace (CM) matches student teams from universities throughout the U.S. with national military units to explore innovative approaches to real-world challenges. Read the summary report for the 2023-2024 program here. Learn more about the projects at the Capstone Marketplace website.

Defense Acquisition University (DAU) Digital Engineering Simulation Option Year 2
This research report summarizes SERC efforts to develop a digital engineering simulator to support the DAU's mission of educating the defense workforce to support U.S. DoD digital transformation objectives. Credentials have been established for Digital Engineering (DE) and Secure Cyber Resilient Engineering (SCRE).

SERC Talks: System Certification
As part of the ongoing SERC Talks series, on 11 June Myron Hecht of the Aerospace Corporation spoke on how model-based systems engineering (MBSE), and SysML in particular, can enable and support certification. Hecht described three MBSE approaches to support certification - requirements traceability, profiles, and formal model - and provided an example and demonstration of each as well as advantages and disadvantages.

View the presentation abstract, slides and video here.

The Acquisition Game
The U.S. Defense Civilian Training Corps (DCTC) curriculum has incorporated a table-top gaming approach to deliver a deeper understanding of the DoD's acquisition processes and strategic decision-making to acquisition personnel. The Acquisition Game challenges players to support communities affected by a simulated crisis while navigating the DoD's three-phase acquisition process - technical solution, contracting approach, and program management - and balancing user satisfaction, schedule, and cost.

Access the latest SERC news here.
Follow SERC on LinkedIn.

INCOSE 2023 Annual Report and Q2 2024 Highlights

In June, INCOSE published both its 2023 Annual Report and Q2 Members Newsletter. A sample of various highlights is provided below.

2023 Annual Report

The INCOSE 2023 Annual Report replaces the previous annual Impact Statement and provides a more comprehensive overview of the organization's accomplishments, impact, and influence throughout the previous year. The report includes detailed information on membership enrollment data, demographics, and growth, showcasing INCOSE's initiatives, events, products and services that are indicative of INCOSE's expanding global reach.

Download the report.

Leadership Notes

Rolf Hartmann, INCOSE President, summarized progress in the "One INCOSE" initiative, citing refinements to the INCOSE Strategy based on broad community inputs.

Steve Records, INCOSE Executive Director, discussed how the phrase "*Think global, act local*" applies both to the contributions of the SE discipline to global sustainability, but also to the internal working of INCOSE. He cast a vision of INCOSE as a global network in collaborating volunteers.

INCOSE has joined the World Federation of Engineering Organizations (WFEO), which should increase global recognition and create new opportunities for collaboration with other global engineering societies. INCOSE plans to start a Systems Engineering Working Group within the WFEO.

David Long, INCOSE Director of Strategy, reported on progress in developing a new INCOSE strategic plan and how this plan better aligns the future of the INCOSE organization with the future of the SE discipline that was proposed in the Systems Engineering Vision 2035 document.

The Corporate Advisory Board (CAB) has added three new members:

- Wabtec Corporation
- Universidade Federalde Minas Gerais (UFMG)
- Weber State University (WSU)

UFMG is notable as the first Latin American university to join the CAB.

Sector and Chapter Updates

A sample of the second quarter highlights from INCOSE sectors and chapters include:

- The new INCOSE Thailand chapter reports the appointment of an interim slate of chapter officers who will guide chapter development and the planning for TSEC2024 – the first Thailand Systems Engineering Conference that will take place in August.
- JCOSE, the INCOSE Japan chapter, reflects on the impact of the INCOSE Japan Symposium 2024 that was held in February. Two SE books have been translated to Japanese: "*Systems Engineering Demystified*" by Jon Holt, and "*Don't Panic! – The Absolute Beginners Guide to SysMLv2*" by Tim Weilkiens and Christian Muggeo.
- KOSSE, the Korean Society of Systems Engineering, held a two-day symposium in May with the theme of *Systems Engineering-based Convergence Technology for the Realization of a Carbon-Neutral Society*.
- The Los Angeles chapter continued its monthly Speaker Meeting with a talk by Dr. Barclay
- Brown on *ChatGPT for SE*. Chapter members were also active in outreach at the local *City of STEM + Los Angeles Maker Faire* event.

- The San Diego chapter hosted a presentation on Zero Trust (ZT) by the U.S. Navy's David Voelker.
- The Huntsville Regional chapter (HRC) learned more about the keys to success when applying MBSE to defense programs from Jennifer Montgomery. The chapter also hosted the Digital Engineering/Model-Based Systems Engineering (DE/MBSE) Symposium in May with over 150 attendees. The Rocket City student chapter associated with HRC hosted a "paint night" to engage future engineers in fun activities that displayed their artistic skills.
- The Brazil chapter celebrated its 12th anniversary with the appointment of a new slate of chapter leaders. Chapter members were active in the process brought about CAB membership for the Federal University of Minas Gerais (UFMG). The chapter also participated in a well-attended MBSE-focused event sponsored by Dassault Systèmes.
- The Canada chapter heard from Lou Wheatcraft on Needs, Requirements, Verification, and Validation Management (NRVVM). Chapter members also took part in the IEEE's SYSCON 2024 Conference that was held in Montreal in April.
- GfSE, the German chapter is participating in the CASCaDE (Collaborative Advanced Specification, Content and Data Exchange) project to harmonize the SpecIF and Digital Data Package (DDP) data exchange standards.
- The UK chapter is preparing for two events: A one-day online course on Don't Panic! The Absolute Beginner's Guide to MBSE will take place on 8 October. ASEC 2024, the INCOSE UK Annual Systems Engineering Conference, will be held on 5-6 November.
- The Turkey chapter held the INCOSE Istanbul Meet Up in May with the theme "*Extended SE Toolbox for Sustainability*", with keynotes from Cecilia Haskins and Terje Fossnes.

Working Group and Initiative Updates

Various working groups and initiatives reported their progress, such as:

- The Healthcare Working Group (HCWG) reported on the outcomes from the 9th Annual Systems Engineering in Healthcare Conference that took place in April with the theme of "*Advancing the Practice of SE in Healthcare*". Key takeaways include the significance of AI progress and its potential impacts on the SE process, the growing importance of cybersecurity architecture practices, increased interest in digital SE (simulation + MBSE), and the enhancement of medical device safety through MBSE-enabled Failure Modes and Effects Analysis (FMEA). The importance of the latter was also underscored at the first International Conference on Medical Device Risk Management that also took place in April.
- The Technical Leadership Institute (TLI) reports that the twenty members of Cohort 8 will be inducted as full members in June at the completion of their two-year TLI journey and three demonstration projects.
- In May, the Systems Security Engineering (SSE) Working Group's Future of Systems Engineering – Security project team heard from Dr. Ron Ross, Technical Fellow at the U.S. National Institute of Standards and Technology (NIST) and a moving force behind NIST's Cybersecurity and Risk Management initiatives.
- The Systems Engineering and Architecting Doctoral Network (SEANET) held an event in March in conjunction with the 2024 Conference on Systems Engineering Research (CSER). In addition to guest speakers and round table discussions, the event enabled graduate students to network with fellow PhD students and mentors.
- The INCOSE SE Lab now provides member access to full-version software for non-commercial use. Tools currently available include Innoslate, Spicy SE, Trace.Space, and GENESYS.

The 2Q 2024 Member Newsletter also includes an article on Artificial Intelligence for Systems Engineering (AI4SE) by Dr. Steven Dam of SPEC Innovations. Dr. Dam described the flow of Natural Language Processing (NLP) algorithms and how NLP and Generative AI can create value within the SE process.

Download the full (87-page) INCOSE Q2 2024 Member Newsletter for details on these and other topics.

PDMA Strategic Planning Goals

The Board of Directors of the Product Development Management Association (PDMA) held a recent strategic planning session with a focus on enhancing PDMA's relevance and services, and expanding its global reach. Published goals and outcomes include:

- Expanding the New Product Development Professional (NPDP) Certification Program through a transition to online learning, investigation of outside accreditation and further development of educational solutions.
- Increasing the number on "connectedness" of PDMA chapters around the globe to promote sharing of sharing of knowledge and best practices across borders.
- Evaluating and selectively upgrading PDMA's technology platforms to enhance user experience.
- Enhancing governance practices including volunteer recruitment, leadership development, and succession planning.
- Assessing PDMA's relevance to the product community through surveys and voice of the customer research to inform longer-term strategic decisions.

INCOSE: Georgia Tech SEP Academic Equivalency Agreement

INCOSE has announced that an Academic Equivalency Agreeement has been approved for courses at the USA Georgia Institute of Technology. Students who pursue the Professional Master's Degree in Applied Systems Engineering (PMASE) at Georgia Tech will be assessed to have Academic Equivalence (AcEq) and are allowed to bypass the certification knowledge exam when applying for ASEP and CSEP Certification. The assessments they complete through their coursework have been recognized by the INCOSE Certification Program's volunteer reviewers as an equivalent alternative to the standardized test developed by INCOSE.

Learn more about the Academic Equivalency process here and in the Certification Blog.

Georgia Tech's two-year applied systems engineering program allows professional students to gain the knowledge and experience to advance in their careers. PMASE uses a cohort model that blends face-to-face instruction with 24/7 online learning. Learn more here.

Opportunities to Contribute to the Future of Augmented Reality (AR)

The Augmented Reality for Enterprise Alliance (the AREA) is a global non-profit, member-based organization dedicated to widespread adoption of interoperable AR-enabled enterprise systems. The mission of the Alliance is to "*help companies in all parts of the AR ecosystem to achieve greater operational efficiency through the smooth introduction and widespread adoption of interoperable AR-assisted enterprise systems*."

By identifying opportunities and challenges, disseminating information, spearheading research, promoting dialogue, and providing a forum for AR providers and enterprises, the AREA is clearing a path to interoperable AR-enabled enterprise systems that fully deliver on their promises.

The AREA has announced four new initiatives and is seeking partners to accelerate the maturity of AR-enabled enterprise systems:

- AREA Security Maturity Model: Proposed by the Security Committee, this will be a tool to understand potential AR security barriers and information on how to overcome them.
- AREA Academy: Committees have begun work on developing a leading edge training capability to educate professionals on how to successfully deploy augmented reality.
- Interoperability and Standards Policy: This is a new program and process to formalize and extend our interoperability and standards framework.
- AREA Statement of Needs Tool: AREA members are developing a global set of enterprise AR hardware and software requirements to accelerate the growth of the ecosystem.

Recognizing that augmented reality may be an important part of future solutions and also an engineering enabler, PPI SyEN readers are encouraged to investigate and contribute their expertise to these AREA initiatives.

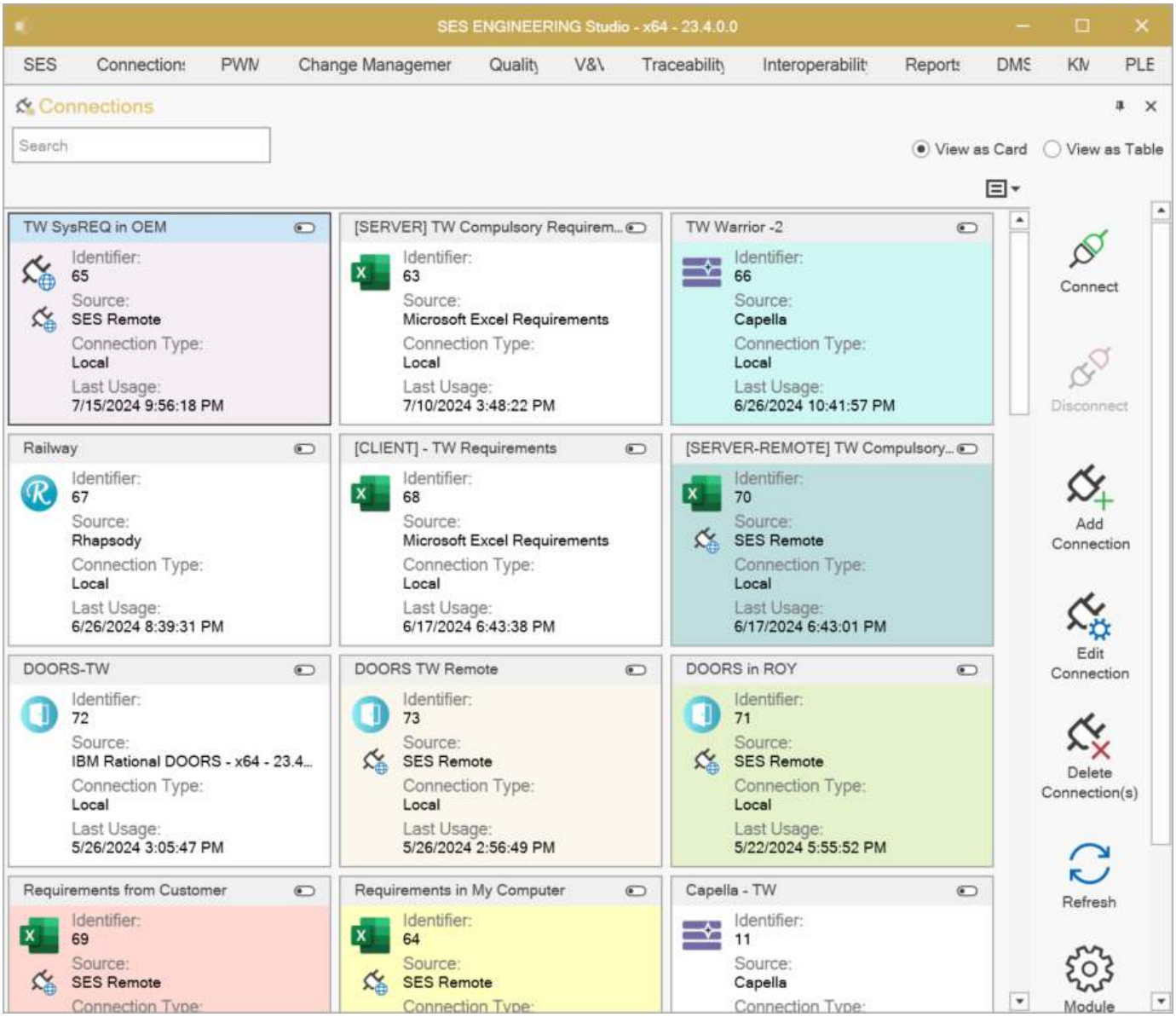
Investigate AR use cases.
Read the AREA blog. View the AREA news.
Join the AREA.

SES Engineering Studio and Interoperability Hub

SES ENGINEERING Studio, first released in 2023 and currently at v23.3, is the latest software solution from The REUSE Company, designed to tackle and enable the Systems Engineering digital thread. SES stands for Systems Engineering Suite and the SES ENGINEERING Studio is designed to support the following capabilities:

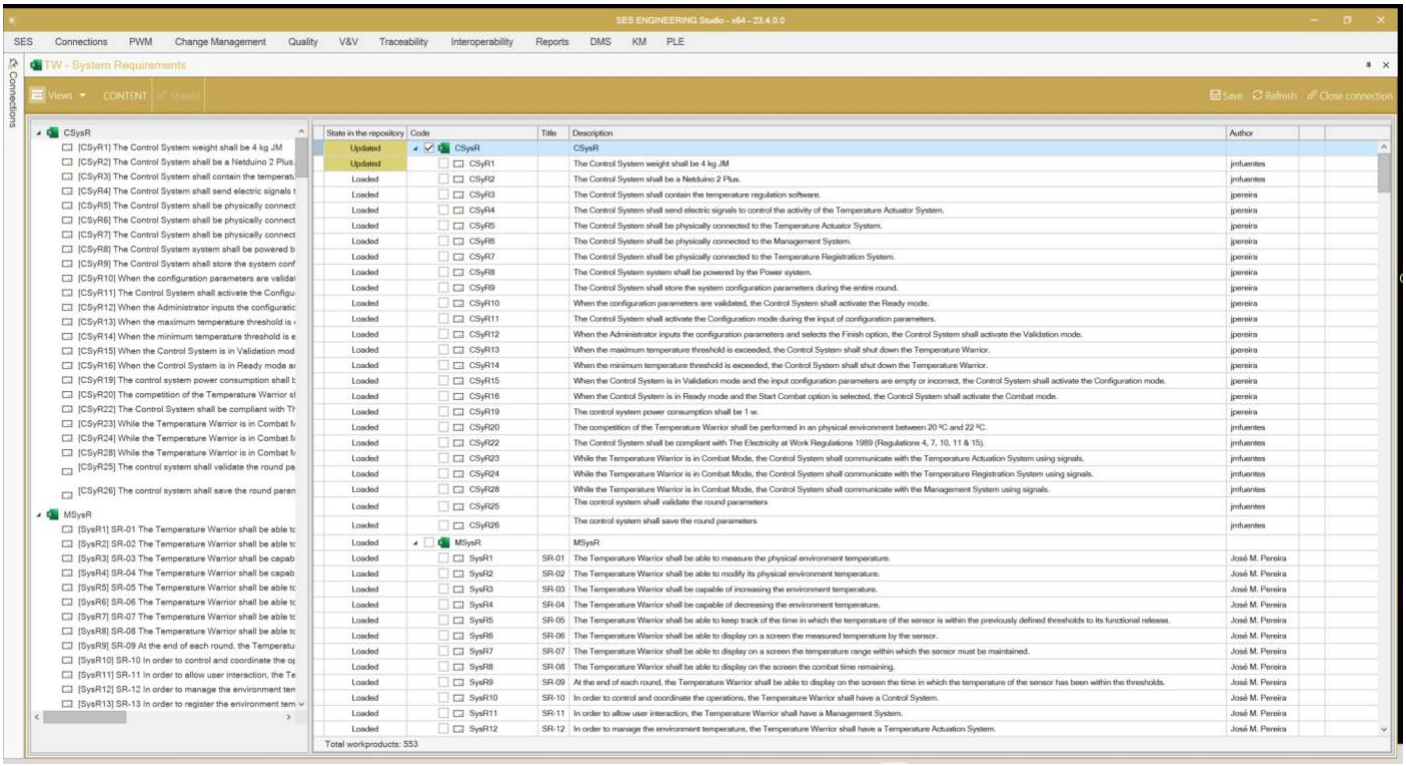
- Connectivity to the organization's tools ecosystem (either commercial or in-built)
- Traceability management between the artifacts of the connected tools
- Technical and organizational management digitalization
  - Quality Assurance
  - Decision Management via Artificial Intelligence Management
  - Risk Management
  - V&V Management
  - Information Management

    - Knowledge Management
- Project Lifecycle/Workflow Management
- Semantic Interoperability support



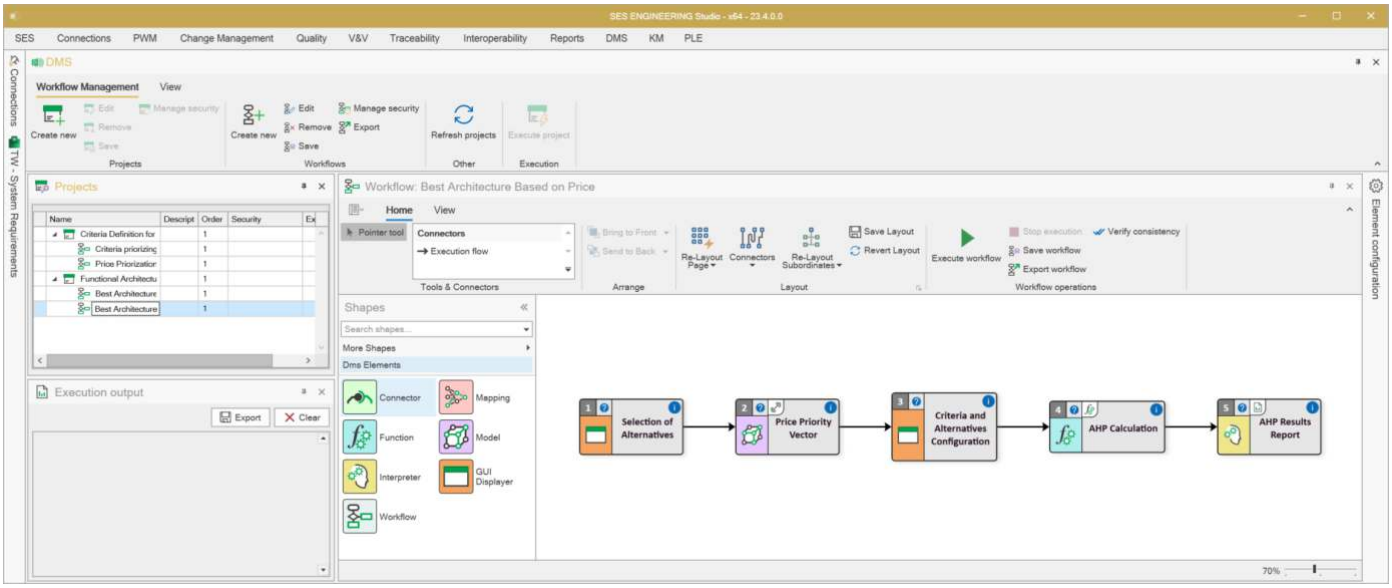
The set of capabilities has been designed to follow the concepts enabling systems reuse: an ontology as a repository and strong semantic methods for properly connecting the information from the connected tools.

To support the Semantic Interoperability capability, the REUSE Company has launched a new add-in for SES ENGINEERING Studio called the Interoperability Hub.



The **Interoperability Hub** aims to solve the challenge of integrating all the assets in the large ecosystem of tools, file formats, modeling languages, etc. to maintain the digital thread in a system engineering project. SES ENGINEERING Studio connects to more than 50 tools, and by doing so, the Interoperability Hub can establish a Synchronized Source of Truth. This approach is based on six pillars:

1. Connectivity: By connecting to more than 50 widely used tools, the Interoperability Hub enables a complete digital thread, allows the establishment of full traceability, and the exchange of information between the tools.
2. Semantic Traceability: SES ENGINEERING Studio includes a complete traceability module, that suggests new traces by using semantic methods and artificial intelligence.
3. Copying/Moving/Synchronizing work products: The Interoperability Hub enables data migration between heterogeneous tools and suggests operations for each pair of objects that are being synchronized. The mapping between source and target is fully customizable and one or more additional attributes in the source can be merged or synchronized with the target.
4. Transforming work products: A semantic engine makes transformations from one tool to another seamlessly, e.g. generation of requirements from models, and vice versa, generation of test cases from textual requirements, transformation of models into other domains, etc.
5. Remote Connectivity: The Interoperability Hub allows real-time connectivity between different tool ecosystems, in the same or different organizations, e.g., you can establish a connection from the customer's infrastructure to the content of the repositories where the provider is developing a document or a model, etc. The level of access has different possibilities, e.g., read-only mode.



The 6 pillars of the Interoperability Hub: https://youtu.be/F7g3bEBfMCE

For additional information on this approach, see Extended Interoperability

Learn more about The REUSE Company's technologies, products, and services.

SE Tools Database (SETDB) Updates

SETDB SYSTEMS ENGINEERING TOOLS DATABASE

The Systems Engineering Tools Database (SETDB), developed by PPI in partnership with INCOSE, provides a virtual platform for engineering tool vendors to communicate their latest offerings.

Recent SETDB updates, including both new tools and updates to existing tools, include:

Vendor: Perforce Software

- Helix ALM: Suite includes modules for different phases of development intended for enterprises to do requirements management (Helix RM), test case management (Helix TCM), and issue management (Helix IM).
- Helix RM: A requirements management tool intended for teams to capture requirements, perform requirements reviews, know what requirements are approved and stay aware of requirements change using Helix RM on its own, as part of the Helix ALM suite or with Jira.
- Helix IM: An issue management tool intended for teams to create, prioritize, and manage issues or product defects using Helix IM on its own or as part of the Helix ALM suite.
- Helix TCM: A test case management tool intended for teams to create, execute, and track cases and tests either using Helix TCM on its own, as part of the Helix ALM suite or even pairing it with your existing tools including Jira.
- Helix Plan: An enterprise Agile planning tool that provides a single place for decision-making at the project, program, and portfolio levels.
- IPLM: A scalable IP lifecycle management platform that tracks IP and its metadata across projects, providing end-to-end traceability and enabling effortless IP reuse.
- Jira Integration: Perforce Helix products come out of the box with a Jira integration. That means that no matter which application you're in — Helix ALM or Jira — you'll be up-to-date

on your project status. Plus, this makes it easy to link Jira issues with other artifacts in the development lifecycle.
- Helix Core: A version control platform for the gaming, VFX, and semiconductor industries, with an unrivaled ability to handle the expanding size and complexity of today's projects. it can store and track changes to all of your digital assets while enabling team collaboration.
- Helix Team-Hub: A code hosting and collaboration solution that can be utilized in either a cloud-hosted or self-hosted configuration. It can be used independently of Helix Core (cloud-hosted or self-hosted) or you can store your Git assets natively inside of Helix Core (self-hosted only).
- HELIX QAC: A preferred static code analyzer in tightly regulated and safety-critical industries that need to meet rigorous compliance requirements. It is certified for functional safety compliance including IEC 61508, ISO 26262, EN 50128, IEC 60880, and IEC 62304.
- Klockwork: A static code analysis and static application security testing (SAST) tool for C, C++, C#, Java, JavaScript, Python, and Kotlin. It scales to projects of any size, integrates with large complex environments and a wide range of developer tools, and with control, collaboration, and reports.

- Vendor: Siemens PLM Software

- Requirements Management: A modern data-driven approach by implementing a product lifecycle management (PLM) system. You can leverage an open, interoperable and flexible backbone which will manage the comprehensive digital twin and provide an integrated requirements and verification solution.

- Vendor: The REUSE Company

- SES ENGINEERING Studio: Software Tool designed to orchestrate the development of all kinds of systems (hardware, hybrid, software). It allows interoperability between an unlimited number of existing Systems Engineering Tools (RM), MBSE tools, Simulation Tools, Risks Management, RAMS Management, MS Office, etc.).
- SES RAT - AUTHORING Tool: Help authors compose requirement statements or other documentation, improving the project's overall quality. It is available for multiple engineering tools, like PTC Integrity, IBM DOORS and DNG, Microsoft Excel and Word, Capella, and IBM Rhapsody.
- SES Requirements Engineering for MS Word: This connector to MS Word allows you to define, measure, improve, and manage the quality of your requirements specifications. It allows assessment of Correctness, Consistency, and Completeness (CCC), traceability, verification, validation, and maintaining a digital thread.
- SES KM - KNOWLEDGE Manager: Allows you to manage knowledge from the systems engineering point of view and to store valuable information from requirements, models, system architectures and other documents in a common System Knowledge Base.
- SES RQA - QUALITY Studio®: A tool to automate the routine quality inspection and analysis of different engineering items, minimizing the cost of quality appraisals while increasing the quality and overall quality of the projects.
- SES V&V Studio: Merges the three concepts of verification, validation and quality assurance & management and offers V&V by managing the corresponding verification and validation actions through quality measures and other measures.
- SES Interoperability Hub: This add-in allows connectivity and interoperability between all the tools in your ecosystem. A digital thread is maintained and ensures traceability across

the system life cycle. The Interoperability Hub establishes a Synchronized Source of Truth (SSoT).

PPI SyEN readers are encouraged to check out these new and updated systems engineering tool offerings.

Access the SETDB website.

Upcoming PPI Live-Online ™ and In-Person Systems Engineering Five Day Courses

Click here to view the full schedule or register for an upcoming courses

P006-944	Las Vegas, USA PDT 8:00 (UTC -7:00) In-Person	05 Aug – 09 Aug 2024
P006-945-1	Asia SGT 6:00 (UTC +8:00) PPI Live-Online™	19 Aug – 23 Aug 2024
P006-945-2	Oceania AEST 8:00 (UTC +10:00) PPI Live-Online™	19 Aug – 23 Aug 2024
P006-946-1	Europe CEST 9:00 (UTC +2:00) PPI Live-Online™	23 Sep – 27 Sep 2024
P006-946-2	United Kingdom BST 8:00 (UTC +1:00) PPI Live-Online™	23 Sep – 27 Sep 2024
P006-946-3	South Africa SAST 9:00 (UTC +2:00) PPI Live-Online™ *(Exclusive to South Africa)*	23 Sep – 27 Sep 2024
P006-946-4	Turkey TRT 10:00 (UTC +3:00) PPI Live-Online™	23 Sep – 27 Sep 2024
P006-946-5	Saudi Arabia AST 10:00 (UTC +3:00) PPI Live-Online™	23 Sep – 27 Sep 2024
P006-947	Eindhoven, the Netherlands CEST 8:30 (UTC +2:00) In-Person	21 Oct – 25 Oct 2024
P006-948	Las Vegas, USA PDT 8:00 (UTC -7:00) In-Person	28 Oct – 01 Nov 2024
P006-949-1	Asia SGT 5:00 (UTC +8:00) PPI Live-Online™	11 Nov – 15 Nov 2024
P006-949-2	Oceania AEDT 8:00 (UTC +11:00) PPI Live-Online™	11 Nov – 15 Nov 2024
P006-952-1	Europe CET 9:00 (UTC +1:00) PPI Live-Online™	02 Dec – 06 Dec 2024
P006-952-2	United Kingdom GMT 8:00 (UTC +0:00) PPI Live-Online™	02 Dec – 06 Dec 2024
P006-952-3	South Africa SAST 10:00 (UTC +2:00) PPI Live-Online™ *(Exclusive to South Africa)*	02 Dec – 06 Dec 2024
P006-952-4	Turkey TRT 11:00 (UTC +3:00) PPI Live-Online™	02 Dec – 06 Dec 2024
P006-952-5	Saudi Arabia AST 11:00 (UTC +3:00) PPI Live-Online™	02 Dec – 06 Dec 2024

CONFERENCES, MEETINGS & WEBINARS

Smart Cities Week APAC

The Smart Cities Council (SCC) is hosting Smart Cities Week APAC in Adelaide, South Australia from 5-9 August. The conference will bring together leading global policymakers, thought leaders, academics, researchers, philanthropists and corporations to build capability, capacity and cross-sector collaboration that will deliver global positive social, environmental and economic outcomes.

Keynotes, technical and use case presentations, and expert panels will be organized into tracks, including domains such as:

- Buildings and Infrastructure
- Health and Aged Care
- Public Safety
- Resources and Utilities
- Tourism
- Transport and Mobility

Technology verticals that will be represented include:

- Artificial Intelligence & Machine Learning
- Augmented, Mixed & Virtual Reality
- Autonomous Mobility
- Blockchain
- Digital Infrastructure
- Digital Twins
- Internet of Things (IoT)

A sample of highlighted speakers include:

- Imelda Alexopoulos, Fleet Space
- Karandeep Chadha, Senior Manager, Transport for New South Wales (NSW)
- Delton Chen, Project Director & Founder, Global Carbon Reward
- Abi Croutear-Foy, Managing Director, AquaWatch Solutions
- Matt Gijselman, Bentley Systems
- Corey Gray, President, Smart Cities Council
- Dan Isaacs, CTO Digital Twin Consortium and SCC Digital Twin Lead
- Fanni Melles, Future of cities researcher at Vitruvian and SCC Youth Engagement Global Thought Leader

View the conference agenda.

Learn more about Smart Cities Week APAC. Register here.

Webinar: Tensions and Opportunities Between the Disciplines of PM and SE

The INCOSE Los Angeles chapter will be hosting a hybrid presentation on 13 August on the topic, *Tensions and Opportunities Between the Disciplines of PM and SE*. The in-person venue will be the Aerospace Corporation in El Segundo, California, USA.

Dr. Tina P. Srivastava and Mark Kaufman, PMP, Co-Chairs INCOSE PM-SE Integration Working Group will compare project roles performed by program managers, systems engineers, and those performed jointly.

Abstract:
The disciplines of Program Management and Systems Engineering are inherently intertwined. To develop and deliver complex systems, all three sides of the "iron triangle" (cost, schedule, and scope) must be known, traded, and evolved in consideration of the others. When there is tension and confusion over the roles of program managers versus systems engineers, programs suffer from deadline overruns and failures. This presentation will discuss project roles performed by program managers, systems engineers, and those performed jointly. Success in these roles depends on strong collaboration. Sources of tension will be identified and ways to manage this tension discussed. This presentation will highlight the work of the PM-SE Integration Working Group.

Learn more and register here.

Product Development Learning Opportunities in August

The Product Development Management Association (PDMA) is offering several learning opportunities in August to advance product development and innovation skills.

Sustainable Product Innovation: Integrating B Corp Principles & UN SDGs (8 August)

Dr. Dawn Rennick, CEO of Piercing Sun Consulting, will present this free one-hour webinar to explore how to seamlessly integrate sustainable product development methodologies and lifecycle management with B Corp and B Movement principles to align with and achieve the United Nations Sustainable Development Goals (UN SDGs). This webcast will provide actionable insights and strategies for embedding sustainability at every stage of product development, from ideation to end-of-life. Learn how adopting these holistic frameworks can drive innovation, enhance brand value, and contribute to a sustainable future, all while meeting consumer demand for responsible products.

Learn more and register.

Workshop: Being a Strategic Superstar in Your Company is a Matter of VOC (15 August).

During this virtual half-day workshop, Ulrike Laubner-Kelleher, founder of RedStringMethods, will teach attendees both how to interview customers and how to make sense of the data they collect. The event will consist of an introduction, a bit of lecture, ample time to practice interviewing, and a

module on data analysis to the vast impact of VOC for product strategy, prioritization and marketing. Expected outcomes include:

- Learn interviewing best practices
- Practice interviewing and receive live coaching
- Learn how to analyze and make sense of their interview data for product creation, development and marketing
- Receive an interview template to help with future interviews
- Get access to The Strategic Product Management Workbook, which is designed to help product managers understand their everyday work
- Leave with personal actions to boost their product strategy

Learn more and register.

Join PDMA.

Business Process Management Conference: BPM 2024

The 22nd Business Process Management Conference (BPM 2024) will take place in Krakow, Poland on 1-6 September. BPM 2024 is organized and hosted by the AGH University of Krakow. Technical presentations will be organized into three tracks: Foundations, Engineering and Management.

BPM 2024 combines multiple learning, collaboration and networking experiences including:

- Doctoral Consortium on 1 September
- Workshops on 2 September
- Main Conference (including Industry Forum) on 3-5 September
- Co-located event – 5th BPM Symposium (to be conducted in Polish) on 6 September

Keynote speakers for BPM 2024 include:

- Alexander Serebrenik, Eindhoven University of Technology, The Netherlands
- Flavia Santoro, Institute of Technology and Leadership (Inteli) and University of the State of Rio de Janeiro, Brazil
- Tomasz Głowacki, Żabka Group, Poland

BPM 2024 will offer eleven elective workshops:

- Artificial Intelligence for Business Process Management (AI4BPM)
- Business Process Intelligence (BPI)
- Business Process Optimization (BPO)
- Business Processes Meet the Internet-of-Things (BP-Meet-IoT)
- Change, Drift, and Dynamics of Organizational Processes
- Declarative, decision and hybrid approaches to processes (DEC2H)
- Formal Methods for Business Process Management (FM-BPM)
- Managing Process Innovation and Value Creation in the Era of Digital Transformation
- Object-centric processes from A to Z (OBJECTS)

- Natural Language Processing for Business Process Management (NLP4BPM)
- Social and Human Aspects of Business Process Management (BPMS2)

Register for BPM 2024.

ACM International Systems and Software Product Line Conference (SPLC 2024)

The 28th Association for Computing Machinery (ACM) International Systems and Software Product Line Conference (SPLC 2024) will take place on 2-6 September in Luxembourg. SPLC 2024 provides a forum for where researchers, practitioners, and educators can present and discuss the most recent ideas, trends, experiences, and challenges product line engineering for software and systems. The SPLC is an international collaboration that has resulted from the merger of two former events: SPLC (which started in 2000 in the USA) and Product Family Engineering (PFE, which started in 1996 in Europe).

In addition to keynote speeches, demonstrations, tutorials, panels, and a doctoral symposium, SPLC 2024 will feature two workshops:

International Workshop on Reverse Variability Engineering and Evolution of Software-Intensive Systems (Re:Volution)
Managing variability in configurable systems remains a challenging endeavor for multiple reasons. First, variability must be properly defined using domain knowledge and reusable software artifacts, often relying on extraction and refinement of legacy assets. Second, variability must be maintained during evolution in time (revisions) and space (variants). Recently, several research activities have focused on enabling the integrated management of evolution and variability. Existing approaches stem from multiple origins, notably software configuration management and product line engineering.

Re:Volution joins the motivations originating from REVE and VariVolution and aims to bring together active researchers eliciting software variability and studying its evolution from different angles and practitioners who encounter these phenomena in real-world applications and systems. The workshop offers a platform for exchanging novel ideas, case studies, and tools and fosters future research collaborations and synergies.

Seventh International Workshop on Languages for Modelling Variability (MODEVAR@SPLC 2024)
More than 30 years ago feature models were invented. Nowadays they play a major role in Software Product Line engineering. Since then many different feature modelling variants and extensions have been developed. Although there have been several attempts to establish a standard approach (e.g., OVM, CVL, TVL, ...) there is still no consensus on a simple feature modelling language. However, such a language would improve information sharing among researchers and tool developers. Thus, the seventh edition of the workshop follows the spirit of previous editions at SPLC (2019–2022) and at VaMoS (2020 and 2024), to develop a simple feature modelling language that the community can agree on. After questionnaires and discussions among participants of the past six editions, community members proposed the Universal Variability Language (UVL). During this full-day, interactive event all participants shall share knowledge and progress about how to improve and integrate the language to further increase its outreach.

Learn more about SPLC 2024 and prior SPLC conferences.
Register for SPLC 2024.

Registration Open for SWISSED24 Conference

The Swiss Society of Systems Engineering (SSSE), an INCOSE chapter chartered in 2011, is hosting the annual Swiss Systems Engineering Day 2024 (SWISSED24) in Zurich on 9 September. The conference theme of *Building Bridges* will be supported by presentations concerning transformational journeys from:

- Practice to Science
- Waterfall to Agile
- Startup to Corporate
- Methodology to Process

Keynote lecturers include:

- Udo Scheff, PhD. Vice President Engineering for the Small and Mid Tractor series at John Deere
- Tobias Luthe, PhD. Program Director, ETH Zurich. Associate Professor for Systemic Design, The Oslo School of Architecture and Design. Director of the MonViso Institute.

A virtual attendance option is available.

Learn more about SWISSED24. Register here.

Follow SSEE on LinkedIn.

> *Physical concept drives logical design. If it doesn't, we have an exercise in fantasy.*
>
> **Robert Halligan**

FEATURE ARTICLE

The Reformation is Overdue: Advancing Systems Engineering towards Holistic Engineering

by Roger McCowan

email: rmccowan@bigpond.net.au

Authored for PPI SyEN

Abstract

The superpower of Systems Engineers is Integration - integration of disciplines, integration of subsystems and systems based on their relationships and respective behaviors. To design, develop and implement sustainable solutions to real world problems that integrate social, environmental, cultural, and economic systems, we can extend our approach through 'Holistic Engineering'. Holistic Engineering views situations as sensitive systems, focusing not on objects and their properties but on dynamic hubs having permeable boundaries evolving on a distributed continuum of connectivity and sensitivity. Furthermore, it is particularly applicable in developing communities, where the resources may not support full-scale systems engineering.

Introduction

Like the Christian Church that underwent a reformation in the 1500s due to perceived differences in doctrine, Systems Engineering can now evolve through a reformation. Although the name and focus seemed logical in the early days within Defense and Aerospace for the complex systems those sectors required, expanding our approach will better prepare us for the solutions needed in the third millennium and beyond.

Engineering involves the application of science to optimally convert nature's resources for humankind's use, based on physics, chemistry, and mathematics and their extensions into materials science, solid and fluid mechanics, thermodynamics, transfer and rate processes, and systems analysis. Thus we have:

- Electrical Engineers are problem-solvers who study and apply the physics and mathematics of electricity, electromagnetism and electronics to both large- and small-scale systems to process information and transmit energy.
- Environmental engineers use engineering disciplines to design systems for managing and cleaning municipal water supplies, developing solutions to problems of planetary health.
- Civil engineers design, construct, manage and maintain the infrastructure of modern

society, which includes developing transport systems, water supply and sewage systems, and flood mitigation works.

Other branches of Engineering (such as Chemical) also claim to design and develop systems to provide solutions. So what distinguishes 'Systems Engineering' from these other engineering disciplines that develop systems? From INCOSE, we have the definition that

"*Systems Engineering is defined as a transdisciplinary and integrative approach to enable the successful realization, use, and retirement of engineered systems. This involves applying systems principles and concepts, along with scientific, technological, and management methods, to achieve desired outcomes. The term "engineering" is used in its broadest sense to encompass the creative and artful process of bringing something about.*

An engineered system, according to INCOSE, is a system designed or adapted to interact with an operational environment to achieve specific purposes while complying with applicable constraints. These systems can be composed of various elements, including people, products, services, information, processes, and natural elements.

Systems Engineering focuses on several key areas:

- *Establishing and integrating stakeholders' goals, purposes, and success criteria.*
- *Defining customer needs, operational concepts, and required functionalities early in the development cycle.*
- *Establishing appropriate lifecycle models, process approaches, and governance structures.*
- *Generating and evaluating alternative solution concepts and architectures.*
- *Baselining and modelling requirements and selected solution architectures for each phase.*
- *Performing design synthesis, verification, and validation.*
- *Considering both the problem and solution domains, including necessary enabling systems and services.*

The approach ensures that the interactions between the parts and the whole system, as well as the environment, are considered to achieve a satisfactory outcome. Systems Engineering provides the facilitation, guidance, and leadership necessary to integrate relevant disciplines and specialty groups into a cohesive effort from concept to production, operation, evolution, and eventual disposal."

At the Australian Systems Engineering Workshop in 2019, Dr. Richard Hodge delivered a presentation postulating that the '*superpower*' of Systems Engineers is *Integration*. But are these aspects necessary and sufficient to retain the title of Systems Engineering?

I perceive that there is a void in the spectrum of engineering disciplines on a global scale; a void which potentially can be filled by those Systems Engineers who are willing to commit to this evolution. This expanded discipline, which I refer to as Holistic Engineering (Vengerov, 2002), aims to fill that void and address the complex challenges we face.

The Void and Reformation of Doctrine

Let me start by paraphrasing and transforming the definition of Engineering. The altruistic purpose of Engineering is to apply science, mathematics, and their extensions along with ingenuity to design, develop and implement sustainable solutions to real-world problems that **integrate social, environmental, cultural, and economic systems**. Throughout this article, I shall refer to this

expanded view of Engineering as Holistic Engineering.

Consider this: From its inception 30 years ago, the Systems Engineering Society of Australia (the Australian Chapter of INCOSE) has experienced a remarkable ten-fold growth to now have a membership of over 1000. Australia's peak engineering body, Engineers Australia, has a current membership of about 112,000, the majority in the field of civil engineering and other fields aligned with the traditional colleges. This suggests that Systems Engineers account for about 1% of all engineers. To date, the practice of Systems Engineering has been adopted in about 25% of the world's countries/nations. Even within this 25%, I would venture to suggest that Systems Engineers account for approximately 1% of the engineering population. It would be the subject of a research program of its own to ascertain and understand the circumstances limiting the uptake of systems engineering. Perhaps the resources are not available for full-scale systems engineering, whether it is needed or not, particularly in developing countries. Perhaps it is not seen to be relevant (or applicable) to a lot of systems such as electrical systems, water distribution systems, communication systems, transportation systems, and manufacturing systems.

In 2015, the United Nations established 17 Sustainable Development Goals, as outlined below:

1. *End poverty in all its forms everywhere.*
2. *End hunger, achieve food security and improved nutrition and promote sustainable agriculture.*
3. *Ensure healthy lives and promote well-being for all at all ages.*
4. *Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.*
5. *Achieve gender equality and empower all women and girls.*
6. *Ensure availability and sustainable management of water and sanitation for all.*
7. *Ensure access to affordable, reliable, sustainable, and modern energy for all.*
8. *Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.*
9. *Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.*
10. *Reduce inequality within and among countries.*
11. *Make cities and human settlements inclusive, safe, resilient, and sustainable.*
12. *Ensure sustainable consumption and production patterns.*
13. *Take urgent action to combat climate change and its impacts.*
14. *Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.*
15. *Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.*
16. *Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels; and*
17. *Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.*

Achieving each of these goals addresses problems which have multiple layers of complexity, which is where systems engineering can excel. Regardless, this list of goals prompts the question, *"Now nine years, hence, how well does the Systems Engineering Process align with what is needed to achieve these goals?"*

While many professions can (and must) contribute to the achievement of these goals, it is Engineers,

through their training, ingenuity, and innovation, who can design, develop, and implement the myriad of solutions needed. Even using the INCOSE description for the role of Systems Engineers, can we truly believe that the Systems Engineering processes as espoused in the INCOSE Systems Engineering Handbook are adequate and sufficient to guide the development of solutions to all these 17 goals?

Other developments in this third millennium also challenge the adequacy of the Systems Engineering view as it currently exists. One such example is that of Artificial Intelligence. In René King's feature article, *Systems Engineering and Artificial Intelligence: Evolution, Challenges & Application,* in PPI-SyEN #136 (May 2024), are the following observations.

"Integrating AI with SE presents several challenges due to the dynamic nature of AI systems, rapid technological advancements, and the complexities involved in merging AI with existing systems engineering frameworks.

- *Complexity in Requirements: AI systems are characterized by dynamic and complex requirements that are difficult to manage with traditional SE approaches. The iterative development nature of AI, particularly with machine learning models that evolve with new data, poses a significant challenge to the static processes typically used in SE (Lee & Kim, 2021).*
- *Technological Pace: The swift progression of AI technology frequently outpaces the slower, more systematic procedures of conventional SE. Keeping up with AI innovation while guaranteeing comprehensive testing and validation poses an ongoing challenge (Jones et al., 2022).*
- *Integration with Existing Systems: Incorporating AI into established SE frameworks often requires substantial modifications to existing processes and infrastructure, making integration efforts resource-intensive and complex (Sheikh, 2024)."*

Holistic Engineering embodies the intent of sublime Systems Engineering. This is not to say that traditional Systems Engineers are no longer needed. Just as 2,000 years ago saw the rise of civil engineers who designed and built aqueducts, roads, and bridges, civil engineers are still needed today. Just as 200 years ago saw the rise of mechanical engineers who could design and build the machines that fed the Industrial Revolution, mechanical engineers too are still needed today. So in recent years the world has seen the rise of Systems Engineers who could design and build complex systems, and this need for Systems Engineers will continue into the future.

Holistic Engineering considers the concept of "system of systems" within the context of planet Earth. It involves developing methods and practices that reflect the holistic approach, considering the impact on developing economies and countries. In simple terms, it is about transforming Systems Engineering into a viable discipline in countries that do not have the resources that first-world countries have.

The creation of sustainable solutions therefore calls for a Holistic Engineer, someone steeped in technology but also fluent in many "languages", including those of design, management, economics, and the social sciences. By integrating these concerns into the engineering sciences, engineers can solve the complex problems we face in improving our world.

A Vision for the Reformation

My undergraduate engineering studies were in the fields of electronics and communications, the latter having a heavy emphasis on interfacing and integration, which led to my transition to Systems Engineering. However, to properly practice Systems Engineering required additional ingredients beyond Communications Engineering. The same applies to Holistic Engineering. It is not just new

name for the Systems Engineering that gets applied to solving the complex problems; it introduces a new ingredient that must be learned, understood, and applied. That ingredient is "Harmonomics", which is the discipline that studies the most general and universal forms, ways, and dynamics of all evolving systems (Vengerov, 2002). Harmonomics focuses on the processes of natural harmonization of all types of sensitivity. Holistic Engineering utilizes this knowledge and skills by studying and practicing harmonomics, making it the approach to handling complex systems satisfactorily, irrespective of their composition.

Let me explain. Similar to the ideas of the General Systems Theory introduced by the Austrian biologist Ludvig von Bertalanfi (Bertalanfi, 1968), everything can be seen as a system with some kind of universal laws and principles. Bertalanfi claims that at the initial stage, all systems (biological, neurological, and psychological) are controlled by a dynamic interaction of their components. His view is that organic and nonorganic systems have much in common. At a later stage, systems with dynamic interactions develop a stable mechanism that makes the system more effective. Bertalanfi asserts that this fixed mechanism gradually reduces and finally disposes of the equipotentiality previously inherent to the system. This means that even when starting from unequal initial conditions and following diverse routes, the systems still retain the chance of arriving at the same destination (Lektorski, Sadovski, 1960).

Thus the difference with the Holistic Engineering approach lies in the way we see these systems, what we pay attention to, and what we seek to achieve after their analysis. Holistic Engineering sees situations as sensitive systems and deals not with objects and their properties but with aspects of *connectivity and sensitivity* that constitute the main tissue out of which everything is made.
This vision largely determines the reaction of an observer and follows behavioral and engineering practices. The main aspects of the Holistic Engineering vision include the shift:

- From attempts to control creating and maintaining harmony.
- From environments to more amorphous, fluid, and fuzzy concepts of situations.
- From objects and relationships to dynamic hubs with permeable boundaries evolving on a distributed continuum of connectivity and sensitivity; and
- From structures to dynamic patterns.

These differences themselves can gradually increase and decrease depending on the level of sensitivity in various systems.

Before there is too much runaway development of niches of Holistic Engineering, there needs to be universal acceptance of the term to describe the quintessential engineer of the third millennium. From dictionary.com, the following definitions of holistic have been extracted:

- Emphasizing the importance of the whole and the interdependence of its parts.
- Emphasizing the organic or functional relation between parts and the whole.

In essence, whilst Systems Engineering provides the engineering approach that considers the interactions of non-natural systems (built environment, anthrosphere), Holistic Engineering addresses the encompassing engineering approach that considers the interactions of non-natural systems with natural systems (biosphere, atmosphere, geosphere, and hydrosphere). As such, Holistic Engineering becomes a central element of human society. Therefore, Holistic Engineers need to understand and Consider the relationships between natural and non-natural systems when creating the

solutions needed to sustain the quality of life of current and future generations.

Traits of Holistic Engineers

Having encapsulated a vision for Holistic Engineering, there is merit is examining the traits which distinguish Holistic Engineers from Engineers in other fields, particularly Systems Engineers.

Whilst recent research has demonstrated that the left-brain/right-brain theory is outdated, its popularity persists. This theory suggests that people who are left-brain dominant exhibit traits such as logical, analytical, linear, verbal, factual and sequential. These individuals typically excel in careers involving linear thinking, math, and verbal information, such as accountant, scientist, and engineering. Conversely, people who are right-brained dominant exhibit traits such as creativity, intuition, artistic ability, non-verbal communication, emotionality and imagination. These individuals often excel in careers involving creative expression and free-thinking, such as art, psychology, and writing.

To be effective as a Holistic Engineer, one must exhibit the traits of both left-brained and right-brained in equal or balanced proportion. Whilst it would be beneficial for a Holistic Engineer to apply the principles of Systems Thinking – endeavoring to understand the big picture and recognizing that a system's structure generates its behavior – these principles, steeped in logic and analysis, fall short of what is needed to properly perform Holistic Engineering. What is also needed is a heightened sensitivity, being aware of the aspects of connectivity and sensitivity that constitute the main tissue of everything. This allows for designing solutions that properly address all aspects of problems existing within any environment, any culture, or any society.

Beyond the Vision

To sustain the quality of life of current and future generations, we must transition our thinking and ensure that Holistic Engineers are available to create the structures needed for the future.

As a start, we must train students to understand the interaction of the built environment with natural systems, and the role of technical and non-technical (economic, social, ecological, ethical, cultural, etc.) issues shaping engineering decisions in the world today. In particular, we should educate globally responsible engineering students and professionals who can offer sustainable and appropriate solutions to the endemic problems faced by developing communities worldwide, as encapsulated in the UN's Sustainable Development Goals.

The intended aim is for emerging and practicing engineers to make intelligent and harmless decisions that enhance the quality of life on Earth while at the same time preserving natural and cultural diversity. This vision encompasses a profession committed to a more sustainable world, avoiding consequences of engineering projects and systems that are socially, culturally, or economically inappropriate. Engineers have a central role in building a sustainable future; we have an obligation to provide leadership in that direction. The aim of this obligation is a world where all 17 of the UN Sustainable Development Goals have been achieved. At the very least, we seek a world in which all people have access to adequate sanitation, safe drinking water, and the resources and knowledge to meet their development needs.

However, it would be naïve to believe that there won't be hard tradeoffs required between the SDG's. The hard-to-solve global challenges are hard because they have to account for:

- Widely varying stakeholder beliefs and values
- A set of historical system "states"

- Real and significant resource constraints, absent a transformative breakthrough such as cheap, universally available fusion energy

None of these realities imply that the SE processes as taught by INCOSE are fundamentally deficient. A premise of this article is that the education and development of Systems Engineers has fallen short of equipping them with the tools needed to fulfill such goals. Consequently, there are several other aspects that should be addressed to ensure that Holistic Engineers are provided with the wherewithal they need. These include:

- Educating to develop a new generation of engineers, who will benefit from seeing the many facets of engineering solutions to problems in developing communities, beyond the technical skills obtained in their basic education; and in the education of host-community partners.
- Recognizing that the non-engineering components of local needs are often more complicated than the engineering aspects and seeking to instill this reality within the engineering profession.
- Establishing partnerships with a broad cadre of institutional, academic, development, and engineering professionals that are willing to assist in building toward a more equitable and sustainable world.
- Believing in sustainable projects that are symbiotic with the environment, society, and culture and build capacity for people to solve their own problems.
- Affirming change that can contribute positively to communities; change that if started now will provide new solutions over time; and change that can interrupt the cycle of poverty.
- Upholding ethics that require the highest level of integrity; promoting honesty, communication, and forthright disclosure; promoting human dignity, value, and respect of diversity; promoting social responsibility and appropriate action; promoting fairness and equitable distribution of time, effort, and resources; promoting responsibility to share skills and resources; and recognizing that people should not be exploited in any form whatsoever.

At the Australasian Systems Engineering and Test and Evaluation Conference (SETE) in 2006, there was a panel session to discuss "*Beyond Traditional Systems Engineering*", triggered by issues of the time such as Systems of Systems, Internet of Things, etc. The intention was to get delegates to think outside the box. I was invited to be a panelist and used the occasion to briefly touch on the concept of Holistic Engineering as the bigger box which the Systems Engineering box sits inside. If you have read this article to this point, no doubt you have started contemplating how you might incorporate the ingredient of Harmonomics into your systems thinking to become a Holistic Engineer. The Reformation is overdue, but it is not too late. Of all the engineering disciplines, I believe that Systems Engineers are the best placed to become the Reformers and Holistic Engineers who develop solutions for the future of our world.

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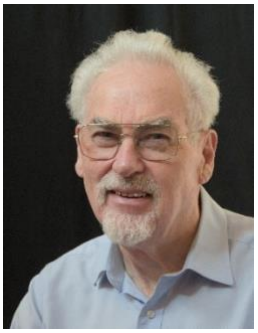
About the Author



In a career which spans 50 years, Roger McCowan has mentored, guided and encouraged others on their engineering journey. He was co-founder of the Systems Engineering Society of Australia, and for several years was an industry-based lecturer to Master of Systems Engineering Students at RMIT University. He graduated with a degree in Communications Engineering and worked for several years in the telecommunications industry before transitioning to Systems Engineering, where he worked on a range of major projects for civil infrastructure (Air Traffic Management Systems, Road Transport Tolling Systems) as well as numerous Defense projects, one of which was leading a small team to investigate an operational issue encountered by the Royal Australian Navy and develop a solution. This project was awarded a Gold Commendation by the Chief of Navy at the time.

Roger has specialized in requirements analysis and development, and in verification and validation. He has presented papers at various systems engineering conferences, as well as co-authoring several articles which were published in the quarterly magazine of the Systems Engineering Society of Australia.

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Teaching is not the filling of the pail, rather the lighting of the fire.

William Butler Yeats

PPI SyEN SPOTLIGHT: Deploying Modeling in the Field

PPI's John Fitch (JF) sat down with Juan Navas (JN) from Thales to discuss practical lessons learning concerning the deployment of system modeling "in the field".

This interview is based on the author's talk during an event of the French association GIFAS (Groupement des Industries Françaises Aéronautiques et Spatiales) in November 2023.

JF: What would you say to naysayers of INCOSE Vision 2035 who question the primacy and realism of the model-centered future that the "consensus" vision statement implies?

JN: MBSE surely is a strong trend, a fact – even if it is a bit slow in the systems domain compared with software engineering. That's especially true if you use the wider definition of models, including not only architectural models but also encompassing simulation and analysis models. Given this wider definition, we can say that more and more people are using formalized approaches based on data to perform engineering. In a sense it doesn't matter if this is a consensus view; it's a trend and most likely those who don't follow this trend can expect to lag behind their competitors.

Of course, there are also other trends (such as AI, to be discussed later) that may completely redefine how models are used in engineering.

JF: What parts of this vision give you the most concern?

JN: It's a vision, so of course it's challenging. I wholeheartedly share the INCOSE vision, which is much larger than the use of models. Models are enablers for other components of the vision – acceleration of engineering processes, data analysis and pattern analysis to name a few.

JF: Which anticipated benefits of models (as methods to unleash the power of computing) are the primary drivers of modeling investments today?

JN: The drivers are project-driven and often a combination of factors. The most common objective that triggers investment is the expectation of better technical communication among stakeholders – knowing assumptions, unleashing the power of computing to create diagrams and views that are understandable by the largest number of project stakeholders, that improve the quality of communication between these stakeholders, and that allow them to reach a shared understanding of the engineering outcomes.

Another common driver is that models help to secure the design in terms of reliability, engineering quality and repeatability of outcomes. Still another driver is projects using the power of computing to increase the speed of system development, perhaps by generating a 50-page document directly from the model.

There is no single answer; the typical drivers are some combination of communications, design quality and speed.

JF: What trends do you see as driving the evolution of modeling practices today?

JN: Focusing on architecture models, the effort that it takes to build a model is being reduced over time. When I began my career, we used UML for system architecture. It was quite cumbersome because we were doing things that weren't natural to us. Much of UML was not adding value in defining systems architecture, but we didn't know that at the time.

To some extent MBSE is also about building artifacts that can be understood and leveraged by machines. Just as software engineering has moved from low-level to higher-level languages (e.g. from Assembler to Python), MBSE languages are becoming better adapted to us humans. I expect that this trend will continue and even accelerate.

JF: In previous talks you have recommended the development of a "Guide to Building and Assessing Models" that would have the same spirit as INCOSE's "Guide for Writing Requirements". What in-progress work have you seen that represents a good start toward this Guide?

JN: I have not seen a lot of progress so far. We at Thales did some work a few years ago in defining quality criteria for models – accuracy, consistency, completeness, … - and some guidelines on how to assess and achieve these criteria. As a systems engineering community, we need a modeling equivalent to the INCOSE Guide for Writing Requirements where they clearly define assessment criteria and the characteristics of requirements that comply with these criteria. Simply said, we need to know whether a model is a "good" one with regards to some criteria.

However, models are very different from requirements. Requirements are units of knowledge: they are mostly used as atomic units with some links between them, this is their strength but also their weakness, as addressing large sets of requirements is quite challenging. Models assimilate this complexity, as models are networks of knowledge. Assessing model consistency will be different from requirements consistency. We need to leverage languages that are well-adapted to systems engineering and that can help us ensure consistency by construction.

It's also very difficult to assess the completeness of a model; there is a lack in our ability to do this. We have done some work on model completeness at Thales, but there is much more to be done – a call to the systems engineering community. Personally, I would be very interested in working on this with others.

Although there are good quality models, it is very difficult today to provide an objective assessment of the quality of an architectural model.

JF: Given the very broad range of modeling approaches (e.g. descriptive/architectural, state machine, math/physics/multi-physics, event simulation, system dynamics, etc.) that are relevant to system modeling, how useful can a generalized Model Building/Assessment guide be when compared to specialized guidance by modeling type?

JN: That's a very good question. There's a similar problem with the Guide to Writing Requirements. It's a very good guide, but it's a very general one. So, when we want to focus on something like

requirements in the avionics domain, the guide needs to be tailored.

We can define general guidelines for modeling, but when we want to work on guidelines for the assessment of architecture models, they will differ from other modeling types. And perhaps they will need to be tailored per domain as well. Modeling guides need to be tailored for the various modeling types, however there are general principles that span these types of models. At Thales, we have been focused on architecture modeling.

JF: Which "field-proven strategies" for the development and use of analytical models do you recommend?

JN: One major one is that we need to narrow our focus initially to one type of model and overcome our tendency to "simulate everything" at system design level.

When we work with static models (those that can't be simulated) we can have a wider scope of analysis – perhaps the whole set of capabilities to be offered by a system, allocated down to the physical components of the system. When we do simulation, we have to narrow the scope of analysis. We must significantly enrich the architecture model before it can be simulated. Perhaps new technology will reduce these constraints over time. In the meantime, we can use the architectural model to identify the critical functional chains or scenarios that really need to be simulated – while remaining within cost and schedule constraints.

I hope that future technologies will simplify the architecture to simulation modeling process – build the simulation model from the architecture. But even with these improvements, we believe that we will always need to focus on critical capabilities, critical functional chains or scenarios to bound our modeling efforts.

There are many other simulation-related strategies, but this ability to focus our analysis scope is the most significant. Just because it is possible to simulate the entire model, this doesn't mean that it is a wise or effective use of systems engineering resources. Simulation has to be planned and framed to be cost-effective.

JF: What criteria typically determine when MBSE practices should or should not be applied?
JN: There are very few cases – just one in my working experience – when MBSE isn't a good fit or investment. That project addressed simple, low-level physical components. But this raises an important point. It is essential to define a modeling strategy to consider the project context and needs of the stakeholders. We need to apply an SE approach to modeling to tune the modeling strategy to these needs and constraints and provide the most added value to the architecture and engineering effort.

In almost all cases, we should use a tailored approach toward MBSE that represents the most cost-effective strategy. This Modeling Strategy also needs to be updated as the project progresses and discoveries are made – do a little bit of MBSE upfront and then adapt the strategy to the challenges that arise or as challenges are resolved. At the beginning of a project, we may focus on external interfaces and then based on modeling priorities move to other areas such as component interfaces. Some people say that MBSE is for complex systems only, but there are different perceptions of complexity. Generally, systems are more complex than people think. Complexity arises from multiple factors. An extremely complex system, if done before, may be a simple project or vice versa. Our Modeling Strategy needs to analyze the context of both the system and the project.

JF: How does Systems Thinking education create or contribute to shared mental models among engineers?

JN: Education in Systems Thinking provides a very important foundation for modeling. It's a very positive trend that gives engineers better Systems Thinking and Systems Science background – enables young engineers to take a holistic view of systems.
Without this background, when engineers talk about architecture, they may only think about physical components and interfaces. But what is a system? It has an environmental context. It has a deployment context. So, architecture is a lot more – it includes analysis of the problem, not just the solution.

Learning Systems Thinking will also accelerate the integration of young engineers into engineering teams.

JF: What breakthroughs or changes are needed to reduce MBSE learning cost/effort significantly?

JN: I have observed the need for several significant changes, particularly in the context of architecture models. Modeling languages have been cumbersome - making training more difficult. Using languages that are closer to SE concepts will help. MBSE puts lots of focus on visuals (diagrams) because "boxes and arrows" are a very useful way to represent architectural information.

But we spend too much time focused on how to do diagrams. This should not be the case. Diagrams are not MBSE – we need more focus on doing systems engineering, not doing diagrams. I hope that progress on diagramming and web-based interfaces will provide benefits in this area. In the end, we want to use the time that we currently spend on diagrams to focus on knowledge and adding value through such knowledge, and less on the way to represent that knowledge (even if this is also important).

JF: How do the modeling needs of Systems Engineers differ from those of Software Engineering and Scientists?

JN: Systems Engineers have different interests – they deal with higher level concepts such as capabilities and functions. For example, all engineers are not data scientists; they don't create ontologies every day. As a result, SE's need tools adapted to them, not vice versa. When in the past we tried to use a software-focused language such as UML to express systems engineering concepts, it was poorly adapted to this challenge.

Such a mismatch prevents or slows adoption of valuable systems engineering capabilities and raises barriers to accelerating the engineering work.

JF: Provide an example where you have seen that MBSE practices are isolated from the engineering environment?

JN: This isolation problem is very common. For example, requirements. There are very good requirements management tools. There are very good system architecture tools. But the bridges between architecture and requirements tools are sometimes missing or weak or poorly integrated in practice. This can lead to inconsistencies and misalignment between the requirements and the solution architecture. Poor integration between architecture and test models is another example.

JF: What caused this isolation? How might this isolation be overcome?

JN: There is a general lack of tool (and process) integration, not just a need for better tools. However, there is no certain and easy answer. Tools that claim to do everything often don't do some things very well. Other tools do specific tasks very well, but don't cover the whole scope of the engineering effort. For example, we use Capella, and it is very good at defining system architectures. Mastering Architectures is crucial for our company and the tandem Arcadia method and Capella tool help us on this. But Capella only addresses architecture design. As in a project we cover the wider scope of engineering activities, we developed a very powerful integration between the requirements management tool and the architecture tool.

In general, we need better end-to-end integration across engineering processes and consequently, engineering tool chains.

JF: What insights occur when developing a modeling strategy makes that effort indispensable?

JN: A modeling strategy is only useful to the extent that it is continually updated to match current conditions. The strategy defines different courses of action, but these need to be adapted as the project progresses. Aligning the modeling strategy with project priorities enables quicker reaction as things change.

JF: In your opinion where are the most common weaknesses on defining Modeling Strategies in most organizations?

JN: People tend to focus too much on enablers, and in particular on tools. Personally, I focus on management dimension first, and then the scope dimension: what needs to be done. Governance is key – roles and responsibilities and who is in charge of what.

JF: How do you distinguish the task of diagramming from the work of performing engineering?

JN: There is no clear frontier between diagramming and engineering. As you diagram, you are doing engineering, e.g., allocation. In some cases, you are doing both.

Though important, making diagrams aesthetically pleasing isn't engineering. It's important, but not engineering. It's the decisions implied by the diagrams that are most important.

For instance, representing architecture design alternatives from a diagramming point of view is very hard in most MBSE tools. With current tools, we may spend 1 hour to analyze and think through a design decision, but way more to draw up the solution alternatives.

JF: What are the minimum characteristics of a Human-Machine Interface (HMI) that could attract the next generation of engineers?

JN: Ideally the HMI should do almost everything for engineers – such that engineers don't do diagramming at all. And probably we are not that far along in our modeling capabilities.

JF: How should MBSE tools be enhanced to help Model Readers/Users (as opposed to Model builders)?

JN: Most of today's modeling tools focus on modelers, and much less on those who use/exploit the models. For example, a Verification & Validation (V&V) engineer may use an Activity Diagram to create test plans. Their job is not to create architecture models, but to understand them to do the test planning task or to build its own test-focused models. At Thales, we created a specific tool to take a Capella architecture model and present it in a user-friendly web page interface that helps the V&V teams and managers do their work.

JF: What would be your Top 3 focus areas in the road ahead toward better MBSE?

JN: This is a difficult one. I would say:

- Seamless integration of MBSE with processes/tool environments
- Consider User Experience (UX) as a major input when designing MBSE
- Educate our youth on Systems Thinking and Systems Engineering

I think of these three focus areas as equally important, but I would choose education if I had to choose just one. Education provides the greatest long-term impact.

SysML v2.0 might provide a breakthrough in the user experience if the language is simplified from the user point of view. I'm hoping that the existence of a formal textual representation will enable improvements such as automatic diagramming or generation of models-from-text, which will improve the user experience significantly.

JF: How do you see AI shaping the future of MBSE?

JN: In our company, there are software engineering teams that are now "programming" with natural language text. Perhaps the future will see the ability to talk with the machine in natural language and have the models built automatically. This could be a game-changer and redefine what MBSE means. If so, I hope that AI will reduce the focus on diagrams and put more emphasis on the systems engineering thinking that creates value. In my opinion, AI would be a valuable companion by creating diagrams or identifying inconsistencies, but not the design decision-maker. In order to make trustable architecture models, we need to keep our (human) expertise in the loop.

Juan Navas

Juan Navas is a systems architect with over 15 years' experience in systems engineering and the implementation of innovative engineering practices in several industrial organizations. He led the Modeling and Simulation team at Thales Corporate Engineering providing expertise and advice to Thales business units on MBSE practices. He is currently implementing these best practices in complex Systems of Systems (SoS) design programs for which he is responsible. He holds a PhD in embedded software engineering, a master's degree in control and computing, and an engineering degree in electronics and electrical engineering.

SYSTEMS ENGINEERING RESOURCES

Useful artifacts to improve your SE effectiveness

E-Learning Course: Practical Understanding of Systems Modelling and Simulation

NAFEMS, the international modeling and simulation association, is offering an e-learning course titled "Practical Understanding of Systems Modelling and Simulation". This 4-session series will run from 24 September – 15 October. The course is designed to answer fundamental questions such as:

- What are complex and cyber-physical systems?
- How do I numerically evaluate their behavior?
- How can I efficiently model a complex system?

Topics include:

- Complex systems and the method for their development
- Simulation-based process and numerical simulation
- Organization and process for modelling
- Model management and models architecture
- Industry applications

Learn more and register here.

Investigate membership in NAFEMS.

IIBA Analyst Catalyst Blog

The International Institute of Business Analysis (IIBA) is a non-profit professional association that helps business analysts develop their skills and further their careers by providing access to relevant content. IIBA publishes an Analyst Catalyst Blog that is open to non-members. The blog is very active, with over fifty posts so far in 2024. A sample of 2024 posts include:

- 4 Ways to Deliver Value with Business Analysis and AI: What is good business analysis in a world being changed by AI? Explore four ways to deliver value in this new landscape.
- 5 Ways to Create Value for Stakeholders: While there isn't a one-size-fits-all approach to stakeholder management, there are many ways to create value for stakeholders. Here are five of them.
- Analysis for Good, BRDs, and Machine Learning: Here are three key takeaways from the latest edition of Business Analysis Digest.
- Business Analysis Blueprint: In this month's Business Analysis Blueprint, we ask business analysis professional and IT engineer Masashi Ioki about his professional journey, his engineering background, and the Takumi Method.

- Fun and Learning: The Soft Side of Business Analysis: Fun and games have a big role to play in business analysis. In this article, we explore several BABOK Guide techniques that encourage critical thinking and creativity.
- Learn Business Analysis from a Chameleon: Aspiring business analysis professionals can learn a thing or two from an unlikely source: the adaptable and clever chameleon.
- Starting Out in Business Analysis? Dive Into These Helpful Resources: IIBA's KnowledgeHub is your one-stop shop for everything related to business analysis. And thanks to AI, it's now easier than ever to navigate.
- The Impact of MVP on Modern Business Strategies: This article explores the transformative impact of minimum viable product (MVP) on modern business strategies, explaining the crucial steps that guide its effective implementation.
- The Importance of a Business Analysis Approach: The business analysis approach is fundamental to successful projects, providing a roadmap for stakeholders and ensuring alignment with business objectives.
- The Rise of Machine Learning: A Game-Changer for Business Analysis: With its transformative capabilities, machine learning is poised to revolutionize how companies gather insights, make informed decisions, and drive growth.
- Unlocking the Power of Business Analysis with AI: By mastering prompt engineering, understanding biases, and maintaining ethical vigilance, business analysis professionals can unlock AI's superpowers.
- Want a Career in Business Architecture? Start Here: Here are three steps to take when considering a career in business architecture. And no, it's not just about training.
- Why Change Management Needs Business Analysis Expertise: This article discusses the crucial role of business analysis professionals in change management and how their skills can contribute to managing change effectively.

The Analyst Catalyst blog has almost 500 posts, searchable by content categories, publication date ranges, and keywords.

INCOSE INSIGHT Practitioners Magazine: Systems Engineering Technical Leadership

The June 2024 edition (Volume 27, Issue 3) of INSIGHT, INCOSE's Practitioner Magazine published by Wiley, has been released. Electronic subscriptions to INSIGHT are available as a member benefit to INCOSE members. Hard-copy subscriptions to INSIGHT are available for purchase by INCOSE members for one membership year, and to the public.

The focus of this issue is *Systems Engineering Technical Leadership*. Contents of this 68-page resource include:

Building a Technical Leadership Model
by Patrick Godfrey

INCOSE's Vision 2025 identifies the development of systems thinking and technical leadership as one of seven key areas of systems engineering 'competency' required for delivery. Vision 2025 states: "Education and training of systems engineers and the infusion of systems thinking across a broad range of the engineering and management workforce will meet the demands for a growing number of systems engineers with the necessary technical and leadership competencies." "The roles and

competencies of the systems engineer will broaden to address the increasing complexity and diversity of future systems." "The technical leadership role of the systems engineer on a project will be well established as critical to the success of a project." These requirements imply the need to rapidly expand the art and science of systems technical leadership. In response to this need, INCOSE established an institute for technical leadership. This paper describes the Institute and the work that the first cohort ("Cohort of 2017") has accomplished on developing a technical leadership model for systems engineers. It is envisaged that this first technical leadership model for systems engineers will be further developed and matured by the following cohorts of the INCOSE's Technical Leadership Institute.

Experiments in Leading through Influence: Reflections from a Group of Emerging Technical Leaders
by Chris A. Browne, Jeffrey Brown, John Cadigan, Heidi Davidz, David Fadeley, Heather Feli, Karl C. Geist, Myra Parsons Gross, Maz Kusunoki, Clement Lee, Al Meyer, Louis-Emmanuel Romana, Brad Spencer, Lauren Stolzar, Luca Stringhetti, and Ming Wah Tham

Technical leadership is a skill defined in the INCOSE professional competencies. This paper presents reflections on a shared learning journey about technical leadership from the perspective of a group of emerging technical leaders. These reflections provide insights around building awareness, navigating power and influence, benchmarking personal performance, developing capacity for change, and establishing critical friends. The final section provides lessons for working as a global team in technical leadership. This paper is of relevance to any technical leader looking to develop this capacity across technical sectors.

Technical Leadership of Virtual and Remotely Distributed Teams
by Francesco Dazzi, Elena Gallego, W. Patrick Keen, Mark McKelvin, Sean McCoy, Allison Weigel, and Lisa Ziliox

The world is increasingly virtual and complex, with many relationships and teams at a global scale. The situation will not be changing any time soon. Sometimes, it is only possible to interact at a distance, of not only time zones and space, but also sometimes interpersonal distance, where names and voices make up another person. Regardless, technical teams will need good leadership to address complex situations in these virtual and remotely distributed (VaRD) environments. So, in a VaRD environment, do leadership practices and skills have to change? Do the tools, techniques, and technology make current practices for leadership in general, and the application of those practices obsolete? Maybe not.

This paper seeks to examine the nature of what is really changing when leading in a VaRD environment through the lens of engineers leading teams in global and complex technical challenges. Those perspectives are analyzed to determine the factors that go into a VaRD environment. In addition, this paper analyzes how interactions between teams compare to an in-person environment, how leadership practices are applied in this environment, and how technical leadership is tailored for these new environments.

Collaborative Systems Thinking Culture: A Path to Success for Complex Projects
by Mickael Bouyaud, Natalie Davila-Rendon, Alex Deng, Jean Duprez, Anabel Fraga, Leema John, Ryan Noguchi, Erika Palmer, Jay Patel, Maria Romero, Raymond Wolfgang, and Michael Wozniak

The world is filled with hard and complex problems, oftentimes requiring involved solutions. In large organizations attempting to solve these types of problems, a mindset shift and key candidate

methodologies centered on collaborative systems thinking culture (CSTC) can assist significantly. The paper explores the state of the practice, change involved with implementing systems thinking, impacts of a collaborative approach within an organization, as well as the seven phases that a reader can introduce into their organization to realize some of the benefits. The same approach was used to create this paper under collective authorship from cohort 6 of the INCOSE Technical Leadership Institute (TLI); an international group of individuals collaborating exclusively through virtual platforms. From writing papers to executing large technical programs, the CSTC approach will prepare technical teams for tackling challenging problems in an inclusive way with the intent to finish projects on time while also cultivating healthy systems engineering habits and practices. This lessens the reliance on corporate engineering procedures to drive collaborative behavior by fiat. Finally, blending CSTC into the fabric and culture of an organization is emphasized as being needed for the full benefit. That benefit includes saving programs by moving to a CSTC.

Future Trends Influencing Technical Leaders and Technical Leadership
by Timothy D. West, Midori Daida, Fabio Silva, Paul Jean and Nazanin Sharif

This paper summarizes the authors' reflections on global trends and key factors influencing systems engineering in the post COVID era. The discussion builds upon INCOSE's Systems Engineering Vision 2035, as well as multiple virtual workshops and peer discussions conducted by the authors as part of their experience in INCOSE's Technical Leadership Institute (TLI). The authors focus on three key factors affecting technical leaders and their technical leadership role: 1) the heightened societal awareness of environmental concerns along with the associated demand for more environmentally friendly products, 2) the increasingly interconnected, multicultural, multigenerational work environment, and 3) the increasing capability of advanced digital tools, techniques, and processes. The authors' analysis acknowledges the need for technical leaders to think green, build an inclusive work environment, welcome differing viewpoints, avoid stereotyping, and expand their virtual tradecraft. Ultimately technology changes how technical leaders do their jobs, but not the job itself. Leaders must still set the vision and direction of the organization, communicate that vision to their stakeholders, and provide the resources and support that the team needs to achieve the vision. Emerging technologies offer leaders new and innovative means to do this in a more inviting and inclusive manner.

A Systems View of Career Development for Systems Engineering Leadership
by Stueti Gupta, Grace Kennedy, Jonathan Keim, Brandi Opland, Yoeri Sigterman, and Brandi Wingate

Systems engineering leaders' career development journeys are primarily driven by their experiences that shape their capability, qualities, and perspective; however, the pathways that individuals take are not only broad and varied, but also equally affected by personal life decisions and external factors. This paper describes a two-fold study that aimed to: a) provide insight into commonalities in the career journeys of systems engineering leaders, and b) ascertain how key areas affect career development. Five key areas were explored: education, technical experience, soft skills experience, job satisfaction, and work-life balance. A mixed and multi-method approach was taken, gathering data from sixty-one participants through interviews, surveys, and facilitated workshop. The study found that although there was no 'blueprint' that yields successful systems engineering leadership, there were themes/trends that were common. An influence model was developed to highlight these trends in the form of the key areas, factors affecting them, and the interrelationships between them.

A Tinkerer's Mindset: Lessons from the Technical Leadership Institute's Cohort 8 on Safe to-Fail Probing as a Tool for Informing Judgement

by Adam D. Williams, Leandro V. Aveiro, Rachel A. McGrath, Carlo Leandri, Guilluame Terpant, Dimitri Masson, and Adrian Unger

Tinkering - or making small changes to experiment toward an improvement in performance - is seemingly a natural characteristic of many systems engineers. As such, systems engineers are uniquely qualified to develop complex solutions necessary to overcome
lack of clarity, achieve order, and avoid failure. Further, there is a much broader conversation surrounding the possibility of "failure" being beneficial in systems engineering projects. In response to the need to inform judgment in situations shrouded in uncertainty, members of INCOSE's Technical Leadership Institute (TLI) cohort 8 examined the role of safe-to-fail probes play in informing judgement for systems engineers. Within the constraints of the TLI's major project, virtual workshops and qualitative interviews were two data collection mechanisms established to empirically investigate the role(s) of safe-to-fail probing in systems engineering. Overall, the data sets offered conclusions describing the potential role(s) of safe-to-fail probes for systems engineers working in uncertain environments. Resulting from this (limited) empirical exploration are additional insights and implications
for how systems engineers may invoke safe-to-fail probes to improve decision-making in uncertain and challenging situations. Such a tinkerer's mindset can help systems engineers transition from the constraints of "intolerable failure" to the opportunities related to probing-sensing-responding to "responsible failures."

Join INCOSE here to access this rich systems engineering resource.

Download INSIGHT Volume 27, Issue 3 from the INCOSE iNet.
View this issue in the Wiley online library.

Recommended System Dynamics Resources

The System Dynamics Society (SDS) continues to curate and/or recommend a variety of system dynamics resources in the form of blogs, videos and papers. Here are some of the latest resources to check out:

Developing a Systemic Understanding of Climate Change
Common Earth offers a free comprehensive course to help people develop their ability to see interconnections and to recognize their inherent agency and resiliency, thereby forming a compassionate community of people developing holistic responses to climate change.

This course gives participants the opportunity to develop their thinking and understanding alongside people equally committed to moving towards a more sustainable and compassionate planet. This classic course remains our hallmark and will always be where people are encouraged to enroll to benefit from the deep insights that can only result from significant time spent engaged with the material and with one another. The course consists of 28 sessions (2 per week) from 9 September to 12 December 2024. A time commitment of approximately 7 hours per week is expected.

Expanding System Dynamics with Hybrid Modeling
In this one-hour webcast, a continuation of the University of Bergen's MINDS Cast series, Scott Fortmann-Roe discusses extensions to System Dynamics modeling to integrate other modeling methods, notably Agent-Based Modeling. He explores techniques for Agent-Based Modeling and how

to integrate them into System Dynamics models; including extending stock/flow diagrams with state/transition diagrams and directly extending models with bespoke code.

Scott is the founder and developer of Insight Maker, an open-source, web-based modeling and simulation platform that supports System Dynamics modeling, Agent-Based modeling, and programming features. Insight Maker, which has over 50,000 registered users, will be used for interactive demonstrations.

From Text to Map: A System Dynamics Bot for Constructing Causal Loop Diagrams
This webinar, led by Niyousha Hosseinichimeh of Virginia Tech, explores the capabilities and challenges of a novel tool designed to automate the creation of causal loop diagrams (CLDs) from textual data. Topics include:

- Overview of the System Dynamics Bot, including capabilities of large language models and bot effectiveness and practical examples
- Evaluation of the Bot's performance against two data sets
- Applications and future directions, including use for education, group model building, comparative studies, developing causal loop diagrams from literature reviews and mapping individual mental models.

The recording of this talk is available to SDS members or ticket purchasers only. Join SDS here.

Hybrid simulation in healthcare: a systematic exploration of models, applications, and emerging trends (Journal of Simulation article)
Hybrid Simulation (HS) refers to the utilization of multiple simulation techniques, such as Discrete-event, Agent-based, and System Dynamics, within a single simulation study. The field of HS is expanding rapidly, with a substantial body of literature exploring its conceptualizations, frameworks, and case studies across diverse application domains. This article provides an extensive examination of the prevalence and utilization of HS in healthcare. Through an in-depth review of fifty-seven relevant papers, we contribute to a comprehensive understanding of the current state-of-the-art in HS as applied to healthcare. The review encompasses a categorization of modelling and simulation techniques, a thorough exploration of application types, software packages, emerging trends, potential opportunities, and challenges associated with HS in healthcare. Additionally, the review critically evaluates the limitations present in the existing literature and presents potential avenues for future research in this field.

Integrating AI language models in qualitative research: Replicating interview data analysis with ChatGPT (System Dynamics Review open-access article)
The recent advent of artificial intelligence (AI) language tools like ChatGPT has opened up new opportunities in qualitative research. We revisited a previous project on obesity prevention interventions, where we developed a causal loop diagram through in-depth interview data analysis. Utilizing ChatGPT in our replication process, we compared its results against our original approach. We discuss that ChatGPT contributes to improved efficiency and unbiased data processing; however, it also reveals limitations in context understanding. Our findings suggest that AI language tools currently have great potential to serve as an augmentative tool rather than a replacement for the intricate analytical tasks performed by humans. With ongoing advancements, AI technologies may soon offer more substantial support in enhancing qualitative research capabilities, an area that deserves more investigation.

System Dynamics Learning Lab

The South Africa chapter of the SDS has been conducting a series of free interactive learning labs that provide deep dives into the dynamics of various systems. The series is suitable for learners with all levels of modeling experience. Future sessions (each consisting of five 2-hour virtual events) focus on modeling Hydrological Pollution (10-24 September) and Advanced Application (October 2024)

Siemens Next Generation Design (Construction Industry) Podcasts

The Digital Industries Software division of Siemens has completed a three-part series on technology in the architecture, engineering, and construction (AEC) and building information modeling (BIM) industry. The series is part of Siemens Next Generation Design podcasts. Episodes include:

Visualization and the digital twin for AEC and BIM

Derek England, the NX Product Manager for AEC and BIM at Siemens Digital Industries Software, explains why technology advances have been relatively stagnant over the past few decades in AEC and BIM. Topics include:

- Challenges facing the construction industry
- Latest innovations in the construction industry
- How Metaverse impacts the construction industry
- How integrated multi-discipline Building Information Modeling (BIM) works with the digital twin

How to simplify the BIM design review in construction projects

Derek England talks about the design review process for the construction industry and how to improve it, particularly by eliminating data and design silos. Topics addressed include:

- The purpose of a design review
- Why it isn't easy to collaborate and coordinate design reviews
- How NX simplifies design reviews
- The role of the digital twin in design reviews
- How a single-file approach hinders collaboration
- How the BIM collaboration space might look like in the next five years

What is modular construction?

Derek England discusses how modular construction is changing the construction industry, the factors that have led to the rise of modular construction, two types of modular construction and the benefits of each. Content includes:

- What does "modular construction" mean
- Why modular construction is appealing to customers
- Problems solved by modular construction
- How the digital twin helps modular construction
- What a modular construction factory is like
- Modular construction barriers

Systems Innovation Network

The Systems Innovation Network is a global online platform supporting individuals and organizations on their journey of learning and applying systems innovation ideas and methods towards addressing complex challenges. Its purpose is to build the world's capacity for systems innovation, to better understand and address complex challenges and co-create a world where systems work for all. The organization envisions a world where everyone thinks in systems and has an understanding of complex systems.

The Network is designed to enable an *innovation journey* that consists of four phases:

- Awareness – through communications
- Connecting – forming collaborative relationships with others using System Innovation Hubs
- Learning – about innovation ideas and methods
- Co-creating – solutions to challenging problems in System Innovation Labs

Network participation is subscription-based, i.e., with fee-based access to learning content arranged in tiers (Learning, Pro, Team). For example, the Learning tier subscription includes content such as:

- Actor Mapping - Getting Started
- Complex Adaptive Systems
- Complex Engineered Systems
- Complexity Theory Introduction
- Critical Thinking
- Emergence Theory

Learning tier content is delivered in the form of starter guides, concept cards, video courses and e-books.

The Pro tier adds topics such as:

- Ecosystem Building Tutorial
- Innovation & Entrepreneur
- Systems Design Key Principles
- Nonlinear Systems

Pro tier content adds additional resources and features such as explainer videos, course completion certificates, video downloads, knowledge base articles and expert support.

Get started investigating the Systems Innovation Network.

FINAL THOUGHTS FROM SYENNA

Why Are People Not Adopting Systems Engineering? Food for Thought**

Despite its many benefits, systems engineering often faces resistance in adoption across various industries. In this month's closing of PPI SyEN, we want to explore some aspects and provide food for thought on why this may be the case.

Proposed Factors Hindering the Proliferation of Systems Engineering

1. **Perceived Complexity**

Barrier: Systems engineering is often perceived as complex and overwhelming, particularly for organizations that are not familiar with its methodologies and principles.

Thoughts on overcoming this barrier: Developing simplified frameworks can help demystify systems engineering and make it more accessible to those new to the discipline. Sharing success stories and case studies that highlight the tangible benefits of SE can demonstrate its value in a more relatable way.

2. **Initial Investment**

Barrier: The initial investment in terms of time, resources, and training required to implement systems engineering can be a deterrent, especially for smaller organizations or those with limited budgets.

Thoughts on overcoming this barrier: Ecouraging organizations to adopt SE practices incrementally can help spread out the investment cost and make the transition more manageable. Clearly communicating the return on investment of systems engineering, focusing on cost-effective and low-resource activities that yield high-leverage gains, including long-term cost savings and efficiency gains, can help justify the initial expenditure.

3. **Resistance to Change**

Barrier: Organizational inertia and resistance to change are common obstacles in adopting new methodologies. Employees and management may be comfortable with existing processes and hesitant to embrace a new way of working.

Thoughts on overcoming this barrier: Implementing robust change management strategies can help address resistance and facilitate smoother transitions. Securing buy-in from top leadership is crucial. Leaders can champion systems engineering and drive its adoption throughout the organization. This is perhaps the most difficult aspect to address!

4. **Lack of Awareness and Understanding**

Barrier: There is often a lack of awareness and understanding of what systems engineering entails and how it can benefit an organization. This knowledge gap can lead to skepticism and reluctance to adopt SE practices.

Thoughts on overcoming this barrier: Increasing educational initiatives and outreach can help bridge the knowledge gap. Workshops, seminars, and online courses can provide valuable insights into

systems engineering. Communicating the benefits and applications of SE in clear, non-technical language can help make it more appealing to a broader audience.

Closing thoughts

Addressing these barriers requires a multifaceted approach that includes education, communication, incremental implementation, and strong leadership support. By understanding and addressing the reasons behind the resistance to systems engineering, we can develop more effective strategies to promote its adoption and realize its full potential.

What would you add to the list of barriers above and what are your thoughts on overcoming these barriers? Send your reflections to ppisyen@ppi-int.com.

PPI RESOURCES

PPI offers a multitude of resources available to all of our clients, associates and friends! Click on any of the links below to access these resources today.

Systems Engineering FAQ: https://www.ppi-int.com/resources/systems-engineering-faq
Industry-related questions answered by PPI Founder and Managing Director Robert Halligan.

Key downloads: https://www.ppi-int.com/keydownloads/
Free downloadable presentations, short papers, specifications and other helpful downloads related to requirements and the field of Systems Engineering.

Conferences: https://www.ppi-int.com/resources/conferences-and-meetings/
Keep track of systems engineering-relevant conferences and meeting dates throughout the year.

Systems Engineering Goldmine: https://www.ppi-int.com/se-goldmine/
A free resource with over 5GB of downloadable information relevant to the Engineering of systems and a searchable database of 7,800+ defined terms. You can expect the content of the SE Goldmine to continue to increase over time.

Systems Engineering Tools Database (requires SEG account to log in from the Systems Engineering Goldmine): https://www.systemsengineeringtools.com/
A resource jointly developed and operated by Project Performance International (PPI) and the International Council on Systems Engineering (INCOSE). The SETDB helps you find appropriate software tools and cloud services that support your systems engineering-related activities. As a PPI SEG account holder, you have ongoing free access to the SETDB.

PPI SyEN Newsjournal (actually a substantial monthly SE publication): https://www.ppi-int.com/systems-engineering-newsjournal/

You're already reading our monthly newsjournal! However click on the link to access the history of 100+ monthly newsjournals containing excellent articles, news and other interesting topics summarizing developments in the field of systems engineering.