PPI SyEN

Pathways to Progress: Growth, Learning, and Transformation

A Common Notation for Capturing States and Modes Requirements and Design

Reflections on INCOSE IS2024

WELCOME

In this edition, we embrace the theme of **"Pathways to Progress: Growth, Learning, and Transformation,"** reflecting the exciting new opportunities for learning and the strategic shifts that are reshaping the systems engineering landscape.

This issue covers a wide range of topics that highlight various pathways to progress. We start by exploring the key elements of INCOSE's recently released strategic plan, which is designed to encourage forward-thinking and foster global collaboration in systems engineering. This plan sets the stage for growth across the field, emphasizing the need for innovation and collective effort.

Additionally, we provide an overview of upcoming learning events in September and October. These events offer valuable opportunities to enhance your knowledge and skills in product development and management, supporting your journey of continuous learning and professional development.

Our featured articles, authored by PPI experts, include insightful pieces such as "A Common Notation for Capturing States & Modes Requirements and Design" by John Fitch, along with reflections from INCOSE IS 2024 by Paul Davies and René King.

In her final thoughts, Syenna shares her insights on "Lifelong Learning Secrets," exploring the six levels of learning, from basic recall to the ability to teach others. Her reflections remind us that knowledge grows in value with each application and that fostering a culture of continuous learning and knowledge sharing is fundamental to both personal and professional growth.

Finally, we present a collection of curated resources aimed at enhancing decision-making capabilities and fostering effective team collaboration, offering practical tools and insights for systems engineering practitioners looking to expand their strategic impact.

As we navigate these pathways to progress, PPI SyEN remains committed to providing you with the latest insights, tools, and resources to help you excel in your systems engineering journey. Together, let us embrace these opportunities for growth and learning as we continue to expand our horizons.

Warm regards,

René

Managing Editor (on behalf of the PPI SyEN team)

Views expressed in externally authored articles are not necessarily the views of PPI nor of its professional staff.

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>
> *The problem definition drives the solution; the adequacy of the problem definition drives the validity of the solution.*
>
> **Robert John Halligan**

PPI Systems Engineering Newsjournal (PPI SyEN) seeks:	**PPI defines systems engineering as:**
➢ 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	*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.*

INCOSE Unveils New Strategic Plan

The International Council on Systems Engineering (INCOSE) has announced the release of its new strategic plan. The plan introduces a refreshed vision, mission, and strategic objectives, underscoring INCOSE's commitment to building a better world through a systems approach. The plan will serve as a guide to the organization's growth and impact over the coming years. Elements of this updated strategy include:

A New Vision: *To unite and advance the global systems community*.

An Updated Mission: *INCOSE fosters systems engineering knowledge exchange, application, education, and research. We are dedicated to being the world's trusted authority and forum for the practice, science, and art of systems engineering*.

Consistent with the vision and mission, the primary objectives of INCOSE have been distilled as:

- *Advance systems engineering as the world's trusted authority*
- *Expand the systems engineering community while growing INCOSE*
- *Foster professional development and systems engineering competencies*
- *Achieve operational excellence*

INCOSE encourages systems engineers all over the globe to join INCOSE's efforts in building a better world through a systems approach

René King, PPI Senior Engineer and Business Development Manager, echoed these sentiments.

It's fantastic to see systems thinking emphasized as a core value in INCOSE's updated strategy, alongside a balanced focus on both community collaboration and individual influence. The emphasis on partnerships and professional development strengthens INCOSE's role as the leading voice for systems engineering across diverse sectors. I particularly appreciate the "ONE INCOSE" mindset to unify global chapters and the insight that a strategy truly comes to life when we have the discipline to say "No" or "Not Now." This strategic approach promises to elevate INCOSE's impact in meaningful and lasting ways.'

Learn more about INCOSE and its strategic plan here.

Modelica Association News

Modelica is a freely available, equation-based, object-oriented language for convenient and efficient modeling of complex, multi-domain cyber-physical systems described by ordinary differential, difference and algebraic equations. The Modelica Association is a non-profit organization that develops coordinated, open access standards and open source software in the area of cyber physical systems. The Association publishes a quarterly newsletter. Here are highlights from the latest (July 2024) newsletter.

Conferences and User Meetings
Keynote speakers have been announced for the American Modelica Conference 2024 to be held on 14-16 October in Storrs, Connecticut, USA. See an expanded description of this event in the Conferences section of this PPI SyEN edition.

Preparations are underway for the Asian Modelica Conference 2024 that will take place in Jeju Island, South Korea on 12-13 December.

The Modelon Innovate conference will take place on 10-11 October in Copenhagen, Denmark.

Interested parties are encouraged to save the date for the 16th International Modelica Conference, planned for 8-10 September 2025 in Lucerne, Switzerland.

Functional Mock-up Interface (FMI) News
Developers of software tools for the Functional Mock-up Interface (FMI) met in May in Munich, Germany and made progress on a variety of FMI 3.0 standards. 41 tools already support FMI 3.0.

The next candidate-draft, the eFMI® Standard 1.0.0 Beta 1, for the first official release of the eFMI® Standard has been released. This release focuses on the Behavioral Model representation, whose specification has been finalized and significantly extended and improved to achieve semantic completeness. Interested parties may submit feedback here.

Modelica Vendor News
Features committed for the upcoming release of Wolfram System Modeler 14.1 include:

- GUI Support for editing replaceable models
- Clear and concise error messages
- Configuration of error handling

OpenModelica version 1.23.0 was released on in June 2024 with numerous fixes and feature improvements.

Engineering support capabilities associated with Modelon expanded during the second quarter,

including:

- A new Energy Systems Library (ESL) for planning and optimizing industrial to utility-scale energy systems (electricity/heat/hydrogen).
- A new e-book that explores the benefits and trade-offs of in-house and commercial system

simulation tools.
- A new blog explores the modeling of cooling systems for electric vehicle powertrains

News from Libraries
The ThermoFluid Stream Library announces new features including:

- Static head
- New pipe models
- Improved pump models
- 2-phase Heat Exchanger models
- Interface to TIL Media

The Process Systems Library, developed by TLK Energy, has deployed a new calculation method for the state variables of a medium, enabling simulation of Power-to-X processes including water electrolysis, carbon capture, and synthesis of complex chemicals like methane or methanol.

View details of these and other announcements in the latest Modelica Association newsletter.

Capella 7.0 Released

Version 7.0 of the Capella open-source MBSE software has been released. In additions to fixes for various issues, feature and user interface (usability) enhancements in this release include:

- A new option has been added that allows you to quickly paste images from the clipboard onto nodes in diagrams
- Automatically resize newly created or inserted elements in Capella diagrams
- Diagram Toolbar buttons are accessible in all cases
- Highlight selected Functional Chain or Physical Path elements in diagrams
- Linked ports are now properly laid out when D&D in a diagram or automatically inserted during a diagram refresh
- Log Capella Accelerator command updates inside the Information View to understand modifications and their impacts on the model
- Make label decorations in Semantic Browser present and consistent with those in the the Project Explorer
- New addon "Basic Requirement" to move Capella legacy requirements
- New customizable color menu for easy selection and reuse of recently used colors
- New "Quick Fix" to detect and remove missing image from diagram
- Newly created elements on a diagram are added in a predefined layout
- Notes attached to an element are retained after a tool execution or a refresh on the element
- Paste options in diagram toolbar have a different user interface
- Renaming and more features added to the Automatic Layout tool
- Semantic Browser improvements to show non-oriented Physical Link ends
- The layout is maintained in an open diagram when D&D elements from the Project Explorer or changing Diagram containment

View the LinkedIn post summarizing Capella 7.0 features. Read the full Capella 7.0 release notes.

Read the full Capella 7.0 release notes.

Watch brief overview videos to learn more about Capella and the associated Arcadia systems engineering method.

INCOSE Announces Two New Academic Equivalency Agreements

INCOSE has announced the approval of two new Academic Equivalency Agreeements for courses at the University of Maryland and Queen Mary University of London (QMUL). Students who do well in university courses assessed to have Academic Equivalence (AcEq) can bypass the certification knowledge exam when applying for ASEP and CSEP Certification. The assessments they complete through their coursework at each university have been recognized by the INCOSE Certification Program's volunteer reviewers as an equivalent alternative to the standardized test developed by INCOSE.

Queen Mary University of London is the first university to be recognized with Academic Equivalence in Europe and the second university outside of the United States. Courtney Wright, INCOSE Certification Manager notes the significance of this milestone:

"INCOSE is happy to recognize the QMUL systems engineering course as an educator of top-notch systems engineers. Academic Equivalency provides an alternative method for systems engineers to bypass the knowledge exam portion of the certification requirements, and we are glad to see QMUL bring this option to Europe."

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

New Release: INCOSE Systems Engineering Agility Primer
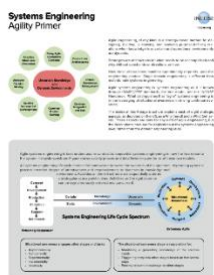
INCOSE has announced the release of a new resource, *The Systems Engineering Agility Primer*. This 4-page document provides a foundation for understanding what it means to be agile in the context of systems engineering based on the insights by authors Rick Dove, Kerry Lunney, Michael Orosz, and Mike Yokell. The primer answers the question *"What constitutes agile systems engineering and why?"*

Topics addressed include:

- Adaptable modular architectures
- Iterative incremental development
- Attentive situational awareness
- Attentive decision making
- Common-mission teaming
- Shared-knowledge management
- Continual integration and test
- Being agile as an operations concept

Learn more about the Primer here.

Download the Systems Engineering Agility Primer (free for INCOSE members, else USD $10).

Call for Abstracts: OMG Journal of Innovation - Shaping the Future in a Data-centric Connected World

The Object Management Group (OMG) has issued a Call for Abstracts for the upcoming Winter edition of the Journal of Innovation. The theme of this edition is "*Shaping the Future in a Data-centric Connected World, from Creation to Usage and Compliance*". This issue will explore the multifaceted role of data in the rapidly evolving landscape of digital twins, artificial intelligence, and the Internet of Things.

Topics of interest for this edition include:

- Managing all facets of the data lifecycle – in a single system or across multiple systems
- Protecting the authenticity, integrity, privacy, confidentiality, ownership, and sovereignty of data throughout its lifecycle and across ecosystems
- Interoperability and integrability of data in systems of systems, digital and virtual twins and extended reality
- Role of data-centric architecture, decoupling data from applications, and the needs of industry standards for common concepts, definitions, and data formats
- Applying semantics across the data lifecycle – ontologies, taxonomies, and other semantic resources
- Collaboration, data sharing, and monetization across industries
- Assessing and managing the tangible and intangible value of data as digital assets
- Role of data in the digital thread in manufacturing and supply chains
- Ethical considerations in data collection and use
- Future trends on data: what businesses should prepare for

Abstracts are due by 24 September 2024 and should be submitted to Karen Quatromoni, OMG Director of Public Relations at Karen@omg.org.

Download submission guidelines and templates here.

INCOSE Canada Systems Engineering Student Challenge 2024

The Canada Chapter of INCOSE has announced its inaugural Systems Engineering Student Challenge 2024 competition which aims to help promote the application of systems engineering to their student projects while giving these students practical experience on the benefits of Systems Engineering in their future careers. The challenge connects these students with industry and the INCOSE Canada Chapter providing a focal point for the dissemination of systems engineering best practice. Benefits of participation include:

- Improving job hunting prospects
- Gaining national and international recognition
- Competing for cash prizes (5 awards available)
- Learning and applying systems engineering

Final year undergraduate students are eligible if enrolled in Canadian educational institutes with fields of study that include Industrial, Digital, Operational Science, Mechanical, Aerospace, Electrical, Computer, Software, or Biomedical Engineering.

Applications are due by 30 September and submissions by 25 November. A finalist ceremony will be conducted on 18 December.

Learn more here.

Updates to SE Tools Database (SETDB)

The PPI-INCOSE Systems Engineering Tools Database (SETDB) provides a virtual platform for engineering tool vendors to communicate their latest offerings. Recent SETDB updates, including both new and exising tools:

Vendor: IBM
- IBM Engineering Requirements Management DOORS: A requirements management tool that captures, traces, analyzes, links to test cases and manages changes to information. Using the DOORS product, you can optimize requirements communication, collaboration, and verification throughout your organization and across your supply chain.
- IBM Engineering Requirements Management DOORS Next: A requirements management tool intended for teams to capture, trace, analyze and manage changes to requirements while maintaining compliance with regulations and standards. Doors next supports all engineering domains.
- IBM Engineering Systems Design Rhapsody: Delivers higher-quality systems and software faster with trustworthy modelling, seamless simulation, production code generation, and digital thread across domains.
- IBM Engineering Test Management: Helps to increase efficiency and quality of systems and software delivery with test planning, workflow control, tracking and metrics reporting. Available on premises and on the cloud.
- IBM Engineering Workflow Management: A tool to collaborate across teams, manage code, run standup meetings, plan sprints and track work. Available on premises and on the cloud.
- IBM Jazz Reporting Service: Consolidate, publish, analyze and visualize data for software and systems engineering in one view to speed up decision making.

Obeo:
- Eclipse SysON: An open-source web-based tooling to edit SysML v2 models. It includes a set of editors (graphical, textual, form-based, etc.) enabling users to build the various parts of system models.

Vendor: TraceCloud
- TraceCloud: A SaaS Requirements Management and Traceability solution. You can configure your project's structure to map to your Requirements Management Plan. Your extended team can collaborate and manage change using a single source of truth database for your project's requirements.

Access the SETDB website.

Product Development Learning Opportunities in September-October

The [Product Development Management Association (PDMA)](#) is offering several learning opportunities in September and October to advance product development and innovation skills.

Together We Create: Integrating customers in product development (5 September)
In this free webinar, Jake McKee, a founder of the modern customer community movement, will explain how to harness the Community Voice and revolutionize the way products are conceived and developed, all while delighting customers and bringing positivity to product teams. Key takeaways include:

- Understand what Community Driven Product Development (CDPD) is and how it applies to your business.
- Learn how you can build a CDPD program for your product team.
- Dive into core CDPD best practices that you can bring back to your team/business.

Learn more and register [here](#).

The Business Model Canvas (10 September)
The PDMA Carolinas chapter is hosting a free webinar on 10 September. The speaker, Helene Cahen, Founder & Innovation Strategist at Fire Up Innovation Consulting will discuss the Business Model Canvas (BMC), a simple yet powerful tool for creating alignment around a business and identifying sources of high-value innovation. The workshop will help participants learn how to create and use a canvas with their team and organization. It will also provide time for the participants to create the beginning of their own canvas and ask questions to help them complete it. Learning objectives include:

- How to create meaningful and actionable Business Model Canvas (BMCs)
- Provide participants with a deep understanding of the tool
- How to use it to break silo thinking and support innovation, and planning

Learn more and register [here](#).

2024 Fall Body of Knowledge Training (Tuesdays - 10 September through 29 October).
The PDMA Pittsburgh chapter is conducting an eight-week *in-person* professional development training program covers the fundamentals of product management and innovation. Expert product development practitioners and talented educators will be teaching seven key areas of study, including:

- Strategy
- Market Research

- Portfolio Management
- Product Innovation Process
- Culture, Teams, Leadership
- Product Innovation Management
- Product Design and Development Tools

Program Benefits include:

- Learning methods and tools by applying them to your own business challenges during and after class
- Interacting with instructors with various areas of expertise and backgrounds
- Collaborating with participants from diverse industries

Learn more and register [here](#).

New Product Development (NPD) Body of Knowledge Professional Development Training (Wednesdays, 25 September – 6 November)
The PDMA St. Louis chapter is offering a series of *online* courses that cover the fundamentals of Product Management and Innovation and is designed to prepare attendees for the NPD exam. The seven course series covers the entirety of the NPD BoK.

Learn more and register [here](#).

Innovate Your Planning Process with Quartz (3 October)

In this free webinar, Steve Johnson, CEO of Product Growth Leaders and co-creator of the Quartz Open Framework, will share ways to streamline and innovate product planning processes using Quartz and to reduce the number of living documents needed to guide market insights and product innovation.

Learn more and register [here](#).

INCOSE Webinar: Into the Great Digital Unknown: MBSE & DE

INCOSE, as a part of its Sector III (Asia & Oceania) Speaker Program, will host a presentation titled *Into the Great Digital Unknown: MBSE & DE* on 13 September. David Long, President of INCOSE from 2014-2015 and and current INCOSE Director for Strategic Integration will share his insights on this topic.

Abstract:
Model-based systems engineering (MBSE) … model-based engineering (MBE) … digital thread and digital twin (DT) … digital engineering (DE) … digital transformation (yet another DT). There is an explosion of concepts and the corresponding acronym soup as we apply the power of digital to systems engineering and the greater engineering lifecycle.

- What are the various concepts?
- How do they interrelate?
- What do they mean for me, my organization, and the greater practice?
- How do I adopt and apply the right practices?

We will move beyond the marketing, myth, and misconception to a practical understanding of what digital transformation means for systems engineering, the fundamentals we need to know, and the value we expect to achieve.

Learn more and register here.

PDMA Inspire Innovation Conference: Keynotes and Program Details

Keynote speakers and program details are now available for the Inspire Innovation Conference of the Product Development Management Association (PDMA). The conference will take place on 14-17 September 2024 in St. Louis, Missouri, USA and is held in conjunction with the Journal of Product Innovation Management (JPIM) Research Forum.

Keynote speakers and talks for the conference include:

- Aligning for Innovation Success: An Innovation Process for Predictable Outcomes (Tony Ulwick, Strategyn)
- Driving Radical Innovation: Strategies for Long-Term Growth and Resilience (Chris Elmore, UNC – Charlotte & Queens University of Charlotte)
- AI Decision Sprint (Atif Rafiq, Ritual)

Here is a sample of technical presentations and workshops that might be of interest to systems engineering practitioners:

- 99 Problems but Discovery Ain't One: Finding the Right Problems to Solve
- A Novel Systematic Product Managers Framework
- Connect, Co-Create, Innovate- Power of Community-Driven Product Innovation
- Elevated Insight Techniques for Product Managers
- Gut-Level Design: How to Trust (but Verify) Your Innovation Intuition
- How can I cultivate creativity in back-end development to enhance product innovation and effectiveness?
- Innovation for Everyday Products
- Leveraging AI for New Product Development
- Radical Product Thinking

View schedule details here.
Register for the Inspire Innovation Conference.

INCOSE Nordic Systems Engineering (NoSE) Autumn Tour

INCOSE's five Northern European chapters (Norway, Denmark, Sweden, Finland, Germany) have hosted the Nordic Systems Engineering Tour since 2013. The NoSE 2024 Autumn Tour will be the 14th in the series and will take place on 16-18 September. The Tour will include meetings in three sites:

- Helsinki, Finland (16 September)
- Stockholm, Sweden (17 September)
- Oslo, Norway (18 September)

Each site will include a full-day program with relevant presentations by systems engineering practitioners and thought leaders. A sample of the types of content to be presented includes:

- Early Validation of SysML Architectures by Extending MBSE with Co-Simulation using FMI and SSP
- Lifecycle considerations from Defense Acquisition
- Solving Sustainability Challenge with Systems Engineering
- Stories from the Front Line of Systems Engineering and Technical Leadership

View the evolving program details for each site here.

Participants may register independently for each site here.

Webinars on the Data Distribution Service (DDS) Standard

The Object Management Group (OMG) is hosting a webinar on 19 September titled "Designing your DDS System for Performance and Scalability". This is the third in a series of free learning opportunities that highlight the scope and applications of the Data Distribution Service (DDS) Standard – all part of the OMG's 35th anniversary outreach.

The 19 September event will cover a set of best practices when it comes to designing a DDS based system. It will present a step-by-step process to go from initial design to eventual deployment, and cover topics like:

- How to break up your domain specific information model into a set of normalized topics that minimizes overhead and maximizes performance and throughput?
- How to select the appropriate QoS policies for each of those topics?
- How to efficiently separate the various Traffic Flows in your system to balance latency vs throughput and manage traffic priorities.

A follow-on webinar on 17 October, "Edge Intelligence and Beyond: Transforming Systems with DDS", will explore how the DDS can revolutionize software architectures. This webinar will provide an in-depth look at the architectural advantages of DDS over MQTT (OASIS standard for IoT connectivity) and the OPC Unified Architecture (UA), illustrating its impact on system design, performance, scalability, and real-time decision-making at the edge. Ideal for software architects seeking to leverage middleware solutions to optimize industrial automation and other complex, data-centric applications. Topics to be addressed include:

- What is DDS?
- DDS vs. MQTT and OPC UU
- Enabling Next-Generation Architecture with DDS
- Real-Time Decision Making at the Edge
- DDS in Industrial Automation

- Designing with DDS: Best Practices
- DDS and the Future of Middleware Solutions

On-demand viewing is available for two prior webinars concerning DDS:

- [The Past, Present and Future of the DDS Standard](#) (1 August)
- [Connecting MBSE with Interface Design Using DDS: A best practice approach](#) (14 August)

OMG's [BrightTALK channel](#) is the source for a numerous additional on-demand talks of standards topics such as DDS, Essence, AI, SysML V2, and Critical Infrastructure.

Registration Open for INCOSE Western States Regional Conference (WSRC 2024)

Registration is open for the INCOSE Western States Regional Conference (WSRC 2024) to be held in Albuquerque, New Mexico, USA on 19-21 September 2024. A virtual attendance option will also be offered.

The theme of this hybrid conference is *Building a more secure world through systems engineering*.

Registrants may choose from optional tutorials on 19 September:

- Navigating the Future: Exploring SysML V2 with SysON - A Hands-On Tutorial
- Risk, Safety, and Reliability Analysis in Model Based System Engineering
- Integrating System Architecture in SysML with Hardware for Rapid Prototyping and Validation and Verification
- Mastering Your Systems Engineering Competencies
- Use a Framework for SE in Early-Stage R&D to Build Your Bridge that Spans the Chasm Between Research and Engineering
- Requirements: A Comprehensive Overview

Planned technical presentations are arranged in the following streams:

- AI Opportunities & Risks
- Architecture/Design
- Case Study
- Cross-Domain Solutions
- Cyber Security
- Digital Transformation
- Modeling
- Operational Technology
- Requirements
- SE & Agile
- SE/Education
- Security
- System of Systems
- Systems Reliability & Resiliency
- Technical Management

CONFERENCES, MEETINGS & WEBINARS

View the program details. Learn more and register here.

Systems Engineering Test and Evaluation Conference (SETE 2024)

The Systems Engineering Test and Evaluation Conference (SETE 2024) will take place in Melbourne, Victoria, Australia on 22-25 September. The theme of SETE 2024 is *"Advancing in an Emergent Digital World."* The conference will explore the interplay between society, systems and an increasingly interconnected world. The theme is intended to challenge the systems engineering, test & evaluation, and modelling & simulation communities to consider the dual ideas of how the digital world is advancing these fields, and how these fields are advancing the digital world.

Co-hosts of SETE 2024 include:

- Engineers Australia
- INCOSE/Systems Engineering Society of Australia (SESA)
- Southern Cross chapter, International Test and Evaluation Association (ITEA)
- Simulation Australasia

Planned keynote presentations include:

- *The current state and trends of renewable energy in Australia and the World* (Sam Evans, aka Electric Viking, technology blogger)
- *The Lean Healthcare Systems Engineering (LHSE) Process* (Bohdan W. Oppenheim, Ph.D, Loyola Marymount University)
- *A Systems Approach to Procurement of a large Power Transmission Program in Europe* (Bart van Luling, Technical Director, INCOSE Netherlands and Co-owner, Dutch Boosting Group)
- *The future of emerging technology through an ethical lens: What have we just made possible?* (Mick Spiers, COO, Rail Infrastucture, Siemens Mobility)
- *Digital Engineering Defence – Panel Discussion* (Brigadier Damien McLachlan, Australian Department of Defence)
- *Digital tools for the SKA Observatory, a truly global scientific enterprise: building the world's largest radio telescope in the Western Australia's outback* (Lucio Tirone, Assembly, Integration and Verification Lead Engineer, SKA Observatory)

A diverse slate of optional full-day and half-day tutorials are planned for 22 September, with topics such as:

- Arcadia and Capella Discovery Tutorial
- Fundamentals of MBSE
- Lean Healthcare Systems Engineering Process
- MBSE essentials: mastering the basics of Model Based Systems Engineering
- Practical Systems Engineering: Principles and Methods for Success
- Protecting Water Infrastructures using Bentley's OpenFlows Hammer Transient Modeling and Simulations
- Responsible lethal autonomy in the emergent digital world
- System architecture and analysis applied in the field of infrastructure and energy projects
- Systems Engineering approach for Artificial Intelligence Intensive Systems

- Unlocking the Black Box: A Beginner's Guide to Explainability in Generative AI and LLM Applications

See conference details. Register here.

PPI is a Gold Sponsor of SETE 2024.

NIST Technical Language Processing (TLP) Virtual Workshop

The U.S. National Institute for Standards and Technology (NIST) and the Technical Language Processing Community of Interest (TLP COI) will host a virtual workshop on 24-25 September. The workshop aims to foster connections and exchange insights across all facets of the TLP Community - from researchers and developers to practitioners and consumers of TLP.

This year's meeting will spotlight the current landscape of language processing needs and emerging applications, with a focus on risk awareness, accessibility, and longevity.

Highlights of this event include:

- Insights into current tools and best practices in TLP systems
- Exploration of emerging applications and use cases
- Roundtable discussion with expert panelists on measuring impacts and results of TLP use in the field

Topics to be discussed include:

- Introductory TLP
- Current TLP Landscape
- Risk Awareness Around TLP
- Data Sharing and Resources for TLP
- Needs, Gaps, and Applications of TLP
- Metrics and Measurement of TLP
- Exploring LLMs
- Humans as observers
- SOP or International Standards mining and support

Learn more about the TLP workshop. Register here.

Webinar: Integration of Capella with Requirements Management Tools

Capella is an open-source solution for model-based systems engineering. On 26 September, OBEO will host a webinar, titled *Integration of Capella with Requirements Management Tools* and delivered by Laurent Delaigue, Product Lead at OBEO.

ABSTRACT:

With the Arcadia method implemented by Capella, engineering is considered through three interrelated activities of equal importance:

- Requirements engineering
- Need analysis and modelling
- Architecture building and validation

The first is generally conducted with a Requirements Management tool (such as DOORS or Polarion), while the last two are conducted with Capella. Using different tools raises questions about efficiently maintaining consistency and alignment between the architecture models and the requirements and exposing a consistent integrated view of this interrelated data.

During this webinar, you will see how the Publication for Capella add-on enables publishing Capella models on a web server and connecting them with requirements, change requests, test cases, releases, and more, defined in third-party repositories.

This solution breaks down silos between teams by providing online access to an integrated view of your system architecture. It facilitates your engineering teams' ability to reuse work items and system elements in a consistent and aligned process.

Learn more about the webinar. Register here.

Modelon Innovate 2024

The Modelon Innovate 2024 event is an international gathering focused on system simulation for innovation and product design within commercial industries. This event consists of two days – a conference day and a workshop day. The conference day consists of presentations by speakers utilizing system simulation at their organizations. The workshop day consists of hands-on, instructor-led classes to help Modelon users improve their capabilities with Modelon technology.

Modelon Innovate 2024, will be held in Copenhagen, Denmark on 10-11 October with a theme of *Where Simulation Meets Sustainability*.

Featured speakers include:

- Michele Bolognese, Hydrogen and Sustainable Energy Researcher, Fondazione Bruno Kessler
- Adelia Drego, Senior Associate Research Scientist, SAAB
- Marc Graaf, Managing Partner, Synergy Thermal Management GmbH
- Jim Harper, Principal Technical Lead, EPRI
- Nicholas Pilot, Technical Leader, EPRI
- Doug Scherbarth, Senior Systems Engineer, Allegion
- Mohamed Takkoush, Vehicle Dynamics Analyst, Volvo Autonomous Solutions
- Kristian Tuszynski, Chief Technology Officer, Aircela

Learn more here.

Register [here](#).

American Modelica Conference 2024

The American Modelica Conference 2024 will take place as an in-person event on 14-16 October 2024, in Storrs, Connecticut, USA. A streaming option will be provided to watch presentations online. The conference is organized by [NAMUG](#), the North American Modelica Users Group, in cooperation with the [Modelica Association.](#)

Keynote talks include:

- *Modeling, Simulation, and Autonomous Vehicles: the challenges and opportunities* by Swaminathan Gopalswamy, Director, Connected Autonomous Safe Technologies (CAST) Lab
- *Energy Urgency, Computation and Role of "Systems" Methods & Tools* by Clas A. Jacobson, Senior Fellow, Systems Engineering at Carrier

The conference will cover topics such as the following:

- Applications of Modelica for optimization and optimal control
- Automotive applications
- Discrete modeling techniques
- Experimental language designs and implementations related to Modelica
- Functional Mock-up Interface (FMI) in Modelica and non-Modelica applications/tools
- Large-scale system modeling
- Mechatronics and robotics applications
- Medicine and biology applications
- Modelica for teaching and education
- Modelica in other application areas (mathematical programming, databases etc.)
- Modelica modeling, simulation and design tools
- Multi-engineering modeling and simulation with free and commercial Modelica libraries
- New features of the Modelica language and of FMI
- Other industrial applications, such as electric drives, power systems, aerospace, etc.
- Real-time and hardware-in-the-loop simulation
- Simulation acceleration by use of many CPU cores or GPU cores
- Simulation and code generation for embedded control systems
- Symbolic algorithms and numerical methods for model transformation and simulation
- Thermodynamic and energy systems applications

Learn more [here](#). Register [here](#).

IIBA SoftEd Festival of Business Analysis 2024

The Australia chapter of the [International Institute of Business Analysis™ (IIBA®)](#) is hosting the 2024 IIBA SoftEd Festival of Business Analysis (FOBA) on 14-18 October 2024. The theme of this hybrid multi-site (Australia and New Zealand) conference is "*Innovate. Inspire. Ignite*" to set the stage for exploration of cutting-edge trends, transformative methodologies, and the limitless potential within the realm of business

analysis.

The in-person elements of this conference will move across New Zealand and Australia as follows:

- 14 October – Auckland
- 15 October – Wellington
- 16 October – Adelaide
- 16 October – Brisbane
- 17 October – Perth
- 17 October – Sydney
- 18 October – Melbourne

The online portion of the conference will run from 14-18 October and have a unique speaker lineup.

A sample of the topics to be addressed across the various sites includes:

- *12 Dumb Ways to Die with Agile*
- *A day in the life of an AI-BA (AI enabled Business Analyst)*
- *As BA's how do we embrace the innovative technologies ignite collaboration and inspire sustainable outcomes*
- *Building Trust: The journey towards reliable Generative AI for SA Power Networks*
- *Functional & Non-Functional Business Requirements – are they really that clear cut?*
- *Maintaining Curiosity to Drive Innovation – How to maintain a curious mindset*
- *Minimum Viable Balloon Modelling – Inflating your agility (with a little bit of help from AI and Jira Product Discovery)*
- *Modular Mastery: Enhancing Business Agility and Robustness through Hybrid Systems with Clear and Well-defined Interfaces*
- *Ready Player One (or more!) Leveling Up Gamification for Elicitation Success*
- *Rethinking Service Quality: The Rater Framework and Beyond*
- *The Pathway to Business Analysis Greatness*
- *Workshop: Applying Design Sprints for Complex Systems*
- *Workshop – Creative Cartography: Experience Mapping for Impact*
- *Workshop – Perfect your Pitch through Ritual Dissent*

Learn more and register.
View prior-year events (2022, 2023).

Program Details: NAFEMS Multiphysics Conference 2024

Program details are now available for the NAFEMS Multiphysics Conference 2024 that will take place in the Carlton Hotel, Singapore on 21-23 October.

The theme of this conference is *Elevating Precision in Simulation Engineering*.

The conference is jointly organized by the NAFEMS Multiphysics Working Group, NAFEMS ASEAN, and A*STAR Institute of High-Performance Computing, and is supported by The International Society of Multiphysics, and the Fraunhofer Institute for Algorithms and Scientific Computing SCAI.

Keynote presentations include:

- *Multi-Physics Simulations and Applications Related to Automotive Product Development* (Sita Rameswara Sarma Akella, Mahindra & Mahindra)
- *Quantum-Native Multiphysics Simulations* (Valtteri Lahtinen, Quanscient)

Technical tracks for the conference include:

- Computational Fluid Dynamics (CFD) and Fluid-Structure Interaction (FSI)
- Battery Simulation
- Electronics
- High-Performance Computing (HPC) – Cloud – Quantum
- AI/ML
- Material Modeling / Additive Manufacturing

Learn more and register here.

Registration Open: Project Summit – Business Analyst World Conference
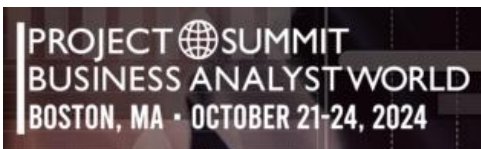
The International Institute of Business Analysis™ (IIBA®) is a professional association with over 30,000 members that helps the global business analysis community to achieve better outcomes through better analysis. IIBA® has endorsed the Project Summit - Business Analyst World conference that will take place in Boston, Massachusetts, USA on 21-24 October 2024.

Keynotes for this conference include:

- Blaze Your Own Trail (Samra Zafar, international speaker, bestselling author, and social entrepreneur)
- Developing The Nimble Characteristics (Fabrício Laguna, Senior Advisor for the President and CEO, IIBA)
- Dysfunction To Dynamic (Amy Yackowski, Founder & Chief Evolution Officer, Painted Porch Strategies)
- Everything You Need to Know About Artificial Intelligence...But Didn't Know to Ask (James
- Spellos, President of Meeting U)
- Navigating Toxic Waters: The Keys to Understanding Organizational Politics (Vincent Mirabelli, Principal Research Director, Info-Tech Research Group)

View the detailed conference program here.

Workshops will address such topics as:

- *Closing the Strategy-Execution Gap with AI*
- *Cracking the Stress Code: Lessons Learned from a Heart Attack, a PM/BA job and raising three sons*
- *Create Extraordinary Teams: Go from Conflict to Connection*
- *Project Management Is The Answer! (But What Are The Questions???*

- *"Real needs" investigation – elicitation techniques applied*

Learn more and register.

NAFEMS Regional Conferences in Iberia and France

In November, NAFEMS is hosting the final two events in its 2024 Regional Conference series.

NAFEMS Iberia Conference (14 November in Madrid, Spain)
The NAFEMS Iberia Conference 2024 will focus on the trends, challenges, best practices and advances in FEA, CFD and data science related to process and product design that will seek to improve our knowledge, efficiency while reducing effort, cost and waste. Submissions are sought on topics such as:

- Advanced simulation methodologies including up-front and reduced modelling
- The role and use of Artificial Intelligence and Machine Learning
- Digital twins and virtual manufacturing applications
- The use of simulation for environmental benefits and sustainable engineering
- Building confidence in simulation credibility for engineering, including Validation and advanced physical testing technologies

View the Call for Presentations (abstracts due by 12 September).

NAFEMS France Conference (19 - 20 November in Senlis, France)
The NAFEMS France Conference take place in Senlis, France on 19-20 November with the theme "*Simulation Solutions for Tomorrow's Challenges*". Digital simulation is significantly impacted by technological developments, in particular generative AI and digital twins, by changes in the demand for personalized products, the management of complex systems, and the consideration of environmental impact, all of which lead to the implementation of new tools, standards, data management and organization.

Keynote talks for this conference include:

- AI & Simulations Strategy at Renault (William Becamel and Rodolphe Gelin, Renault)
- Artificial Intelligence: The Silent Revolution and Time for Change (Mickael Brossard, McKinsey)
- Digital twins for production and load analysis of wind energy assets (Jean Lou Pfister, IFP EN)
- Industrial Digital Twin Learning Techniques, Tools and Models (Alejandro Ribes Cortes, EDF)
- The EDITH Human Digital Twin (Irene Vignon Clémentel, INRIA)

Register here.

Call for Abstracts: NAFEMS World Congress 2025

NAFEMS, the International Association for the Engineering Modelling, Analysis and Simulation Community, has issued a Call for Abstracts for the NAFEMS World Congress 2023 (NWC25). NWC25 is scheduled for 19-22 May 2025 in Salzburg, Austria.

Topics of interest represent all aspects of engineering modelling, analysis & simulation, including:

- AI & Machine Learning in Simulation
- CAE in the design process
- Emerging Methods
- Engineering Data Science
- Integration of Simulation and Test
- Model Credibility
- Physics-based Simulation
- Simulation Data Management
- Simulation Supporting Certification
- System-level Simulation
- The Role of Simulation in Sustainability
- Upfront Simulation

The deadline for submission of a 300–600-word abstract is 22 November 2024.

Digital Thread Conference 2024

The inaugural Digital Thread Conference 2024 will take place on 24-25 September. This virtual event is hosted by Intercax, developers of the Syndeia™ digital thread platform for model-based engineering. The conference will provide an opportunity for the Syndeia community to gather and learn from one another, as well as to explore the broader progress being made in digital threads and digital engineering capabilities.

Presentations will address topics such as:

- Adapting and Adopting the Digital Thread for Enterprise Transformation
- Architecting A Digital Thread For A System
- *Business Value of Digital Threads and Digital Engineering*
- *Data Interoperability at NASA GSFC with Syndeia: Transparency for Stakeholders*
- *Digital Engineering and Digital Threads in the Open Dragon Architecture for JPL Flight Projects*
- *Exploring the Power of Digital Threads: Integration, Innovation, and Automation*
- *From Data Silos to Digital Thread Dashboards in 40 mins - Live Demonstration*
- *Innovating Digital Threads - A Roadmap for Syndeia*
- *Integrated Model-Based Systems Engineering Framework for Vera C. Rubin Observatory*
- *SysML v2 – The Next-generation Systems Modeling Language enabling Digital Threads*
- *Syndeia - An Overview of the Digital Thread Platform for Digital Engineering*

Download a detailed conference agenda and presentation abstracts here.

Register for the Digital Thread Conference 2024.

Webinar: Systems Thinking for Systems Engineers

The INCOSE Transportation Working Group (RWG) in collaboration with the American Public Transportation Association (APTA) and the INCOSE UK Railway Interest Group (RIG) host monthly joint meetings and webinars. On 12 September, these groups will meet physically in Birmingham UK and also virtually for a webinar titled "*Systems Thinking for Systems Engineers*". A trio of University of Birmingham professors, Dr. Marcelo Blumenfeld, Prof. Jon Elphick and Dr. Bruce Elliot will share their insights on this topic.

ABSTRACT:
The extraordinary explosion of systems thinking in the 1950s and 1960s has left us with a broad range of well-proven systems techniques, of which systems engineering (SE) is only one. At last year's Annual Systems Engineering Conference, Professor Mike Jackson challenged the SE community to arm itself with some of these other techniques in order to be able to tackle problems with which systems engineering (SE) struggles on its own. We (Marcelo Blumenfeld, Jon Elphick and Bruce Elliott) agree wholeheartedly. At the University of Birmingham, we teach master-level engineering students about the range of well-proven systems techniques that are available and introduce them to some of these techniques, including Soft Systems Methodology, the Viable Systems Model, System Dynamics and Critical Systems Heuristics.

In this short lecture we hope to leave systems engineers who are not already familiar with systems techniques beyond SE with an idea of what they are, the sort of challenges that they can be useful for and with the inspiration to learn more. If you are already familiar with some or all of these techniques, then we should be interested to compare our views with yours.

Join the webinar on Zoom.
Contact Dr. Bruce Elliot at b.elliott@bham.ac.uk if you intend to attend in-person.

Other talks in this webinar series are available in the TWG's YouTube channel. Recent topics include:

- Engineering Option Appraisal at Network Rail: A Review and Proposal
- Improving Technology Procurement and Reducing Risk
- Connecting the Dots: Interoperability between your favorite Systems Engineering tools

Learn more about TWG.

FEATURE ARTICLE

A Common Notation for Capturing States & Modes Requirements and Design

by John Fitch

Project Performance International

Authored for PPI SyEN

Introduction

In PPI's flagship Systems Engineering for Technology-Based Projects five-day course, we teach a common notation for performing and capturing Functional Analysis (FA) for both system requirements analysis and system design. This combination of control flow and item flow modeling provides a simple, yet elegant method of representing the logical definition of the problem and the logical architecture of the system solution to that problem. One person's solution, represented functionally, becomes the next person's problem with a simple switch in context, but no fundamental change in modeling approach. When we can keep a single set of "books" as we work through multiple levels of system decomposition, *life is good*.

We are working toward such a common approach for the State modeling of system requirements and design. This brief article is a snapshot of that journey. We welcome your inputs and insights at PPISyEN@PPI-Int.com.

To illustrate this challenge, we will elaborate on a previously used example, the Energy Absorbing Deceleration Barrier (aka Fitch Inertial Crash Barrier) [1]. Please refer to the article, *Rethinking Requirements Derivation – Part 2*, in PPI SyEN Edition #130 (November 2023) for more details on the Crash Barrier system example.

States & Modes Analysis for Requirements Analysis

PPI's recommended process for performing States and Modes Analysis as part of system requirements analysis creates three significant work products. We make a clear distinction between a state – a condition of the system of interest and a mode – a significant grouping (subset) of the system's functionality.

States and Modes Table

After an initial set of candidate states and modes are identified and screened for validity as states (conditions) vs modes (functions), the chosen set of states and modes are added to the States and Modes Table as shown below. States are added first, typically in the order in which they will occur in the life of the system. Modes are then appended to the list of states. It is recommended that a set of definitions be generated for the states and modes to clarify the boundaries of each. Some iteration is to be expected as the States and Modes Table is thought through and refined; but having clear definitions will reduce unnecessary rework.

During requirements analysis, PPI recommends that all states are defined as mutually exclusive, i.e., that they are not required to be simultaneously available. This heuristic implies that a clear transition must be defined between the states such that one and only one system-level state is active at any time. This strong recommendation is not a rule, but rather a guideline based on experience. Creating multiple parallel (simultaneously existing) states adds significant complexity to the model. Note that all of the states for the Crash Barrier have been defined as mutually exclusive as evidenced by the "M" in the State-to-State relationship cells of the table.

It is important to remember that all system requirements do not have to be mapped to the state model. States should represent significant aspects of the system behavior. When in doubt, keep the number of states to a minimum.

The functionality of the Crash Barrier is primarily concentrated in its *Intercepting State* (aka two seconds of terror), which is initiated when an errant vehicle impacts the barrier system. The functions associated with this state have been grouped into a *Decelerate Vehicle* mode. The preceding *Protecting State* also has a required mode, *Maintain Readiness*, which includes functions such as:

- Retain sand (dispersive materials)
- Elevate sand (above the center of mass of impacting vehicles)
- Prevent moisture ingress
- Prevent tampering

Just as with states, the total functionality of the system does not need to be assigned to modes. Both states and modes are useful, but not mandatory constructs. Individual requirements, both functional and non-functional, may be valid characteristics of the system without being limited in applicability to a named state or mode. However, the existence of states and modes provides a convenient way to limit the applicability of a requirement by use of language such as:

The crash barrier, when in Intercepting State and Decelerate Vehicle mode, shall impart a continuous downward force on the impacting vehicle.

States & Modes	ST.0	ST.1	ST.2	ST.3	ST.4	ST.5	M.1	M.2	M.3
ST.0 Unassembled State		M	M	M	M	M	P	P	P
ST.1 Arrayed State	M		M	M	M	M	P	P	P
ST.2 Protecting State	M	M		M	M	M	R	P	R
ST.3 Intercepting State	M	M	M		M	M	P	R	P
ST.4 Sacrificed State	M	M	M	M		M	P	P	P
ST.5 Recycled / Disposed of State	M	M	M	M	M		P	P	P
M.1 Maintain Readiness Mode	P	P	R	P	P	P		P	P
M.2 Decelerate Vehicle Mode	P	P	P	R	P	P	P		P
M.3 Partial Readiness Mode	P	P	R	P	P	P	P	P	

Legend:		
	R	Is required to be able to exist simultaneously with
	M	Is required to be mutually exclusive to
	P	Don't care (permitted)

Crash Barrier States and Modes Table

The States and Modes Table indicates with an "R" (enlarged in this example for visibility) in the intersecting cells that the *Maintain Readiness* and *Partial Readiness* modes are required to be able to exist simultaneously with the *Protecting State*. The *Partial Readiness* mode addresses the possibility that the impacting vehicle will only fracture some of the barrier units because of less-than-maximum vehicle kinetic energy (mass & velocity). In this mode, the remaining units, after removal of the post-crash debris, offer a lower, but still meaningful level of protection for an errant vehicle that might strike the barrier prior to full restoration of all of the missing elements of barrier array.

The *Decelerate Vehicle* mode is required to be available only in the *Intercepting State*.

There are quite a few "P" for Permitted symbols in the table; these represent the case where there is no requirement for supporting either simultaneous existence or enforcing mutual exclusivity. Note that although *Maintain Readiness* and *Partial Readiness* modes are both available in the *Protecting State* and are inherently mutually exclusive representing different barrier configurations and levels of protective deceleration capability; they also have a Permitted mode-to-mode relationship. The nature of the crash event and post-crash cleanup sequence renders it unnecessary to verify either condition, saving the cost/effort associated with verification activities. However, the presence of the "P" indicates that the relationship wasn't overlooked; a conscious decision was made to assert, "*We don't care, so we won't verify*".

The process functional requirements associated with populating the States and Modes table may be summarized as "Capture and visualize X" where X includes:

- System States and their definition
- System Modes and their definition
- Required-to-be-potentially-simultaneous States and Modes
- Required-to-be-mutually-exclusive States and Modes
- Choice to ignore simultaneity or mutual exclusivity

State Transition Diagram

The State Transition Diagram is used to capture and visualize how the states in the States and Modes Table relate to one another. Each state in the table is placed on the diagram. If there is a default state (in which the system begins its existence), that default is shown by an incoming arrow. An incoming arrow represents a requirement that might be worded, in the case of the crash barrier, as:

The barrier, as received, shall be in the Unassembled State.

Next, we need to define how the system will transition between each of the mutually exclusive states. The arrow from the Unassembled State to the Arrayed State may represent multiple requirements, typically one for specifying the transition event and one or more for specifying the system response to this transition.

The barrier, upon assembly and placement of units IAW the site layout, shall transition from the Unassembled State to the Arrayed State.

The barrier, having entered the Arrayed State from the Unassembled State, shall maintain positional integrity in Worst Case Environment Conditions as defined …

We wouldn't want the barriers moving around on a windy day prior to be filled with sand – their relative position and level of sand fill is essential to providing a "smooth" deceleration force on the vehicle that will protect its occupants from harm.

We would complete the remaining required transitions. A few examples of such required transitions are shown in the diagram to illustrate this process. One interesting case is the "backwards" transition from the Sacrificed State to the Protecting State. As noted above, if the errant vehicle kinetic energy is insufficient to fracture all the barrier units in the array, there may be benefit in cleaning up the debris and placing the barrier back into service in the Protecting State and its associated Partial Readiness mode*.*

State Transition Diagram for Crash Barrier

1. Place Required & Permitted States
2. Add Default State (if any)
3. Add Transitions
4. Extract Requirements

→ Required Transition

- - → Permitted Transition

⫻→ Prohibited Transition

The barrier, as received, shall be in Unassembled State.

The barrier, upon assembly and placement of units IAW ... shall transition to Arrayed State.

The barrier, having entered Arrayed State, shall maintain positional integrity ...

The barrier, upon vehicle impact... shall transition to Intercepting State.

The barrier, having entered Intercepting State, shall decelerate the vehicle ...

The barrier, upon filling of units IAW ... shall transition to Protecting State.

The barrier, having entered Protecting State, shall maintain operational readiness ...

The barrier, in Sacrificed State and upon removal of partial post-crash detritus, shall transition to Protecting State.

None, in this case unless a failure state is added

None, because of "one-way" physical realities of externally initiated crash event

Unassembled State → **Arrayed State** → **Protecting State** → **Intercepting State** → **Sacrificed State** → **Recycled / Disposed of State**

State Transition Diagram for Crash Barrier

Systems may have Permitted transitions between their states. These are most common if the state model includes one or more "failure" states, undesirable, but permitted because they are not fully preventable. If needed, these would be added as dashed arrows. Although one could conceive of such failure states for the crash barrier, it would likely be simpler to account for failure mitigation by adding a few requirements (e.g., prevent tampering of barrier units) rather than by detailing out failure-related behaviors as explicit system states. As always, engineering judgment is applied at each step in the process.

Similarly, systems may have a need for specifying Prohibited transitions, but in the case of the crash barrier it "sits there" passively doing its job in the *Protecting State* until an external event triggers it to transition to the *Intercepting State*. There would be limited value (and significant verification cost) in specifying:

The barrier, when in Protecting State, shall not transition to Intercepting State under any conditions other than those specified in the Errant Vehicle Impact event as defined in ...

The process functional requirements associated with the State Transition Diagram may be summarized as "Capture and visualize Y" where Y includes:

- Default system state
- Required state-to-state transitions (triggering event + system response)
- Permitted state-to-state transitions (triggering event + system response)
- Prohibited state-to-state transitions (triggering event + system response)
- Requirements for each state and transition

Modes-in-States Diagram
The logic behind the Modes-in-States diagram is similar to the State Transition Diagram, with some variations in the notation. Modes are "copied" from the States and Modes table to the diagram, but if

a mode is potentially concurrent with more than one state, it shows up as a separate box for each such state with the state name (abbreviation) shown in the lower right-hand corner. In our simple crash barrier example, we have two modes associated with one state, but no modes associated with more than one state. Therefore three mode boxes, one for each mode, will suffice on the Modes-in-States Diagram.

**Modes-in-States Diagram for Crash Barrier**

1. Place Required & Permitted Modes-in-States
2. Add Default Mode (if any)
3. If not, Add Mode-Inactive-Substate for each Mode
4. Add Transitions
5. Add Other Exits
6. Extract Requirements

Required Transition
Permitted Transition
Prohibited Transition

The barrier, having entered Protecting State from Arrayed State, shall maintain operational readiness with less on 0.5% probability of failure

Maintain Readiness Mode — PS
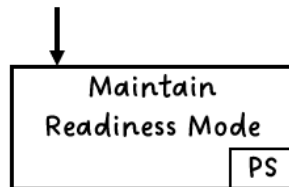
The barrier, having entered Intercepting State from Protecting State, shall enter Decelerate Vehicle mode within 0.5 seconds of vehicle impact with the first barrier unit

Decelerate Vehicle Mode — IS
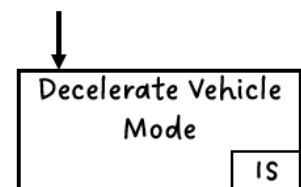
The barrier, in Sacrificed State and upon removal of debris from a prior vehicle impact, shall enter Partial Readiness Mode.

The barrier, having entered Partial Readiness Mode, shall decelerate an impacting vehicle to N% of its specified value where N = ...

Partial Readiness Mode — PS
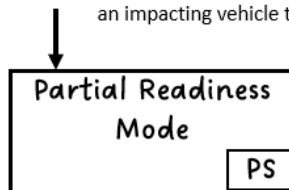
Modes-in-State Diagram for Crash Barrier

Somewhat atypically, there are no direct mode-to-mode transitions for the crash barrier. This is a result of having two unique entry paths into the *Protecting State*. In the normal barrier deployment scenario, the barrier enters the *Protecting State* from the *Arrayed State* and defaults to *Maintain Readiness* mode when all barrier units are filled to the specified level of sand. After a crash leaves the barrier system in *Sacrificed State*, removal of debris and the presence of undamaged barrier units returns the barrier to the *Protecting State but in the Partial Readiness mode.*

For similar reasons to the State Transition Diagram, Permitted and Prohibited transitions are not needed for the barrier system Modes-in-State Diagram.

The process functional requirements associated with the Modes-in-States Diagram may be summarized as "Capture and visualize Z" where Z includes:

- Modes within states
- Default modes per state
- Mode-inactive substate (where default modes are not defined or other exits are needed)
- Required mode-to-mode transitions (triggering event + system response)
- Permitted mode-to-mode transitions (triggering event + system response)
- Prohibited mode-to-mode transitions (triggering event + system response)
- Requirements for each mode and transition

State Modeling for Design

Harel statecharts are a widely used notation for capturing and visualizing state-based system designs. Defined in 1987 by Professor David Harel of the Weizmann Institute of Science in Israel, the notation has found its way into the SysML 2.0 standard and numerous other Model-Based Systems Engineering (MBSE) software tools. [2, 3]

Harel statecharts extend state transition diagrams by adding constructs for hierarchy, concurrency and communication, providing a compact, compositional and modular way to express complex system behaviors.
An example statechart for the crash barrier system is shown below.
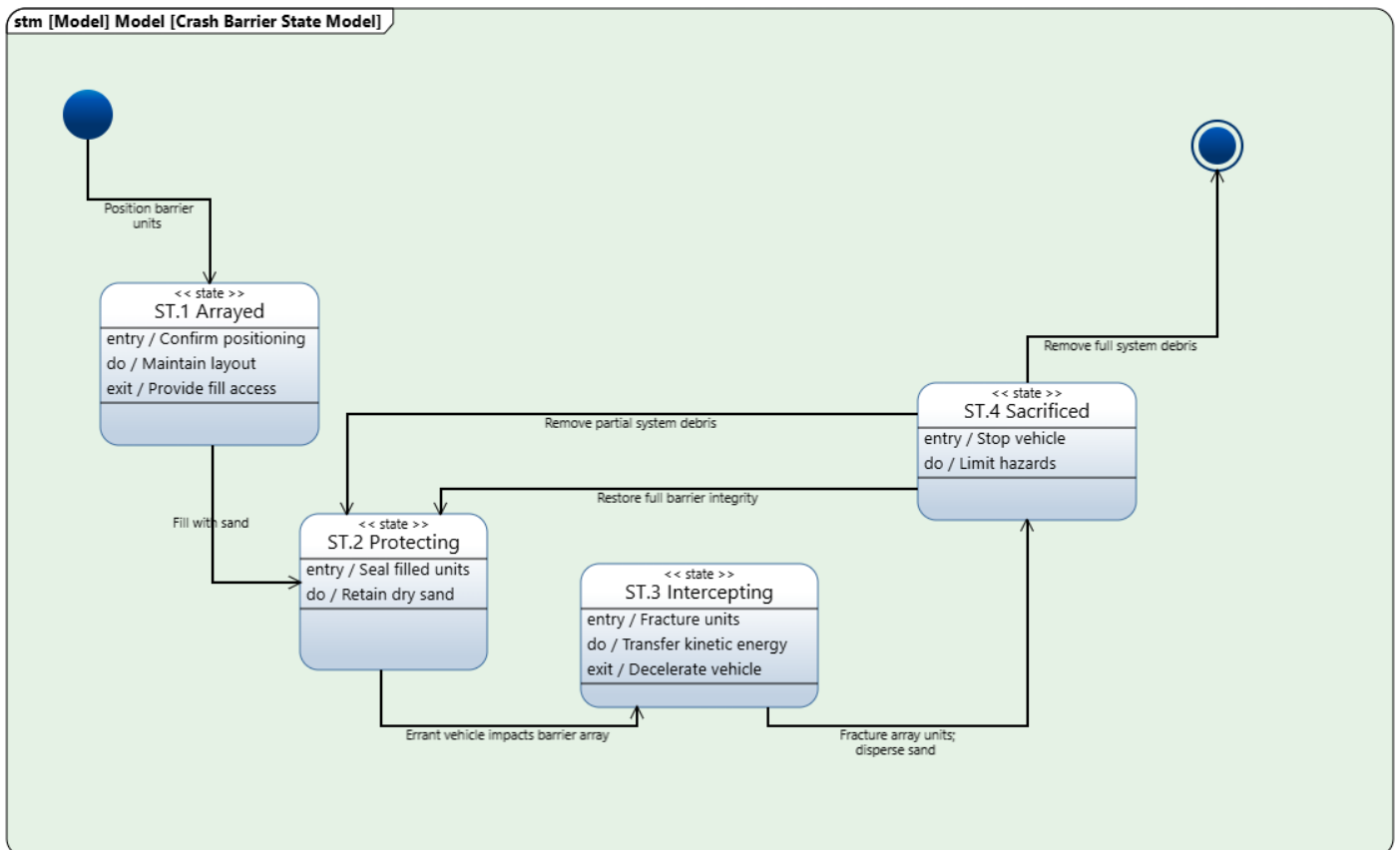
Crash Barrier Statechart

The states illustrated match those in the States and Modes Table that was previously presented, with the Initial State (*Unassembled)* and Final State (*Recycled / Disposed of*) represented by the two circles. Each state may include three types of actions which the SysML 2.0 Beta 1 standard defines as:

- An *entry action* starts when the state is activated.
- A *do action* starts after the entry action completes and continues while the state is active.
- An *exit action* starts when the state is exited, and the state becomes inactive once the exit action is completed.
-

Transitions are shown on the arrows between the states. Transitions are not synonymous with Entry and Exit actions. Transitions may include triggers, guards (conditional statements that must evaluate as TRUE for the transition to occur) and resulting actions that move the system between states. The general logic of a transition may be expressed as:

transition

>   **first** *state1*
>
>   **accept** *trigger1*
>
>   **if** *guard1*
>
>   **do** *action1*
>
>   **then** *state2;*

For example, the transition from *Protecting State* to *Intercepting State* is triggered when an errant vehicle impacts the barrier. This transition may be modeled as:

>   **first** *Protecting State*
>
>   **accept** *Errant vehicle impacts barrier array*
>
>   **if** *Force of impact sufficient to fracture at least one barrier unit*
>
>   **do** *Fracture first barrier*
>
>   **then** *Intercepting State;*

For brevity, the statechart diagram example shows only the triggering event as the label on the transition arrow instead of the more complete *trigger[guard] / action* logic.
The actions associated with the Intercepting State would be:

- Entry: Fracture barrier unit(s)
- Do: Transfer kinetic energy from vehicle to barrier materials (a summary of the Decelerate Vehicle functional model depicted in the November 2023 Crash Barrier article)
- Exit: Decelerate the vehicle to 0 (or minimum achievable velocity)

There may be multiple *do actions* for a state, although not all MBSE tools support such display.
A more thorough textual description of the crash barrier states and transitions is provided in the table below.

Crash Barrier States	Labels	Outgoing Transition
ST.0 Unassembled: Unassembled barrier units at the site	State, Initial State	Position barrier units: Place barrier units at the site IAW with the array design layout
ST.1 Arrayed: The units that comprise the barrier array are positioned IAW the design, but not filled with dispersive materials	State	Fill with sand: Fill the individual barrier units with the specified volume of dispersive materials (dry sand) IAW with the array design
ST.2 Protecting: The barrier array is protecting errant vehicle(s) by shielding them from immoveable highway infrastructure	State	Errant vehicle impacts barrier array: An errant vehicle impacts the barrier array with sufficient force to cause fracturing of one or more barrier units.
ST.3 Intercepting: The barrier array is intercepting an errant vehicle on a path toward an immoveable highway infrastructure element	State	Fracture array units; disperse sand
ST.4 Sacrificed: The barrier array is fully or partially sacrificed with one or more barrier units fractured and their dispersive materials ejected by the impact of an errant vehicle	State	Remove full system debris: Remove the debris from the vehicle - barrier collision included fractured barrier units (full set) and dispersed sand, likely mixed with vehicle parts.
		Remove partial system debris: Remove the debris from the vehicle - barrier collision included fractured barrier units (a subset) and dispersed sand, likely mixed with vehicle parts.
		Restore full barrier integrity: Restore the operational integrity of the barrier by removing post-crash debris and replacing damaged barrier units and lost sand.
ST.5 Recycled / Disposed of: Fractured barrier units within the array and dispersed sand are removed and disposed of, primarily through recycling.	State, Final State	

Crash Barrier State Model Summary

Harel statecharts support a hierarchical view of states, with nested states that enable hiding of substates. This enables abstractions that simplify the presentation of a complex state model when compared with very large "flat" state transition diagrams.

Harel statecharts support composite states that include parallel (potentially simultaneous) substates. It is not clear (to this author) from the literature whether the original Harel statechart notation or its derived variant within the SysML 2.0 Beta 1 standard defines parallel as signifying "enforced concurrency" between substates or the less restrictive "potentially simultaneous" meaning that is captured in the PPI States and Modes table. By convention in the SysML 2.0 Beta 1 standard, there are restrictions on defining transitions between these parallel substates which tends to support the "enforced concurrency" interpretation. The linear cause-effect simplicity of the crash barrier example obviates the need to use the parallel states capability of the notation.

Harel statecharts depend on the presumed existence of a near-instantaneous communication method by which state-to-state interactions can occur without separately detailing the communications functions or modeling message traffic and timing concerns.

Harel statecharts seem to have no explicit concept of permitted and prohibited transitions. The author assumes that these are handled as requirements which may be associated with states, actions or transitions.

Harel statecharts don't explicitly address modes (system functionality groupings), other than by the ability to define multiple or summary "do" actions within a state. Without a *Modes* class of information in the language (or a blending of conditions and functionality within the State class), there is no

obvious equivalent for useful information such as modes-in-states or mode-to-mode transitions.

The process functional requirements associated with the Harel Statechart notation may be summarized as "Capture and visualize A" where A includes:

- System States and their definition
- Composite states and their substates
- State-to-state transitions (trigger[guard] / action)
- Entry action(s)
- Do actions(s)
- Exit action(s)
- Requirements for each state, transition and action

Differences to Explore

The Comparison Table below provides an initial AS-IS mapping between the process functional requirements for PPI's States & Modes Analysis (for requirements analysis) and Harel statecharts (for design).

FUNCTIONS: States & Modes Analysis Capture and Visualize:	FUNCTIONS: Harel statecharts Capture and Visualize:
System States and their definition	System States and their definition
System Modes and their definition	
Required-to-be-potentially-simultaneous States and Modes	Composite states and their substates
Required-to-be-mutually-exclusive States and Modes	
Choice to ignore simultaneity or mutual exclusivity	
Default system state	*Initial State?*
Required state-to-state transitions (triggering event + system response)	State-to-state transitions (trigger[guard] / action)
Permitted state-to-state transitions (triggering event + system response)	
Prohibited state-to-state transitions (triggering event + system response)	
Requirements for each state and transition	Requirements for each state, transition and action

May be embedded in transition action?	Entry action(s)
Mode definitions may overlap Statechart do actions? States included in requirement text to communicate conditions when a requirement applies	Do actions(s)
May be embedded in transition action?	Exit action(s)
Modes within states	*Modes may be addressed as substates without a clear condition vs functionality distinction?*
Default modes per state	
Mode-inactive substate (where default modes are not defined or other exits are needed)	
Required mode-to-mode transitions (triggering event + system response)	
Permitted mode-to-mode transitions (triggering event + system response)	
Prohibited mode-to-mode transitions (triggering event + system response)	
Requirements for each mode and transition	

Methods Comparison Table

Although PPI's States & Modes Analysis methodology provides a more comprehensive and detailed modeling representation, there is good alignment with Harel statecharts. PPI's methodology adds more details in defining state-to-state "timing" relationships (simultaneity or mutual exclusivity) and significant details in terms of specifying modes. Statecharts can provide extensions for handling of parallel states, hierarchical (nested) states and more details concerning the actions associated with an individual state.

Research questions for additional investigation are shown in italics.

Conclusions

This example-based AS-IS comparison of two methods for capturing and visualizing system state information has identified no significant roadblocks to developing a unified or hybrid method that can take advantage of the strengths of PPI's States & Modes Analysis when combined with Harel statecharts. Look for a TO-BE article in a future PPI SyEN edition where a prototype of such a hybrid approach is explored in more detail.

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About the Author

John Fitch is a Principal Consultant and Course Presenter for Project Performance International. John brings over four decades of systems engineering, engineering management, consulting and training experience to the PPI team. In 2012, John was certified by INCOSE as an Expert Systems Engineering Professional (ESEP).

Within the field of systems engineering, John's career has focused on decision management, requirements management, risk management, systems design & architecture, product/technology road-mapping and innovation. In addition to defense/aerospace, John has guided initiatives in domains such as communications systems, software, energy, nanotechnology, medical devices, manufacturing systems, knowledge management and business process improvement.

> "
>
> *Engineers participate in the activities which make the resources of nature available in a form beneficial to man and provide systems which will perform optimally and economically.*
>
> **L. M. K. Boelter**

Reflections on INCOSE IS2024

by Paul Davies and René King (PPI)

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Authored for PPI SyEN

Reflections on INCOSE IS2024

Paul Davies, representing thesystemsengineer.uk, PPI, Loughborough University and INCOSE (all 4!)

My perspective on IS2024 is colored by having acted as the Master of Ceremonies for the event. David and Donna Long, the duo who directed the whole Symposium, had twisted my arm into volunteering, a few months before the Dublin event itself. David then twisted my arm even further by asking me to present on Interface Management as part of the 'Systems Engineering Fundamentals' track. Plus, I had had a presentation of my own accepted, recounting my experiences running a Master's Degree group project based on MBSE for Loughborough University. And PPI had generously agreed to fund my participation provided I helped out on their Exhibitor stand – which was enjoyable in itself, meeting lots of interesting new systems engineers, mostly early-career and enthusiastic. So, all in all I was a busy boy.

I might be a bit biased, but I would say that the running of the event was smooth and successful, almost graceful like swan. And, like a swan, there was some furious paddling going on underneath. Karin Moens and her marvelous event management team had prepared extremely well, they coped with last-minute changes and problems without undue fuss, and David and Donna even managed to see some presentations between dealing with issues. To paraphrase Brian Collins (the opening keynote speaker), we managed to prevent any crises becoming disasters. Not bad, for an event with over 1000 attendees all with different agendas, keeping the changeovers between the ~200 session slots synchronised, and getting everybody fed and watered within the time budgets.

One thing I did not prepare for when agreeing to be MC was the event committee meetings starting before 6.30am every day, so that the Technical Chair and his team could run the Speakers' Breakfast starting at 7.00. All the key messages and award slides had to be ready for review at that first meeting, a half-hour tram ride away from my hotel. What is it with Americans and early starts? Most of Europe far prefers to start, and indeed finish, at least an hour later.

The Keynotes themselves were all interesting and challenging. As MC, I had interviewed each of them on camera beforehand, but they still managed to develop their themes in entertaining and stimulating ways.

Brian Collins, a former UK Chief Scientific Adviser, and flying into Dublin straight after a holiday, recounted experiences and recommendations influencing governments and other major stakeholders on the benefits of systems thinking and modelling in policy-making and crisis preparation and prevention. Along the way, we discovered the acronym TUNA for describing the 'wicked problems' – Turbulent, Uncertain, Novel (and/or Networked), and Ambiguous.

Dave Snowden, founder and Director of the Cynefin Centre, talked about methods and techniques for the quantification of complexity and uncertainty in systems and their environments / contexts, and then on to the understanding and treatment of risks. Beyond systems thinking, of particular interest was the Centre's work in the detection of weak sociotechnical signals in uncertain and changing environments.

Mark Kelly, the founder of AI Ireland, showed a range of emerging AI capabilities – some amazing, some with emergent unintended consequences, and some quite scary – and discussed how AI will change the landscape of our work in system development. In essence, do not compete with AI in finding solutions where it will be quicker and more comprehensive: rather, use AI to find the right questions to ask, and use our skills to choose the right directions and verify the answers that it gives. The subsequent Q&A session had to be truncated in the interests of time, before the hot topic of deliberate misuse of AI could be properly addressed.

The Keynote speaker on the final day was Professor Kathryn Cormican of the University of Galway in Ireland. Her topic was the progression of the engineering profession towards Industry 5.0 – what it means, and how we need to change our SE approaches. Emphasis was put on smarter, user-centric solutions that are of wider societal benefit than the immediate customer focus.

Given that there were over 1000 registrations for the Symposium, the attendance at the Plenary sessions featuring the Keynote speakers was disappointing. Perhaps the early starts contributed to this? Or were attendees spending the time preparing for the rest of the day? With 6 tracks to choose from, plus side events, picking what to see (and read) was difficult, given the mostly excellent quality throughout.

In each Plenary session, on behalf of the organising committee and the INCOSE technical operations team I had to recommend the day's best tracks and papers. Two tracks each day were webcast live, with opportunities for virtual attendees to participate in the Q&A sessions, as these were expected to be the most popular. These covered topics such as:

- Systems Engineering Fundamentals
- Security, Cybersecurity and Industry 4.0
- An 'MBSE Lightning Round', plus Digital Transformation
- Sustainability
- AI and SE
- Leadership and SE
- MBSE adoption
- Modular Open Systems Approach

I cannot comment on the Best Papers themselves, as I only managed to see one of them which I cover below. However, you can still look them up on the INCOSE website.

The SE Fundamentals track, in which I participated, was intended for early-career SE's but was

extremely popular with more experienced delegates and was oversubscribed throughout the day. Particular highlights for me were Paul Nielsen on Engineering the Future, Mike Jackson on Systems Thinking, Maarten Bonnema on Architecting, and Nicole Hutchinson on SE Competencies.

With having to make my own presentations, chair a session or two, and prepare the Plenary Presentations (with last-minute details to be inserted), I didn't get to see as many papers as I would have liked. I also made some bad choices; not all of the papers were world-class... However, there were plenty of great papers / presentations to be found by later study of the Proceedings. In person though, I must mention the one that really impressed me. It was by Brian Johns of the US Air Force Academy plus a team from Studio SE Ltd fronted by Kristina Carroll; they had integrated OpenAI's GPT-4 Turbo with Catia Magic, to create what they called a Systems Modelling Enhancer (AI-SME). They demonstrated the tool live, asking the audience to suggest a system to model. The tool was then prompted to generate a Block Definition Diagram and an Internal Block Diagram for the target system, in this case a Mars Rover. The output was displayed live and looked extremely plausible – and was of course generated at least 20 times faster than a human could have done.

I was not at my best health-wise throughout the Symposium, and it got worse as the week wore on. I had planned to stay on afterwards and explore more of Dublin, but exhaustion and industrial action by Aer Lingus meant I went back to UK on the Friday evening, where I promptly tested positive for Covid. A new strain that it turns out was prevalent in Ireland at that time, and that came with symptoms resistant to prior vaccines. Despite that, I still think it was a successful event of high quality, and worth further exploration of the Proceedings.

About the Author

Paul Davies is semi-retired and was previously the Discipline Manager for Systems Engineering at Network Rail Infrastructure Projects in the UK. In that role he was responsible for promoting improvements in process and in practitioner competence in all aspects of systems engineering. Prior to this, he worked for Thales UK, with nearly thirty years' experience in SE research, innovations management, SE functional leadership, and project engineering management. Over a succession of challenging projects with challenging customers, Paul learned many valuable empirical lessons which he now enjoys passing on to the next generation of systems engineers through training and mentoring. Current involvements include Loughborough University in the UK, through INCOSE, and for PPI.

Paul is a Chartered Engineer, a Certified Systems Engineering Professional, a Past President of the UK Chapter of INCOSE, and has been a popular presenter and tutorial lead at many INCOSE events. When not working, he is a keen chess player, and spending time with family in the UK and in the French Alps.

René King (representing PPI and CTI)

My return to Dublin for the INCOSE IS 2024 after a hiatus since 2017 was a memorable experience. Previously, I had spent less than 24 hours in the city, merely passing through on my way to a vacation in Galway. This time, however, I had the opportunity to immerse myself in Dublin's rich culture and vibrant atmosphere. It was fantastic to see so INCOSE IS many attendees engaging in cultural activities, from Celtic music-driven pub crawls to historical boat tours, showcasing the city's unique charm.

Leading up to the event, I was particularly excited about the program, which promised a diverse array of presentations. This was one of those conferences where, at any given moment, there were likely two or three sessions that piqued your interest, regardless of your background and interest. As often happens, though, I found myself attending fewer presentations than I had planned, choosing instead to focus on building relationships and networking. From that perspective, I would rate the conference a solid 10/10. It was especially rewarding to meet in person with individuals like the students from Tsinghua University, accompanied by Professor Lefei Li, whom I had only previously interacted with virtually.

Among the presentations I attended, several stood out, particularly Paul's. Although I had heard a similar presentation from Paul before, I found myself picking up on much more this time around, and it was very well done. The overview of SysIDE by Sensmetry also intrigued me, especially the potential of a text-based, software coding-oriented approach to SysML v2 modeling. Participants who had used the tool shared mostly positive feedback, which further piqued my interest. Additionally, learning about the advancements in MBSE modeling tools from Capella, Siemens, Ansys, and others was impressive. The future indeed looks promising for the model-based engineering and digital engineering landscape.

Another standout presentation was by Eileen Arnold and Dorothy McKinney on "Human Frailties: Springboard to Systems Engineering Influence." They provided practical insights into leveraging cognitive biases and human challenges to create a more significant impact within organizations and improve team dynamics. This topic, often overlooked in SE, deserves more attention, and I hope their work gains the recognition it warrants. Key points discussed included strategies to mitigate cognitive biases like anchoring, groupthink, and emotional reasoning, and how these can be turned into opportunities for better decision-making and leadership.

I also found the session on promoting neurodiversity through MBSE and other technical approaches to be particularly enlightening. Led by Taylor Duffy of SPEC Innovations and Maria Romero of Modern Technology Solutions, Inc., the presentation highlighted the benefits of a neurodiverse engineering team, emphasizing how diverse perspectives can drive innovation, resilience, and sustainability in technical industries. It was a powerful reminder that embracing neurodiversity isn't just about inclusivity; it's about fostering a more innovative and adaptable engineering environment.

I was also fortunate to participate in a panel on "Participatory Methods in SE" alongside Jennifer Russell (Graver), Dale Brown (Hatch), and Mariet Kurtz (MITRE). We discussed the importance of language, responsibility, and accountability, and how the very tools that sometimes limit our communication with stakeholders can also empower us when viewed differently. The audience's positive feedback provided us with valuable insights for future panels and sessions on this critical topic.

Other memorable moments from the conference included the Digital Engineering Game Show, featuring Terri Chan, Duncan Kemp, and Kerry Lunny, and hosted by Daniel Hettema. This engaging event served as the perfect segue between the day's technical program and the evening's icebreaker, offering a fun yet challenging competition covering topics from digital engineering facts to Irish trivia.

The banquet at the Royal Dublin Society Concert Hall was a delightful end to the day. We were treated to a wonderful performance by Irish singer Lisa Lambe, whose soulful renditions of classic Irish songs and popular covers added a magical touch to the evening. It was a fantastic conclusion to a day filled with learning and networking.

For those like me who missed much of the action at the INCOSE IS, most of the content is available on the INCOSE PDP, provided you registered for the event. This is a great opportunity to catch up on the sessions that you couldn't attend in person.

Overall, the INCOSE IS2024 was characterized by high energy, relevant and exciting content, and excellent execution by the Convention Centre Dublin, the INCOSE team, and the dedicated events staff. The logistics and technical aspects were handled seamlessly, making for an outstanding attendee experience. I am already looking forward to the INCOSE IW 2024 in Seville and the INCOSE IS2025 in Ottawa. It's a privilege to be part of these events, traveling the world, reconnecting with friends, and advancing professionally all at once.
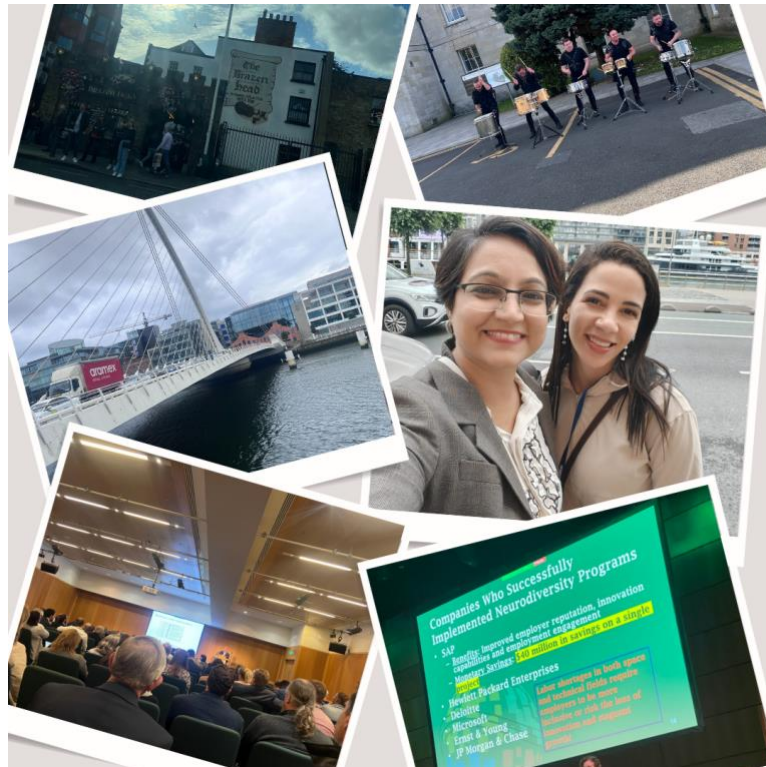
Photos are captioned from left to right, then top to bottom:

1. A lively pub scene in Dublin, capturing the essence of long, enjoyable summer days filled with local culture and music.
2. An Irish band performing outside the Royal Dublin Society Hall, entertaining guests before the formal dinner event.
3. Scenic views of the River Liffey just outside the Dublin Convention Centre.
4. Catching up with longtime friends and colleagues: a selfie with Stueti Gupta of BlueKei Solutions.
5. Paul Davies presenting to a packed room on the topic of Interfaces and the Somebody Else's Problem Field.
6. A notable slide from the presentation on Promoting Neurodiversity Through MBSE and Other Technical Approaches by Taylor Duffy and Maria Romero.

About the Author

René King is a Senior Engineer and Business Development Manager at Project Performance International (PPI). She holds a BSc in Mechanical Engineering and an MSc in Systems Engineering, both from the University of Witwatersrand in South Africa. Her master's thesis focused on evaluating the operational capacity of a freight railway network by integrating multiple analytical frameworks to maximize efficiency with fixed resource inputs. Additionally, René is the Managing Director of PPI's subsidiary, Certification Training International, and leads the PPI-INCOSE Systems Engineering Tools Database project. This collaborative initiative aims to assist engineers in finding tools that enhance their systems engineering activities. Certified as ASEP and SE-ZERT Level C, René is deeply committed to the value of certification in expanding the reach of systems engineering. She is dedicated to exploring ways in which PPI and CTI can better support individuals, teams, and organizations in addressing the engineering challenges of the future.

SYSTEMS ENGINEERING RESOURCES

Useful artifacts to improve your SE effectiveness

System Dynamics Resources for Healthcare and Environmental Management

The wide application of System Dynamics to global challenges such as healthcare and the environment has led to the creation of multiple application-focused resources that are offered through or recommended by the System Dynamics Society (SDS):

A Systems Perspective of Public Health

This book, by Marek Susta, PhD, uncovers otherwise invisible relationships in public health systems, taking them all the way from the basics of a systems approach to complex structures. Readers will learn how to use computer models to unravel the mysteries of government health policy, demography, or epidemiology. The book also teaches how to build models to solve any problem of a complex nature. It covers selected problems in detail from topics, such as epidemiology, pharmaceuticas, government regulatory policy, health care provider staffing, capacity planning, vaccination, and national health policy.

Purchase on Amazon.

Friday Night at the ER – Simulation Game

This simulation game is designed to improve systems thinking and team performance in any industry. It teaches people how to work effectively across boundaries. During this all-industry learning experience, participants are challenged to manage a busy community hospital. They learn to rise above their silos and apply key principles of systems thinking to improve their organization's performance. This resource may be delivered as a game kit, online facilitator training and/or as an onsite program.

System Dynamics Helps Evaluate Anticipatory Action on Cholera Outbreaks

Cholera remains a significant public health problem in the Democratic Republic of the Congo (DRC). It is crucial for humanitarian response to move from a largely reactive to an anticipatory approach according to the Centre for Humanitarian Data.

The System Dynamics model described herein plays a substantial role in the learning process of the anticipatory action pilot project, by simulating various scenarios involving different anticipatory actions. The case-area targeted intervention (CATI) approach involves the early detection of primary outbreak cases and delivery of a rapid response to nearby households to substantially reduce transmission. Depending on the timing and the capacity of the anticipatory activities, the model findings demonstrate positive outcomes from early interventions.

System Dynamics Models for Public Health and Health Care Policy

System Dynamics simulation modeling has been applied to many health care and public health issues since the 1960s. This ten article reprint originally appeared in a Special Issue of the Systems journal and covered a broad cross-section of relevant methodological topics as well as applications to specific

health problems. Available [here](#) as a printed edition or a free PDF download.

[Management Design for Planted Forests in Japan Using System Dynamics](#)
This case study presents a simulation model that offered a novel approach to sustainable forest management in Japan, enabling detailed analysis of labor requirements and changes in forest conditions. The model enables economic benefits such as stable employment, improved financial planning, and enhanced spatio-temporal analysis for 3D visualization of forestry operations.

Environmental sustainability is promoted through operations designed to support reforestation, including planting and thinning. This comprehensive tool empowers regional forestry workers and local governments to devise informed, sustainable management plans based on precise forest stand data.

[Mathematical Models and Environmental Change](#)
This book, authored by Douglas Crookes, demonstrates how mathematical models constructed in System Dynamics modelling platforms, such as Vensim, can be used for long-term management of environmental change. The book is divided into two sections, with the first dedicated to theory, where the theory of co-evolutionary modelling and its use in the system dynamics model platform is developed. The book takes readers through the steps in the modelling process, different validation tools applicable to these types of models and different growth specification, as well as how to curve fit using numerical methods in Vensim. Section 2 comprises of a collection of applied case studies, including fisheries, game theory and wildlife management. The book concludes with lessons from the use of co-evolutionary models for long-term natural resource management.

Purchase on [Amazon](#).

[Modeling the Environment, Second Edition](#)
This book, by Andrew Ford, was the first textbook in an emerging field - the modeling techniques that allow managers and researchers to see in advance the consequences of actions and policies in environmental management. The fundamental principles of the System Dynamics approach are demonstrated here with a wide range of examples, including geo-hydrology, population biology, epidemiology and economics. The applications demonstrate the transferability of the systems approach across disciplines, across spatial scales, and across time scales. All of the models are implemented with stock and flow software programs such as Stella and Vensim.

PDMA Resource Recommendations

The [Product Development Management Association (PDMA)](#) hosts a Knowledge Hub ([kHUB](#)) that offers a wide variety of product development and innovation management resources in the form of blogs, podcasts, videos, conference presentations, feature articles and whitepapers.

Recent recommendations include:

- [2016's Best Practices for NPI and NPD Success: Must-Have Tips to Ensure the On-Time Delivery of New Products](#) (whitepaper)
- [Aligning Product Portfolios with Strategic Plans](#) (article)

- [Breaking Boundaries: Harnessing AI to Fuel Insights for Innovation](#) (webcast)
- [Building Inclusive Products: Why Web Accessibility Equals Customer-Centricity](#) (chapter video)
- [Deliberate Differentiation: Celebrating the Coke Bottle at 100](#) (article)
- [Delivery of Complex Product through Strategy](#) (webcast)
- [Design Thinking](#) (chapter video)
- [Find Pearls and Drive More Innovation](#) (article)
- [From Pitch Deck to NPD: Adapting a Start-up Model for Corporate Innovation](#) (webcast)
- [Getting Senior Executives to Support Your Product Initiative](#) (chapter video)
- [Ideation Techniques: Conceptualizing New Products](#) (blog post)
- [Leading Product Led Change: How to Move Away from Marketing/Sales Led](#) (chapter video)
- [Product Team Motivation: How to get a product innovation team past the storming stage](#) (article)
- [Steve Jobs: A product developer's perspective](#) (article)
- [The Back End of Innovation: The Neglected Stepchild of NPD](#) (webcast)
- [The Frustration of The Product Manager Explained](#) (article)
- [The Future of Digitalizing your Innovation Portfolio](#) (webcast)

Access to kHUB is free and open to the public.
Create a guest account or join PDMA [here](#).

Book: Engaged Decision Making - From Team Knowledge to Team Decisions
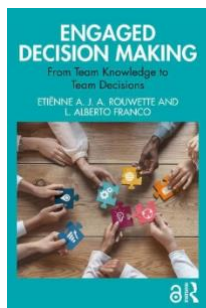
[Etiënne A. J. A. Rouwette,](#) of Radboud University (The Netherlands) and past president of the [System Dynamics Society (SDS)](#) has co-authored with L. Alberta Franco a book titled, *Engaged Decision Making - From Team Knowledge to Team Decisions*.

This 300-page work highlights the central role that teams play in decisions made within and across organizations. It explores the reasons why teams with diverse compositions are observed to have the capability to develop solutions beyond of abilities of individual team members, while recognizing the difficulties faced by such teams that lead to frequent decision and project failures.

Through both theory and practice, the authors show how designed interventions can enable team decision-making to become rigorous, transparent and defensible – improving the probability of team success.

Topics addressed in this book include:

- Decision making traps
- Motivated team decision making
- Interventions to support team decisions
- Group model building: Understanding complex behaviour
- Application: Building the business model of Sioo management education
- Participatory scenario development: Thinking about the future
- Application: Understanding possible futures of Nijmegen municipality
- Group causal mapping: Clarifying issues, understanding purpose and developing options
- Application: Prioritising projects to tackle teenage pregnancies in a multi-cultural

neighbourhood (part I)
- Decision conferencing: Articulating value preferences and trade-offs
- Application: Prioritising projects to tackle teenage pregnancies in a multi-cultural neighbourhood (part II)
- Design choices
- Basics of facilitation
- Managing process and content
- Managing conflict and emotion
- Are interventions used in practice and do they really work?
- Building skills for the study and practice of interventions

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Systems Engineering Goldmine: https://www.ppi-int.com/se-goldmine/
A free resource with over 4GB 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 (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.

FINAL THOUGHTS FROM SYENNA

Lifelong Learning Secrets

Though lacking empirical evidence, Syenna believes that most of the readers of PPI SyEN would classify themselves as being "*lifelong learners*". This assumption is more likely true for those dedicated readers who get to the Final Thoughts article at the end of each monthly edition. Your thirst for knowledge and growth, more than the expectation of my clever writing and pithy humor, drives you forward.

You know who you are!

Many decades ago, Syenna came across an interesting model of learning that has been helpful when designing courseware and delivering workshop-focused training for technical professionals.

					Reproduction	*Pass it on!*
				Realization	*Use an idea skillfully*	
			Relation	*Identify where an idea might be useful*		
		Restatement	*Put an idea or concept in your own words*			
	Recognition	*Classify or categorize an idea or concept*				
Rote	*Recall or recite ideas or concepts without understanding*					

Learning Levels

These six levels of learning can be applied to any idea, concept or skill and are useful in exposing, sometimes painfully, when we mistake *familiarity* with a set of ideas with *competence* in applying them or, even better, with *contagious capability to transfer* such skills to others.

We have all successfully memorized basic content such as definitions, multiplication tables or even important equations. We generally can "bin" such concepts into an appropriate structure of knowledge such as electromagnetics, mathematics or structural engineering. Your "bins" may be different than mine, but having a mental model of the universe gives us a point to hang our ideas and improves retention.

It's a big leap from categorization to the ability to explain a concept in your own vocabulary. Most of our "aha!" moments come at this point when we mysteriously come upon a simple way to state something that up to that point remained opaque to us.

Simplifying ideas gives us a fighting chance to make connections with our current challenges.

- *Where can I use this nugget of truth to create value? Where else?*

Of course, ideas are cheap, skillful execution against real world challenges is a much costlier endeavor. It typically takes multiple cycles of learning, sprinkled with the humility and pain of failures, to achieve personal competence in any skill worth mastering.

Finally, we are not an end in ourselves. Can we pass along what we have learned to our peers and

those in the next generation? Those who help others learn gain not only the satisfaction of making a lasting difference but accelerate their own mastery of skills by trying it out in diverse domains.

All of this seems possible because knowledge is a unique thing – it doesn't wear out with use (as with everything made of atoms and molecules), rather grows in value with each application.

A side note – it's usually a very bad idea to use alliteration when decomposing any list of things. So please don't name all the functions or components in your next product by starting with "Q" or "Z".

Regards,
Syenna

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

P006-946-1	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