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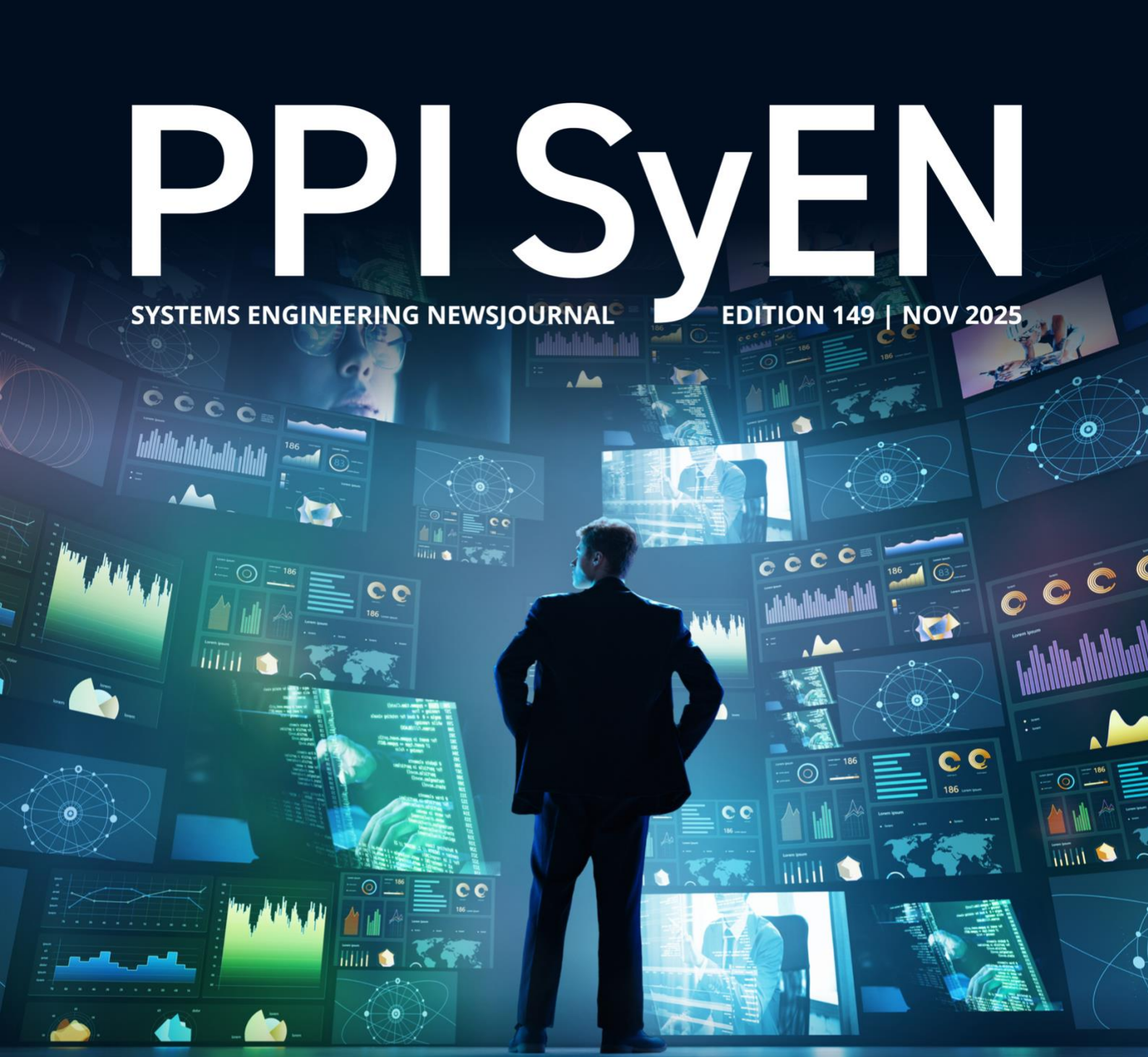

From Models to Meaning: Why Data Matters

FEATURE ARTICLE

Key Decisions Driving an Authoritative Source of Truth Design in a Data-Driven Engineering Ecosystem

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PPI SyEN

EMAIL: PPISyEN@PPI-Int.com

EDITORIAL STAFF

Editor
John Fitch

Editor-in-Chief
Robert Halligan

Managing Editor
Francois Retief

PRODUCTION STAFF

Marketing Manager
Rebeca Verhagen

Graphic Designer
Matthew Wong

Publishing Assistants
Trudy King
Joshua Nagra

PUBLISHER

PROJECT PERFORMANCE INTERNATIONAL

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

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

www.ppi-int.com

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WELCOME

Welcome to the November edition of SyEN. This quarter we explore both the structured precision of data driven engineering and the human experience of working with rapidly advancing tools. Our feature article examines the decisions behind creating an authoritative source of truth in a Data Driven Engineering ecosystem, showing how ontology, set theory and AI can bring coherence and trust to complex system data.

In contrast, Syenna offers a warm reminder that AI, for all its capability, can be confidently wrong. Her story reflects a challenge many of us recognize. These tools can accelerate our work, but they still depend on informed judgment, context and experience.

Across this issue you will also find significant developments in our community. The System Dynamics Society recognizes contributions across modeling and real world application. The Product Development and Management Association highlights global innovation achievements. Updates from the Systems Engineering Research Center showcase progress in trusted AI, supply chain risk, and digital data strategy research. The tool ecosystem continues to evolve, with advances in SysML v2 through Vitech's new Sidekick review environment, SysON, and emerging technologies across simulation, requirements and systems modeling.

Our events calendar remains active, from the INCOSE San Diego and Los Angeles Joint Technical Conference to preparations for the 2026 INCOSE International Symposium in Yokohama. Chapters and societies around the world are contributing through conferences, workshops and collaborative initiatives.

The resources section brings together publications, tools and insights on digital twins, model driven engineering, reliability analysis, innovation practice and business analysis. Each piece plays a part in strengthening both our knowledge and our practice.

As you read this edition, I hope you find both inspiration and clarity. The systems engineering landscape is changing quickly, but our commitment to thoughtful, data informed decisions remains constant.

Warm regards
Francois Retief
Managing Editor

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

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> *Chaos in the world brings uneasiness, but it also allows the opportunity for creativity and growth.*
>
> **Tom Barrett**

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 broad 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 in 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 the technical and management dimensions of problem definition and problem-solving.*

SYSTEMS ENGINEERING NEWS

Recent events and updates in the field of systems engineering

PDMA Outstanding Corporate Innovator Awards

The Product Development & Management Association (PDMA) has announced the winners of its 2025 Outstanding Corporate Innovator (OCI) Award. For over three decades, the OCI Award has recognized exceptional organizations that have demonstrated outstanding innovation excellence. The OCI Award selection process identifies companies that consistently generate and harness long-term value through exceptional product and service innovation. Winning companies demonstrate well-defined new product development practices and processes that have contributed to their innovation success.

Two companies were selected as recipients of this year's honor, presented during the 2025 PDMA Ignite Innovation Summit in Chicago, Illinois, USA.

Moleaer
Moleaer, headquartered in Los Angeles, California, is the global leader and creator of the nanobubble technology category. Since 2016, the company has pioneered patented nanobubble generators that produce bubbles 2,500 times smaller than a grain of salt. The unique properties of nanobubbles transform how gases interact with liquids, accelerating physical, chemical, and biological processes. Moleaer's 3500 installations worldwide have proven that nanobubble technology increases productivity and lowers operating costs through water, chemical, and energy savings, without requiring infrastructure upgrades.

At the core of Moleaer's growth is a disciplined, scalable innovation model that integrates scientific expertise with agile product development and a strong focus on the voice of the customer. The company combines rigorous R&D with real-world field validation to rapidly iterate and scale solutions across industries.

Tempur Sealy
Tempur Sealy is committed to improving the sleep of more people, every night, all around the world. Utilizing over a century of knowledge and industry-leading innovation, we deliver award-winning products that provide breakthrough sleep solutions to consumers in over 100 countries. At Tempur Sealy, we understand the importance of meeting our customers wherever and however they want to shop, and have developed a powerful omni-channel retail strategy.

Learn more about the OCI award here. Read the PDMA press release.

System Dynamics Society 2025 Award Winners

The System Dynamics Society (SDS) has announced a range of awards to organizations and individuals who have contributed to the theory and application of system dynamics, as well as to the advancement of the Society. The winners were

recognized in August during the 2025 International System Dynamics Conference (ISDC 2025) that took place in Boston, Massachusetts, USA.

The **Jay Wright Forrester Award** which recognizes the best contribution to the field of System Dynamics during the preceding five years, went to two research teams:

- Jim Duggan, Jair Andrade, Thomas Brendan Murphy, James Gleason, Cathal (Ka-hul) Walsh, and Phillip Nolan for their work: *An age-cohort simulation model for generating COVID-19 scenarios: A study from Ireland's pandemic response*
- Tse YangLim, Erin Stringfellow, Celia Stafford, Catherine DiGennaro, Jack Homer, Wayne Wakeland, Sara Eggers, RezaKazemi, Lukas Glos, Emily Ewing, Calvin Bannister, Keith Humphreys, Douglas Throckmorton, and Mohammad Jalali for their work: *Modeling the evolution of the US opioid crisis for national policy development*

The En-Roads Team, for their work in delivering, promoting, and supporting the popular En-Roads global climate solution simulator, won the **System Dynamics Applications Award**, which recognizes the best "real world" application of System Dynamics.

The **Outstanding Service Award** recognizes individuals for their long-term, exceptional volunteer contributions to the Society. The 2025 recipient, *Lees Stuntz, co-founder of the Creative Learning Exchange in 1991 with Jay Forrester, was lauded for her three decades of effort in advancing pre-college systems education by making systems thinking more approachable, practical, and impactful.*

The **Dana Meadows Award**, recognizing the very best student work in the field, had two winners and one "honorable mention":

- Mariya Andreeva - *Exploring the Climate-Health-Adaptive Nexus: Insights from a Qualitative Causal Loop Diagram*
- Anna R. Siemer – *Towards a Sustainable Solar Future: Forecasting Photovoltaic Waste and High-Value Recycling for France*
- Jefferson K. Rajah (Honorable Mention) – *A system dynamics modeling framework for endogenizing human behavior change in a global-scale, human-climate integrated assessment model*

Three individuals were recognized with the **Early Career Health Paper Award** for outstanding papers dealing with health-related topics, authored by students or recent graduates:

- Jeroen Uleman - *Exploring the Dynamics of Sleep and Depressive Symptoms in Young Adults*
- Fatima Sadjadpour - *Modeling the Impact of Staff Turnover on Productivity of the Screening System in Critical Care Settings*
- Marya Getchell - *Expanding Diagnostic Testing for Drug-Resistant Tuberculosis in High-Burden Settings: A Cost-Effectiveness Analysis*

Additional awards included:

- Barry Richmond Scholarship Award: Sarah Pritchard and Laura Guzmán-Abello
- Best Poster Award: Kelechi Ibeh, Austin Himes, and Allyson Beall King

See the SDS awards press release for additional details.

Learn more about SDS awards, past and present.

PPI SyEN congratulates these award recipients for their contributions to the field of System Dynamics.

NAFEMS Best Paper Awards 2025

The International Association for the Engineering Modelling, Analysis and Simulation Community, NAFEMS World Congress 2025 (NWC25), which took place in May in Salzburg, Austria, was an opportunity to recognize the 2025 winners of the NAFEMS World Congress Best Paper Awards. These awards celebrate outstanding achievements in simulation engineering across industry and academia. Winners and their contributions to the field include:

- Award for Practical Use of Simulation Technology: Tony Porsch (Volkswagen), Karl Heinz Kunter (Virtual Vehicle Research), and Jean-Daniel Martinez (Audi AG) for Efficient Joining Failure Assessment of Multi-material Car Bodies in Crash
- Best Academic Paper: Roufeng Cao (Cranfield University), Yongle Sun, Wojciech Suder, and Stewart Williams for Computationally Efficient Model for Computationally Efficient Model for Induction Preheating of Moving Wire in Wire-based Additive Manufacturing
- Future of Simulation Technology: Marc Hazenbiler (Test-Fuchs), Antoine Delacourt, and Matthieu Ponchant (Siemens Industry Software) for Cryogenic Hydrogen Systems Simulation for Aeronautic Fuel Cell
- Best Practical Implementation of AI/ML in Simulation: Daniela Steffes-Lai (Fraunhofer SCAI), Jochen Garcke, Rodrigo Iza-Teran, Tom Niklas Klein, Mandar Pathare (Fraunhofer SCAI), and G. N. Devdikar (Stellantis-Opel) for Advanced AI-driven Exploration Possibilities to Link Model Changes and Effects
- Innovative Use of Simulation Technology: Kristian Kvist (Grundfos) for Radiation Efficiency Varying Equivalent Radiated Power
- Award for Business Impact of Simulation Technology: Frank Günther (Knorr-Bremse), Stefan Schneider, Kian Sepahvand, and Oliver Urspruch for The Path to Virtual Product V&V: Uncertainty Quantification of Test and Simulation Results
- Best Paper: Fabiola Cavaliere (SEAT), and Gabriel Curtosi for ML-based Tool to Improve NVH Performance of Body-car Structures
- Best Presentation: Ross Blair (Blow Moulding Technologies) for Measure, Digitise, Execute: Streamlining Sustainable Packaging Design

IEEE Interactive Standards

The IEEE Standards Association (IEEE SA) has announced the availability of a new format for its standards documents. The Interactive Standards (IS) format provides users with the following features:

- Interactive, flipbook format
- Navigational elements
- Interactive Table of Contents
- Introduction page
- Elastic search highlight and zoom
- Easily move between sections and pages with hot links.

Benefits include:

- Quickly retrieve and cross-reference relevant information within the standard
- Share anomalies with colleagues and reduce errors in operations
- Manage complex operations dynamically with data that has been vetted by experts.

The ultimate result for standards users should be productivity improvements measured in terms of faster design times, project completions, and rollouts.

See details and access the standards currently available in IS format here.

Vitech Releases Sidekick Review Software

Vitech has a new product, Sidekick, designed to lower the barriers to MBSE by making models in its GENESYS MBSE platform easier to review, i.e., explore, discuss, and approve or refine by capturing decisions.

Sidekick is a native web application that gives a broader community of stakeholders convenient access to models created and stored in GENESYS. Managers may use Sidekick to define a review, associate the review with a selected set of model objects, define and assign review tasks, and publish the review so that all participants may fulfill their assigned roles.

The review team can view GENESYS objects and models associated with each task within the Sidekick user interface, ask questions, make comments, request and approve changes, and record decisions.

Sidekick is designed to streamline the review process by defining structured, transparent workflows - so that every review is actionable, auditable, and aligned with team member decisions.

View an overview video of Sidekick features.
Learn more here.

Systems Engineering Research Center (SERC) Updates

The August 2025 and October 2025 updates from the Systems Engineering Research Center (SERC) highlight this organization's research-driven contributions to systems engineering practices. Project updates from SERC's partner agency, the Acquisition Innovation Research Center (AIRC), are also published in these editions.

Noteworthy research projects include:

- Automated User Interface for NLP-Driven Keyword Analysis in Department of Defense Documents
- Best Practices In Intellectual Property Management
- Cooperative, Secure Data Science Environments and Repositories
- Digital Data Strategy Pilots: Enhancing Supply Chain Risk Management and Reliability Data Integration for Acquisition and Sustainment
- Trusted Artificial Intelligence Systems Engineering Challenge.

The contributions of the SERC through its 6th AI4SE Workshop and at the 2025 NDIA Emerging Technologies for Defense Conference and Exhibition were also highlighted.

SERC collaborates with other leading global organizations that are highlighted on the Resources and Partners page:

- Center for Trustworthy Edge Computing Systems and Applications
- German Aerospace Center: Institute of Systems Engineering for Future Mobility
- IEEE Systems Council
- NASA Systems Engineering
- National Defense Industrial Association
- Netherlands Organization for Applied Scientific Research: Embedded Systems Innovation Center
- The International Council on Systems Engineering
- The Under Secretary of Defense for Research and Engineering.

This page also includes links to University Affiliated Research Centers (UARCs) that partner with SERC in pushing the boundaries of defense-related innovation and research.

The October edition announced the addition of the University of Michigan and Colorado State University to this network.

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

International Society for the Systems Sciences (ISSS) News

The International Society for the Systems Sciences (ISSS) is a community of researchers, learners, and practitioners dedicated to transdisciplinary inquiry into the nature of complex systems and the application of systems approaches for transformative change.

The ISSS issues a monthly newsletter for its members and subscribers. Recent highlights include:

- Preparations are underway for the 70th (2026) Annual Meeting of the ISSS that will take place in Cyprus on 22-26 June. The theme of the conference is *Elevating Systems Science to Address Humanity's Greatest Challenges*.
- The ISSS continues its program of Mini Symposia with recent and planned topics visible here.

- Ongoing ISSS collaborations with other organizations are listed here.
- An article, Understanding Energy Landscapes, has been published that explains the behavior of any system in terms of a map of possible system configurations expressed as stable energy states (valleys) and unstable states (peaks).
- The newsletters continue with monthly vignettes that explore the topic - *What is General Systems Theory (GST)*?
- Celebrating the 70-year history of the ISSS, the newsletters provide short biographies of the founders and thought leaders of the Systems Science movement (most recently, Ludwig von Bertalanffy, Kenneth Boulding, and W. Ross Ashby).

Visit the ISSS home page to subscribe to the ISSS newsletter and to access other publications and resources.

New Journal: Artificial Intelligence for Engineering

The Institution of Engineering and Technology (IET) has published, through Wiley, the inaugural (September 2025) edition of the Artificial Intelligence for Engineering (AIE) open-access journal. Volume 1, Issue 1 introduces the purpose of this publication as being:

Dedicated to pioneering research at the intersection of artificial intelligence (AI) and engineering. AIE provides a global platform for disseminating cutting-edge advancements, practical applications and visionary perspectives that address the challenges and opportunities of integrating AI into engineering.

This 82-page document includes five open-access articles that highlight advances in the use of AI to empower a broad range of engineering challenges:

- AutoPathML: Automated Machine Learning for Histology Images via Large Language Model and Multi-Agent
- Does Combining Parameter-Efficient Modules Improve Few-Shot Transfer Accuracy?
- FinRL Contests: Data-Driven Financial Reinforcement Learning Agents for Stock and Crypto Trading
- Quotient Gradient System Adversarial Training: Eliminating Robust Overfitting With a Nonlinear Dynamical System Approach
- Understanding Traffic Congestion via Traffic Attacker: A Traffic Demand and Supply View.

Topics of interest for this journal include:

- Advanced AI tools in short- and long-term forecasting for renewable and load profiles
- AI infrastructure for scalable and distributed engineering solutions
- AI-based advanced planning, scheduling, and dispatch in new energy systems
- AI-enforced network infrastructure for engineering
- AI-powered digital twin
- AI-powered traditional engineering applications, including computational biology, healthcare, neuroscience, social good, smart grids, transportation systems, or climate science
- Autonomous technology in engineering scenarios
- Edge and cloud computing for artificial intelligence in engineering

- Ethics and security for artificial intelligence in engineering
- Federated learning for lightweight industrial terminals
- Intelligent data mining for engineering
- Intelligent interaction between humans and engineering
- Large language models for artificial intelligence in engineering
- Next-generation AI engineering applications
- Social and economic aspects of AI in engineering
- Theory, algorithms, and software for artificial intelligence in engineering
- Trustworthy machine learning in engineering.

Learn more about IET journals. Browse the IET Research Hub.

SAE Releases First MBSE-compatible Standard

SAE International, a global leader in mobility standards development, has announced the release of its first MBSE-compatible standard. AS7140: Common, Open Data Exchange Format for Rotorcraft Health and Usage Monitoring Systems (HUMS) includes a digital model that supplements the traditional PDF document format.

The downloadable SysML/Cameo model enables rotorcraft developers to integrate the standard directly into their MBSE tools. It provides a shared vocabulary for capturing, communicating, and analyzing HUMS data across a rotorcraft fleet, encompassing multiple rotorcraft suppliers and variants.

The digital model enables development organizations to avoid the costly, time-consuming, and potentially error-prone task of importing PDF standards documents into their Product Lifecycle Management (PLM) or MBSE tools.

See details in the SAE blog.

PDMA Global Student Innovation Challenge 2025 Winners

The Product Development Management Association (PDMA) has announced the three winning teams in its 2025 Global Student Innovation Challenge (GSIC2025). Winners presented their innovation ideas at the 2025 PDMA Summit in September. A total of 45 teams, comprising 160 students from 22 universities across 10 countries, participated in this event. The winning teams were:

- First place: Uplift – A novel adjustable abdominal compression device (Duke University, North Carolina USA)
- Second place: AssistTech Smart Shower (Rice University, Texas, USA)
- Third place: WattMaintain – Powering the next era of solar aftercare (Technical University Berlin, Germany).

Learn more about PDMA's Global Student Innovation Challenge here. The GSIC2026 competition will be open for submissions from early December 2025 through 1 June 2026.

NCOSE Foundation - Stevens Institute 2026 Doctoral Awards

The INCOSE Foundation has announced the recipients of the 2026 INCOSE Foundation / Stevens Institute Doctoral Award, which recognizes outstanding doctoral research that promises to advance the field of Systems Engineering.

- Serena Campioli (Polytechnic University, Turin, Italy) for *Streamlining Space Systems Design* with a unified framework that integrates Concurrent Engineering, MBSE, data-driven methods, and Design for Testability.
- James Hand (Embry-Riddle Aeronautical University) for *Engineering Resilience in Multi-Agent Systems*, focused on both the design and validation of resilient multi-agent systems using a nature-inspired approach to system architecture.

See details here.

INCOSE Q3 2025 Highlights

INCOSE published its Q3 2025 Members Newsletter in September. This edition highlights key takeaways from the 2025 International Symposium, which took place in Ottawa, Canada. Additional topics of interest can be found throughout this 60-page publication.

Key Findings – 2025 Member Survey
A June 2025 survey of INCOSE members yielded nearly 2,000 responses, reinforcing members' belief in the value delivered by the organization, particularly through professional networking and certification. Members indicate that the development of new services, publications, and research is a priority. Support for individual career progression (beyond personal skills) is also desired.

International Symposium
The 873 participants at IS2025 (668 in-person) were challenged through keynotes on topics such as the future of Systems Engineering in the age of AI, space missions, both real and simulated, and personal reflections on wisdom learned from mentors.

The Symposium included the presentation of numerous awards, most notably:

- INCOSE Pioneer Award to Dr. Dinesh Verma, of the Systems Engineering Research Center (SERC) and Stevens Institute of Technology
- INCOSE Founders Award to Dr. C. Robert (Bob) Kenley of Purdue University
- INCOSE Fellow induction of Jean-Claude Roussel of Airbus.

Chapters' news included:

- AFIS, the French chapter, is preparing for its 29th annual conference to be held in Toulouse in January. This event will be co-located with the 2026 International Workshop on Systems Engineering Research
- The Canada chapter received the Platinum Chapter award based on its contributions toward advancing SE in Canada and in recognition of its extensive efforts in hosting IS2025.

The chapter also hosted an inaugural Transportation Infrastructure Workshop prior to the IS.
- GfSE, the German chapter, hosted Tag des Systems Engineering (TdSE®) in Salzburg, Austria, in October.
- In addition to conducting the ASEC 2025 Conference in November, the Institute for Systems Engineering (IFSE) – formerly INCOSE UK – has announced the publication of the Practical Systems Engineering Journal with the theme of its inaugural issue as "Agile in Systems Engineering". Newly available on the IFSE Online Store is *Don't Panic! The Absolute Beginner's Guide to Configuration Management*.
- JCOSE, the Japan chapter, hosted multiple events, including the Asia-Oceania Sector Meeting, the JCOSE Online Seminar, and a 1-Day Unified Architecture Framework (UAF) tutorial, in addition to starting preparations for IS2026, which will be held in Yokohama.
- INCOSE has announced the chartering of its new chapter for the Middle East and North Africa, MENACOSE.
- The Swiss Society of Systems Engineering (SSSE) hosted Swiss Systems Engineering Day (SWISSED25) in Zurich in September with the theme "SE: Stories Experienced".
- The Thailand chapter conducted two strategic meetings to advance the discipline of SE within and across the country.

Working groups and initiatives highlighted the following accomplishments:

- Configuration Management Working Group (CMWG) members were active at IS through presentations on topics such as "CM as a driver for sustainability" and "CM Challenges in Multi-Team Collaboration using Linked Models".
- The Decision Analysis Working Group (DAWG) shared multiple presentations on its newly released Decision Analysis Data Model (DADM).
- The Digital Engineering Information Exchange (DEIX) Working Group focused on refinements to a Digital Engineering (DE) ontology and a Digital Viewpoint Model (DVM).
- The Empowering Women Leaders in Systems Engineering (EWLSE) initiative conducted a LeadLikeHer workshop in which participants explored various dimensions of successful leadership. EWLSE also celebrated a decade of making a difference on behalf of women engineers.
- The Requirements Working Group (RWG) continues efforts on numerous resources, including the Guide to Model-based Needs and Requirements (GtMBNR) and Needs and Requirements Manual (NRM) Fundamentals Flip Cards. A collaborative project, AI for Requirements Engineering (AI4RE), is also underway with the AI Systems working group.
- The Systems Modeling & Simulation Working Group (SMS WG), a collaboration with NAFEMS, sponsored an IS panel discussion to explore the challenges of connecting architectural and simulation models and tools.
- The INCOSE SE Lab continues to expand its portfolio of software tools (now 34) and members (> 650) who can use these computing resources. The Lab's Demo Day Webinar series continues to deliver semi-monthly events to introduce new tools to the community.
- The Sustainability Working Group was launched at IS2025 to marry the challenge of sustainable development with a systems approach. Multiple papers have focused on the role of the systems engineering discipline in achieving sustainability goals.

Beyond the quarterly newsletter, INCOSE has announced the results of the 2025 election. Newly elected officers, who will begin their term in 2026, include:
- President-Elect: Stephen Cook

- Treasurer: Alice Squires
- EMEA Director: Sven-Olaf Schulze
- Director at Large: Anabel Fraga.

Members also ratified new Bylaws for the organization.
INCOSE continues to publish monthly In Focus issues, providing access to news, resources, and upcoming events. View recent issues:

- August 2025
- September 2025
- October 2025.

Tom Sawyer Software Releases

Tom Sawyer Software continues to expand its portfolio of data and model visualization products while deepening its features in support of model-based systems engineering. Recent product releases include:

Tom Sawyer Perspectives
Perspectives is a low-code graph visualization and analysis development platform that supports the federation of data from diverse sources. Perspectives 13.3 includes enhancements such as:

- Support added for Kuzu, a lightweight, open-source graph database with Cypher support.
- Faster, more efficient web performance through optimized rendering.
- Reduced edge crossings up to 11% on average in circular drawings.
- New Launch Failure demonstration highlighting support for GraphRAG workflows.

View the Perspectives 13.3 webinar and release notes.

Tom Sawyer Explorations
Explorations is a no-code, data exploration platform that empowers analysts to gain insights through data integration, graph pattern matching, and advanced graph visualizations and analysis. Explorations 1.3 adds:

- Kuzu Graph database support
- Annotations added to nodes and edges, with annotation-driven filtering and analysis
- Advanced node and edge styling
- New Schema Tree view
- Multi-page printing
- Smarter circular layout.

View the Explorations 1.3 webinar and release notes.

Tom Sawyer SysML v2 Viewer
The SysML v2 Viewer enables visualization, exploration, and analysis of SysML v2 models. Viewer 1.2 supports:

- Improved support for the SysML v2 graphical syntax
- Automatic language keyword-based coloring
- Sharpened model element rendering

- Graph layout and port controls
- OAuth 2.0–based identity verification
- Incremental layout and multi-page printing.

Watch the Viewer 1.2 webinar and release notes.

Tom Sawyer Model-Based Engineering
Model-Based Engineering enables visualization of Block Definition, Internal Block, and Parametric Diagrams from SysML v1 models that are maintained in Teamwork Cloud, MagicDraw/Cameo System Modeler, and other model stores. Model-Based Engineering 2.0 generates presentation-quality diagrams with significantly less effort to fine-tune layouts for different stakeholders manually.

Learn more about Tom Sawyer Software solutions.

SysON Open Source SysML v2 Software Releases

Obeo, a primary contributor to the Eclipse SysON project, an open-source web-based toolset for editing SysML v2 models, continues to report steady progress with a new release every eight weeks.

Obeo's Stéphane Lacrampe summarizes the positioning of SysON vs SysML v2 as:

At Obeo, our top-level strategy for SysON is to make SysML v2 broadly accessible and affordable to the majority of systems engineers, as we believe this is a key condition for the success of Digital Engineering. That's why we are developing SysON as both an open-source and web-based modeling environment.

In parallel, and in close collaboration with its partners, we are extending SysON with methodology and domain-specific layers. One concrete example is our ongoing prototyping work on an Arcadia library for SysML v2—essentially bringing Capella to the web while aligning it natively with the SysML v2 standard. Another example is our collaboration with ESA on GSEF v3, ESA's Ground and Space Segment Engineering Framework, an open and collaborative web platform supporting a fully model-based approach to modernize and streamline ground-segment engineering for space missions. We see this path as very promising, as it significantly lowers the entry barrier to SysML v2 adoption.

Stéphane Lacrampe points out that SysON is built on top of Sirius Web, a low-code modeling platform, making it highly customizable. This enables large organizations to industrialize their own engineering methodologies on top of SysML v2, especially when not using Arcadia.

In summary, Obeo's strategy is to position SysON as a world-class implementation of SysML v2, while providing the flexibility for others to tailor the environment to their specific needs.

From a business model perspective, Obeo supports organizations with expert services for customizing the open-source platform. To better support these services, Obeo is developing an enterprise edition of SysON with advanced features, including authentication, collaborative team modeling, model review workflows, AI-assisted modeling, and integrations with other engineering tools. A SaaS offering will also be available for those who prefer direct online access. While SysON is focused on graphical modeling with SysML v2, Obeo fully recognizes it as just one part of the broader systems engineering toolchain.

Finally, SysON is also intended to serve as a foundation for other tool vendors who wish to build upon a flexible, extensible, and modern SysML v2 web-based stack, providing another avenue for growth and collaboration.

The SysON 2025.4.0 release brought significant improvements, including:

- Libraries Management: Reuse made simple
- Many UX improvements
- Better textual import
- Improved export to text.

The SysON 2025.6 release added new features that improve how engineers structure, visualize, and manage their models:

- Modular views with ViewUsage
- Better diagram experience
- Textual import/export improvements
- Bug fixes and stability enhancements.

SysON 2025.8 and 2025.10 are fully aligned with the official SysML v2 2025-07 standard release and offer users:

- Modeling that keeps evolving
- Better control of your views
- A smoother modeling experience
- Textual import and libraries
- Integration made easier.

The SysON user interface is built on Sirius Web, another open-source Eclipse project that has also undergone frequent enhancements.

Track these releases here:

- Sirius Web 2025.6
- Sirius Web 2025.8
- Sirius Web 2025.10.

View the complete set of SysON release notes.

Access a SysON overview video.

Get started with SysON here.

Updates to the Systems Engineering Tools Database (SETDB)

The Systems Engineering Tools Database (SETDB), developed by PPI in partnership with INCOSE, provides a virtual platform

for engineering tool vendors to communicate their latest offerings.

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

Vendor: Chief Digital and Artificial Intelligence Office

- Tradewinds: The Chief Digital and AI Office Acquisition Ecosystem, built to disrupt traditional acquisition and procurement processes and enable the delivery of emerging cutting-edge technology solutions across the Department of War (DoW).
- AcqBot: An Acquisition AI Platform that assists the Department of War (DoW) Chief Digital and Artificial Intelligence Office (CDAO) with acquisition by writing user requirements, reaching out to industry, publishing solicitations, and creating agreements. It is free and available to all DoW users.
- Advana: This technology leverages the success of GameChanger, an AI tool for policy, to read contracts in the Procurement Integrated Enterprise Environment/ Electronic Data Access and pilot a user interface that allows searching across all DoD contracts.

Vendor: DGB Technologies LLC

- SAFEST: A probabilistic risk assessment tool based on dynamic fault trees and event trees.

Vendor: IBM

- Rhapsody Systems Engineering: A cloud native, web-based solution built on SysML V2 for systems engineering teams to develop smarter, more complex, and more competitive products.
- Rhapsody Architect for Systems Engineers: An integrated, systems engineering environment for analyzing project requirements. It uses Systems Modeling Language (SysML) and Unified Modeling Language (UML) to enable rapid requirements analysis and visual, model-based design.
- IBM Engineering Rhapsody Designer: Uses SysML and UML - all within an MBSE (Model-Based Systems Engineering) environment. It helps you adapt to changing customer requirements, improves productivity, and reduces time-to-market with advanced validation and simulation features.
- IBM Engineering Systems Design Rhapsody: Delivers higher-quality systems and software faster with trustworthy modeling, seamless simulation, production code generation, and digital thread across domains.
-
- Vendor: Infoharvest Inc.
- Criterium® DecisionPlus®: Helps you make precise, thoughtful, and completely supportable decisions - even for complex problems involving hundreds of criteria and alternatives. It provides a visual, structured approach to decision-making, helping you to select the best choice.

Vendor: Informer Technologies, Inc.

- Axiom: A free-to-use, Windows platform tool for writing requirements, creating use cases, tasks, change requests, test cases, or any other artefact that your project might need.

Vendor: Isograph Ltd

- AttackTree: Model system vulnerability, identify weak spots, and improve security using threat analysis and attack trees. Construct graphical representations of measures designed to reduce the consequences of a successful attack with mitigation trees. Analyzes threats in accordance with standards.

- Availability Workbench: Powerful simulation software for improving asset performance. Maintenance and spares optimization, availability studies, reliability-centered maintenance, life cycle cost evaluations and accelerated life testing all in one integrated suite.
- AvSIM: The availability and reliability simulator is capable of analyzing complex and dependent systems using Monte Carlo simulation and can analyze historical data using Weibull analysis with no limit to hierarchical levels.
- Life Cycle Cost Analysis: The Life Cycle Cost (LCC) module enables users to build an unlimited number of hierarchical cost breakdown structures (CBS). Directly linked to cost predictions produced by the RCMCost or AvSim modules. Other costs may be defined as time-dependent cost equations or simple numerical values.
- RCMCost: The Reliability Centered Maintenance (RCM) module simulates asset performance and recommends the optimal strategy to minimize lifetime maintenance costs. It compares the effectiveness of predictive maintenance, planned replacement policies, inspections, and alternative spares holdings.
- Weibull Analysis: Analyze historical failure data and produce failure distributions that will be used for system availability simulation and maintenance optimization.
- Data Link Manager: Empowers organizations to integrate their requirements management tools with Isograph's safety and cybersecurity products. Reliability Workbench and AttackTree are seamlessly integrated with Jama Connect® and IBM Rational DOORS®, ensuring the consistency and integrity of data.
- Network Availability Prediction: The Network Availability Prediction program enables users to predict the availability and reliability of communication networks. Network block diagram models utilize an extended Reliability Block Diagram (RBD) methodology to address specific characteristics of network elements and their connections.
- Reliability Workbench: Fully integrated reliability and safety workbench featuring diagram analysis, fault trees, event tree analysis, Markov analysis, fault tree requirements verification, and many others. Support for standards for system analysis, such as ARP 4761, IEC 61508, ISO 26282, and numerous FMEA standards.
- Fault Tree Analysis+: Part of the Reliability Workbench, you can quickly build fault models and execute FMEA, Event Tree and Markov analysis with no limit to the number of gates, events, and hierarchical nodes. The Fault Tree Analysis module is ISO 26262 certified and also supports ARP 4671 and IES 61508.
- FMEA/FMECA: The Reliability Workbench FMECA Module provides a complete framework and reporting facility to construct FMECAs and FMEAs to MIL-STD-1629A, GJB 1391-92, BS 5760 Part 5, AIAG & VDA, SAE J1739, ARP5580, and similar standards, as well as customizing the FMEA or FMECA to the user's own requirements.
- Reliability Prediction: Through the Reliability Workbench, users can access a comprehensive prediction module that utilizes MIL-217, Quaternion 217 Plus, SN29500, IEC 61709, FIDES, Telcordia TR/SR, IEC TR 62380, GJB299C, and NSWC libraries to predict the reliability of electronic and mechanical components.
- System Safety Assessment: The System Safety Assessment module provides the framework for recording the hazards and failures associated with a system and demonstrating that the resulting safety requirements are met. Failures can be linked to fault trees, RBDs, Markov models, and FMECAs in an integrated environment.

Vendor: ITEM Software

- ITEM Toolkit: Reliability Analysis Software, ITEM ToolKit is a suite of comprehensive prediction and analytical modules in one integrated environment. ITEM ToolKit utilizes globally recognized standards and methodologies to analyze components, systems, and projects with a system approach to reliability analysis.

- Event Tree Module: Utilizes the logic diagram and consequences you create to provide an analysis of the scenarios presented in the diagram. ETA is used to determine the path from an initiating event to the various consequences and the expected frequency of each consequence.
- Fault Tree Analysis: Uses tree structures to decompose system-level failures into combinations of lower-level events, and Boolean gates to model their interactions. An FTA identifies and ranks combinations of events that cause system failure and estimates the system's failure probability.
- FMECA Module: Analyzes potential failure within a system, identifies the potential hazards associated with these failures, and classifies them according to their severity.
- IEC 61709 Module: Provides models for reliability prediction of electronic components, printed circuit boards, and equipment extrapolated from failure rates from referenced conditions to other operating conditions that permit the prediction of failure rates at the assembly level.
- IEC 62380 Module: Supports reliability prediction methods based on the latest European Reliability Prediction Standard. IEC 62380 represents a significant advancement in reliability prediction compared to older reliability standards.
- MainTain Module: Provides an integrated environment for predicting the expected number of hours that a system or a device will be inoperative, or "down", while it undergoes maintenance, based on the tasks needed to repair the system. Conforms to MIL-HDBK-472.
- Markov Module: Markov analysis is a powerful modelling and analysis technique with strong applications in time-based reliability and availability analysis. Markov models consist of comprehensive representations of possible chains of events that correspond to sequences of system failures and repair.
- MIL-HDBK-217 Module: A powerful reliability prediction program based on the internationally recognized method of calculating electronic equipment reliability defined in MIL-HDBK-217.
- RBD Module: Offers easy construction of network diagrams using point-and-click or drag-and-drop techniques. Once complete, Boolean Algebra expressions are used to determine minimal cut sets or the minimum combination of failures required to cause a system failure.
- SpareCost Module: Calculates spares required for equipment supported at sites and bases, enabling you to optimize the scale of spares at sites for minimum cost.
- Telcordia Module: Calculates the reliability prediction of electronic equipment based on the Telcordia (Bellcore) TR-332 and SR-332 standards. These standards utilize a series of models for various electronic, electrical, and electro-mechanical components to predict steady-state failure rates.
- ITEM QRAS: A fully integrated environment for constructing and analyzing risk models. A powerful aid for conducting Probabilistic Risk Assessment, you can construct and quantify risk scenario models, estimate numerical risk levels, and identify major risk sources and contributions.
- ITEM QT: A revolutionary approach to reliability, safety, and risk analysis software tools. With iQT, you are no longer limited by the technology choices of software vendors or chained to the infrastructure requirements of their products. iQT is an open and extensible system.

Vendor: Kovair Software, Inc.

- Kovair PPM: A unified platform for any enterprise to manage budget, schedule, manage

resources, forecasts, and actuals through a single interface, delivering greater value to the organization by connecting planning to execution.
- Kovair ALM: An application lifecycle management tool intended for teams to manage all phases of the application lifecycle, including project management, requirements management, development, and testing & quality assurance.
- Kovair Requirements Management: A full-featured requirements engineering solution that gathers, parses, tracks, and manages various types of requirements using traceability, baselining, and reporting while executing a process-driven methodology.
- Kovair Omnibus: An Enterprise Service Bus (ESB) platform intended for integrating tools and data across areas of ALM, PPM, CRM, ITSM, ERP, and PLM systems to enable collaboration, tool interoperability, increased agility, and unified product delivery for over 110 software tools.
- Kovair QuickSync: A one-stop, cost-effective, scalable, wide-range data migration solution for any enterprise across industry to migrate data from one source to one target or one source to many targets with zero downtime.

Vendor: Lumina Decision Systems
- Analytica: A visual software environment for building, exploring, and sharing quantitative models to help people make effective decisions. The experience of using it is very different from its usual alternatives: spreadsheets and scripting languages like Python and R.

Vendor: Mgnite Inc.
- Mg: Designed to bridge the gap between Model-Based Systems Engineering (MBSE) and Model-Based Design (MBD) by leveraging the SysML v2 modeling language.

Vendor: Obeo
- Eclipse SysON: Provides 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: Psoda
- Psoda Programme and Project Management: Provides the ability for enterprises to plan, track, and report on their programs and projects, giving their teams real-time planning and execution, configurable data views, extensive out-of-the-box reports, and a customizable report wizard.

Vendor: Quantitative Software Management
- Software Lifecycle Management Tools (SLIM): Draw data from a database of over 13,000 verified software projects (the largest database of its kind) to enable better decision making at every stage of the project development life cycle - estimating, tracking, and metrics analysis.
- SLIM-Control: Helps your projects stay on course. Using statistical process control techniques, SLIM-Control compares project plans against project actuals - then generates a forecast to completion. It offers both built-in and user-defined metrics, as well as earned value charting and reporting.
- SLIM-Estimate: Ases a proven top-down approach that minimizes the input information required to produce fact-based, defensible estimates. In addition to software cost estimation, SLIM-Estimate's high level of configurability accommodates the many different design processes used by developers today.

- SLIM-Metrics: Works with the SLIM-DataManager data repository tool to help you preserve project histories, assess competitive positions, identify bottlenecks, quantify the benefits of process improvements, and defend future project estimates.

Vendor: Siemens Digital Industries Software

- Solid Edge Electrical Design: Helps you overcome electromechanical design challenges with a dedicated solution for electrical design - enabling co-design collaboration across electrical and mechanical domains. Based on industry-leading technology, our electrical design products are trusted and proven worldwide.
- Solid Edge Simulation: Built-in finite element analysis (FEA) allows design engineers to digitally validate part and assembly designs within the Solid Edge environment. Solid Edge Simulation significantly reduces the need for physical prototypes, which lowers material and testing costs and saves design time.
- Simcenter Flomaster for Solid Edge: A fast, flexible, and accurate solution for modeling thermo-fluid systems, Simcenter Flomaster for Solid Edge automatically creates a model based on CAD data, aiding in the computation and visualization of flow velocity, temperature, and pressure drop in pipe works in a 1D environment.

Vendor: Siemens PLM Software

- MBSE: Model-Based Systems Engineering: A critical part of Teamcenter product lifecycle management (PLM). MBSE with Teamcenter brings together multi-domain product development – mechanical, electrical, and software - along with considerations like cost, reliability, and manufacturability.
- Requirements Management: A modern data-driven approach by implementing a product lifecycle management (PLM) system. You can leverage an open, interoperable, and flexible backbone which will manage the comprehensive digital twin and provide an integrated requirements and verification solution.
- Teamcenter Document Management & Publishing: A solution intended for teams to create any product documentation, keeping your product design and documentation aligned with product changes to reduce the time and cost of development while improving document accuracy and effectiveness.
- Teamcenter Integrated Requirements Engineering: Captures and manages requirements and enables you to allocate (trace) them to downstream functional, logical, and physical architectures - all while generating the reports, documentation, and dashboards to manage the requirements process.

Vendor: Siemens Polarion

- AI for Polarion: AI can enhance project management in Polarion through concepts like automated requirements evaluation and task extraction. Ideas such as requirements quality checking and work breakdown automation may improve efficiency and collaboration, leading to better project outcomes.
- Polarion: The Polarion Unified Platform enables development organizations to streamline, automate, and optimize development processes across multiple projects and lifecycles. Polarion is available for cloud-based and on-premises deployments.
- Polarion ALM: Everything you need to accelerate innovation in one Unified Solution. Connect your teams and projects, and improve application development processes with a single, unified solution for requirements, coding, testing, and release management.
- Polarion ALM-PLM Integration: Leverages the latest developments in integration technology to ensure that product development organizations have a single, cohesive product ecosystem, with multi-directional linking of ALM and PLM data and processes.

- Polarion Extension Portal: Siemens Polarion offers over 200 free and paid extensions with other software tools to enhance the functionality of your ecosystem. Connectors include Simulink, Teamcenter, Azure, Enterprise Architect, Planview, Rhapsody, Windchill, Jira, HP QC, and many more.
- Polarion for Automotive: Collaborate across complex internal and supplier ecosystems. Accelerate Functional Safety compliance for ISO 26262, Automotive SPICE, and CMMI standards. Model Driven development with Polarion's Diagram Editor, plus integration with Sparx Systems Enterprise Architect™ and with MATLAB® Simulink™.
- Polarion for Medical Devices: Software has become the key differentiator for manufacturers of medical devices. There are countless opportunities for software innovation, but these are counterbalanced by stringent quality requirements, risks of product failure, and increasing regulatory complexities.
- Polarion PRO: Unify change management, task & issue tracking, and work reporting across all project contributors across the enterprise. Leverage native ReqIF and MATLAB Simulink integration for information exchange and comprehensive traceability.
- Polarion QA: Complete Quality Assurance and Testing Solution to help you design, coordinate, and track all your test management activities in a single, collaborative QA environment. Enables real-time communication between Analysts, Engineers, and QA Members
  and DevOps Teams.
- Polarion Reviewer: Enable internal and external stakeholders to review and comment on work items, and provide industry-compliant electronic signatures and approvals within a cloud-based environment across your supply chain.
- Polarion RM: Complete Requirements Management Solution to enable programs to effectively gather, author, approve, and manage requirements for complex systems across entire project lifecycles. Enables software development teams to effectively collect, author, approve, and manage requirements for complex systems.
- • PolarSAFe: Provides you with the means to not only grow, but also to scale exponentially. Its integration of portfolio management throughout the whole project structure is just one of the many enablers unique to the SAFe methodology. It will provide you with a massive boost to your business's scalability and velocity.
- Polarion Variants (Add-On): Evolve capabilities in development lifecycles to effectively manage variation, mass customization, and 'configured-to-order' deliverables. Polarion is the only ALM solution with variant management capability.
- Teamcenter Polarion Integration: Leverages the latest developments in linked data integration technology. This Integration ensures that product development organizations have a single, cohesive product ecosystem, with bi-directional associativity between ALM and PLM data and processes.

Vendor: Sodius Willert

- SECollab: A web-based data and model review platform for requirements, model content, or document data from a single access point to enable multiple tools and data reviews in one place.

Vendor: Softwareideas

- Software Ideas Modeler: A lightweight and powerful CASE tool for advanced diagramming. It helps you to describe and design your software and processes using UML 2.5, BPMN 2.0, SysML 1.5, SysML v2, ERD, flowcharts, and other diagrams.

Vendor: TechnoSolutions Corp.

- Visual Use Case: A tool for application developers for rapidly defining clear and accurate requirements of an application or a system using the Use Case Modeling technique.

Vendor: Trace.Space

- Trace.Space: AI-Enhanced Requirements Management that can import requirements, tests, and change logs from files or tools. Trace.Space ingests data from PDFs, DOCs, JIRA, Git, Confluence, and APIs – including existing trace links – and instantly creates a central system.

Vendor: Tricentis GmbH

- Tricentis Neoload: Part of the Tricentis Testing Suite that simplifies and standardizes the approach to testing to ensure continuous performance, reliability, and scalability from development to production. Neoload supports web and mobile technologies as well as systems like SAP and Citrix.
- Tricentis LiveCompare: Part of the Tricentis Testing Suite that provides AI-powered impact analysis between a currently deployed SAP system and a proposed update to be released. It analyzes all impacts to processes, integrations, custom code, security, and governance affected by the update.
- Tricentis qTest Explorer: Part of the Tricentis Testing Suite that provides test execution recording and documentation. It tracks all transactions and automatically creates defect documentation and submits detailed documentation to Jira automatically.
- Tricentis Data Integrity: Tricentis Data Integrity testing covers data from entries in your application to the transformations, integrations, and migrations. Applicable to any data landscape, including structured and unstructured data, and message data from any source or technology.

Vendor: TVEC

- RAVE: A proven method and integrated toolset for requirement-based defect prevention and automated testing. By modeling and analyzing system requirements before design and coding, project teams refine the requirements and correct defects before they enter the system.
- T-VEC Tester for Simulink: The T-VEC Tester for Simulink and Stateflow (sl2tvec) automates much of the testing process by analyzing the Simulink model to determine the best test cases for validating the model and testing its implementations. It also generates drivers for executing test vectors against source code.

Vendor: Visual Paradigm

- Visual Paradigm: A suite of design, analysis, and management tools that drive your IT project development and digital transformation.

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

Access the SETDB website.

CONFERENCES, MEETINGS & WEBINARS

Events of relevance to systems engineering

28th Brazilian Symposium on Formal Methods (SBMF 2025)

The 28th Brazilian Symposium on Formal Methods (SBMF 2025) will take place in Recife, Brazil, from December 3 to 5, 2025. The event is dedicated to the development, dissemination, and use of formal methods for constructing high-quality computational systems. Topics addressed in the symposium include:

- Formal aspects of specification languages and theoretical foundations
- Formal aspects of systems development
- Formal verification and validation, e.g., the correctness of software systems and model checking of the requirements.
- Formal verification of neural networks
- Self-formalization and formal aspects in practice.

Keynotes for the symposium include:

- Exploring Modelling Language Engineering (Prof. Hans Vangheluwe, University of Antwerp)
- Formal Reasoning for Assuring Product Lines of Complex Systems (Prof. Marsha Checkik, University of Toronto)
- Safe Evolution of Smart Contracts Supported by LLMs and SMT Solvers (Prof. Augusto Sampaio, CIN – UFPE).

View program details here.
Register for SBMF 2025.

Call for Presentations: NAFEMS Regional Conferences 2026

NAFEMS has announced a preliminary slate of 2026 Regional Conferences to support its vision of shaping the future of engineering simulation and analysis. Four regional conference events are currently planned in Europe and the Americas.

NAFEMS UK Conference (19-20 May 2026 in Coventry, UK)
To support the theme of this event, *From Models to Impact: Engineering the Next Generation*, presentations are sought on hot topics such as:

- Bridging the engineering skills gap in the AI age
- Sustainable engineering and circularity
- Confidence in results for certification by analysis
- The future of virtual engineering
- Combining simulation and physical test to maximize confidence
- Evaluating model validity.

View the Call for Presentations (abstracts due by 30 January 2026).

NAFEMS Americas Conference (27-29 May in Saint Charles, Missouri, USA)
This biennial event will bring together leading visionaries, developers, and practitioners of CAE-related technologies in a unique open forum to share experiences, discuss key trends, identify common themes, and explore future challenges.

View the Call for Presentations.

Early planning is also underway for:

- NAFEMS DACH Conference (5-7 May 2026 in Bamberg, Germany)
- NAFEMS Nordic Conference (19-20 May 2026 in Gothenburg, Sweden)

Stay tuned for updates on this conference series.

Follow NAFEMS on LinkedIn.

INCOSE San Diego-Los Angeles 2025 Joint Technical Conference

The INCOSE San Diego and Los Angeles chapters will host a Joint Technical Conference on 5-6 December. The theme of this event is "*Converging Frontiers: Engineering Resilience Across Domains*."

The 5 December sessions (tutorials and SEP paper exam) will take place at the Dassault Systèmesoffice in Sorrento Valley, California. The main conference will be held on 6 December at San Diego State University (SDSU).

The keynote presenter is Mr. Nick Freije of General Atomics–Aeronautical Systems, Inc., and formerly Assistant Chief Engineer for Mission Architecture at NAVWAR.

Technical presentations will be organized into topic areas such as Artificial Intelligence/Machine Learning (AI/ML), MBSE, and Requirements Engineering. A sample of these offerings includes:

- AI-Driven Predictive Analytics for Enhancing Systems Engineering Decision-Making
- Application of AI-Driven Process to Systems Design and Integration in Transportation Projects
- Concept of Operations and Operational Concept as Critical Requirements Drivers
- Learning from Failure: Using Insights from Disasters and Critical Events to Improve Systems Engineering
- Navigating the Blurry Line: Distinguishing True Requirements from Derived Constraints and Design Decisions
- Resilience Modeling for MBSE and Digital Engineering
- Techniques for Managing Emergent Properties in Complex Systems

Learn more about the Joint Technical Conference.
Register here.

NAFEMS ASSESS Simulation Leadership Summit 2026

The vision of the NAFEMS Analysis, Simulation & Systems Engineering Software Strategies (ASSESS) Initiative is to lead every aspect of engineering simulation toward a more valuable and accessible future in the medium to long term.

The mission of the initiative's Simulation Leadership Summit 2026 is to work together to map out the future of engineering simulation and lead the way toward it. The 2026 Summit will take place in Atlanta, Georgia, USA from 11-13 March 2026. Leadership discussions will focus on:

- Getting measurable business value from simulation investments
- How to address the simulation talent crisis
- Making AI work in simulation (not just for PowerPoint)
- Breaking down the barriers between simulation and decision-making.

The keynote for the Summit will be presented by Gary Fedder of Carnegie Mellon University on the topic: *Bridging AI and the Physical World: Digital Twins in Manufacturing Innovation.*

Mike Henneke of the John Zink Company has also been invited to speak on *The Value of Connecting Simulation Engineers to Business Objectives and Results*.

Learn more and register here.

INCOSE IS2026 Call for Submissions

INCOSE has issued its Call for Submissions for the International Symposium 2026 (IS2026). IS2026 will be a hybrid event taking place on 13-18 June 2026, with the in-person event to be held in Yokohama, Japan. For this premier global forum, INCOSE seeks a blend of research papers, practice papers, paperless presentations, panels, and tutorials that will support the conference theme, "*Beyond Digital Engineering: Seeking Wa (Harmony) in SE*".

Submissions are sought across diverse topic areas, including:

- Agile SE
- Continuous Delivery
- Emergency Management
- Energy Transformation
- Managing System Complexity
- Mission Engineering
- New Innovative Approaches
- Systems Science Foundations
- Systems Thinking.

Key dates, common to all types of submissions, include:

- All Submissions Due: 2 January 2026
- Notification of Acceptance: 16 March 2026

- Authors' Acceptance to Present: 31 March 2026
- Final Submission Due: 16 May 2026.

Submitters are cautioned to carefully follow the unique guidelines and use the templates provided for each type of submittal.

NAFEMS Regional Conferences 2026

NAFEMS has announced a preliminary slate of 2026 Regional Conferences to support its vision of shaping the future of engineering simulation and analysis. Six regional conference events are currently planned in Europe and the Americas.

NAFEMS Eastern Europe Conference (28-29 April 2026 in Budapest, Hungary)
With its theme of *Simulation at the Core of Product Development*, this conference seeks presentations on topics such as:

- Practical applications of Machine Learning
- System Simulation and Digital Twins
- Complex Structural and Fluid-Thermal Challenges
- NVH (Noise, Vibration & Harshness)
- Simulations for Batteries and Electric Vehicles
- Simulation Process and Data Management (SPDM).

Submit abstracts no later than 19 December 2025. View the Guide for Presenters.

Keynotes for the Eastern Europe event include the following:

- Integrated modelling of next-gen battery packs at Rimac Technology (Ivan Krajinović, PhD, Director of Central Engineering at Rimac Technology)
- AI - a threat or an opportunity for scientists and engineers (Prof. Wacław Kuś, Associate Professor at the Silesian University of Technology)
- Modelling the influence of defects on fatigue: Defect Tolerance Approach from Non-Destructive Testing (Prof. Yves Nadot, Prof. Carole Nadot (Institut P', CNRS, ISAE-ENSMA, Université de Poitiers France).

NAFEMS DACH Conference (5-7 May 2026 in Bamberg, Germany)
This conference will feature over 100 technical presentations on topics related to simulation in Computer-Aided Engineering (CAE) and associated enablers such as AI and Machine Learning (ML).

View the Call for Presentations (abstracts due by 13 February 2026)

NAFEMS Italy Conference (7-8 May 2026 in Como, Italy)
Key themes for this event include:

- Integrated and Multiscale Simulation
- AI Applied to Simulation
- Sustainability and Innovative Materials
- High Computational Performance

- Hybrid Approaches and Process Innovation
- Convergence between Research and Industry.

NAFEMS UK Conference (19-20 May 2026 in Coventry, UK)
To support the theme of this event, *From Models to Impact: Engineering the Next Generation*, presentations are sought on hot topics such as:

- Bridging the engineering skills gap in the AI age
- Sustainable engineering and circularity
- Confidence in results for certification by analysis
- The future of virtual engineering
- Combining simulation and physical test to maximize confidence
- Evaluating model validity.

View the Call for Presentations (abstracts due by 30 January 2026).

Keynotes for the UK event include the following:

- Digital Twins for Healthcare: The Long-winded Path to Clinical Translation (Dr. Adelaide De Vecchi, King's College London)
- Establishing Simulation Credibility for Aerospace Structures via the VVUQ Framework (Javad Fatemi, Airbus Defence and Space)
- The Virtual Verification Factory: A Step Towards the Engineering Continuum (Steven Pierson, Jaguar Land Rover)
- From Uncertainty to Capability: Shaping an Ecosystem that Learns Faster than the Technology Evolves (Professor Chris Waldon, STEP).

NAFEMS NORDIC Conference (19-20 May 2026 in Gothenburg, Sweden)
This regional conference will focus on existing best practices as well as state-of-the-art in FEA, CFD, and associated technologies (AI/ML, SPDM, ...).

View the Call for Presentations (abstracts due by 6 February 2026)

NAFEMS Americas Conference (27-29 May in Saint Charles, Missouri, USA)
This biennial event will bring together leading visionaries, developers, and practitioners of CAE-related technologies in a unique open forum to share experiences, discuss key trends, identify common themes, and explore future challenges.

The keynote for the Americas event will be delivered by Brett Soltz on the topic, *IV&V at The Aerospace Corporation in Support of U.S. Space Force Programs*.

View the Call for Presentations (abstracts due by 20 February 2026)

Check the regional conference links for updates on this conference series.

Follow NAFEMS on LinkedIn.

FEATURE ARTICLE

Key Decisions Driving an Authoritative Source of Truth Design in a Data-Driven Engineering Ecosystem

by

John Fitch, ESEP

Warren K. Vaneman, Ph.D., ESEP

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Authored for PPI SyEN

Abstract

This paper extends the previously defined Data-Driven Engineering (DDE) paradigm, which positions data—not models—as the authoritative representation of systems across their lifecycle. Central to this approach is a universal foundational ontology that harmonizes heterogeneous data sources, ensuring semantic consistency, interoperability, and traceability. We begin to define the Authoritative Source of Truth (ASoT) as a virtual, ontology-governed framework that enables federated integration without physical data consolidation. By leveraging set theory and AI, ASoT supports concordance and lifecycle integration, reducing ambiguity and improving decision quality. The paper contrasts conventional ASoT concepts with the ontology-driven perspective, introduces a strategic decision framework as the basis for DDE/ASoT design, and outlines the ASoT Functional Lifecycle Model and physical architecture—providing an initial blueprint for implementing resilient, data-centric ecosystems.

Introduction

As modern systems grow in complexity and interdependence, traditional model-centric approaches to systems engineering are increasingly inadequate. In response, Vaneman (2025) defined a new and compelling paradigm that is emerging: Data-Driven Engineering (DDE). DDE is an innovative systems engineering approach that places data—not models or documents—at the core of system representation, integration, and analysis. Rather than treating models as the primary artifacts of engineering, DDE establishes data as the authoritative and enduring representation of the system across its entire lifecycle. This shift enables more coherent integration across disciplines, fosters semantic consistency, and significantly enhances the quality, speed, and confidence of decision-making. By grounding engineering activities in structured, trusted, and interoperable data, DDE offers a powerful framework for managing complexity and enabling more agile, informed, and resilient system development.

A Data-Driven Engineering (DDE) Ecosystem is a federated environment in which data from a wide range of models, tools, and engineering disciplines is integrated into a unified, authoritative structure through the use of a common ontology. This ecosystem is designed to support seamless collaboration

and comprehensive system understanding by aligning diverse data sources under a shared semantic framework. It is defined by five essential attributes:

- **Authoritative Source of Truth (ASoT)** - a trusted, ontology-governed framework that enables consistent, validated system representation.
- **Data Integration** – the ability to combine heterogeneous data sources into a coherent and comprehensive view of the system;
- **Concordance** – the consistent and accurate representation of entities across varying model perspectives and levels of abstraction;
- **Lifecycle Integration** – the continuous correlation of data across all stages of the system lifecycle, from initial concept through final disposal;
- **Universal Ontology** – a foundational semantic structure that standardizes terminology, relationships, and attributes across domains, enabling interoperability and reducing ambiguity.

This paper utilizes a strategic engineering decision framework to examine the DDE and ASoT concepts as outlined in Vaneman (2025). We first clarify the distinctions between Digital Engineering (DE) and DDE, as well as between conventional interpretations of the ASoT and the novel perspective introduced herein. Subsequently, we present the strategic engineering methodology adopted in this study. The functions of the ASoT are detailed to further elucidate this important subject, along with an analysis of the structures underpinning both the DDE environment and the ASoT.

Clarifying the Distinctions in Definitions and Concepts

Data-Driven Engineering (DDE) and Digital Engineering (DE) both aim to improve systems engineering but differ fundamentally in focus and execution. DE emphasizes models as central artifacts, integrating them across tools and disciplines to support lifecycle activities (DoD, 2018; DoDI 5000.97, 2023). In contrast, DDE shifts the emphasis to data itself, treating it as the core representation of the system. DDE uses a foundational ontology to ensure semantic consistency and concordance, enabling integration across diverse models and domains. While DE often struggles with model interoperability and duplication, DDE leverages AI and set theory to manage complexity, verify relationships, and create a trusted Authoritative Source of Truth for informed decision-making.

At the core of the DDE ecosystem is the Authoritative Source of Truth (ASoT)—a trusted, ontology-governed framework that enables consistent, validated system representation. Rather than serving as a centralized repository of static models, the ASoT functions as a virtual repository, where legacy data and models remain in their native tools and formats but are made accessible through a brokered integration service. This architecture allows data to be shared, queried, and interpreted without requiring physical consolidation. The ASoT is grounded in a universal ontology, which provides the semantic foundation for aligning diverse data sources. By ensuring that each data element is represented once—mirroring its singular occurrence in the real-world system—the ASoT supports semantic consistency, traceability, and confidence in decision-making across the system lifecycle.

Table 1 provides a detailed comparative overview of the conventional ASoT concept and the Ontology-Governed ASoT approach proposed in this paper (Budin, 2005; DoD, 2018; DoDI 5000.97, 2023; Vaneman, 2025).

Table 1: Conventional ASoT vs. Ontology-Governed ASoT.

Aspect	Conventional ASoT	Ontology-Governed ASoT
Architecture	Centralized repository	Virtual, distributed repository
Data Storage	Models and data are physically consolidated into a single system	Data remains in native tools/formats; accessed via integration services; only unique, multi-data set queries are stored.
Governance	Often tool-specific or document-centric	Governed by a universal ontology that defines semantic relationships
Integration	Manual or tool-specific interfaces	Brokered integration enables seamless access across heterogeneous systems
Semantics	Implicit or embedded in documentation	Explicit, machine-readable semantics via ontologies
Traceability	May rely on manual tracking or tool-specific links	Semantic traceability across the lifecycle via ontology-based relationships
Validation	Focused on verifying data accuracy within a system	Emphasizes semantic validation and consistency across systems
Scalability	Limited by centralization and tool compatibility	Scales across organizations and tools without data duplication

Strategic Decision Engineering Framework

In order to flesh out the design decisions that differentiate an ontology-driven ASoT from other Digital Engineering concepts, the authors:

- Imported the previous DDE/ASoT paper into Innoslate, an MBSE tool whose schema has been extended to support an integrated model of requirements, decisions, functional architecture and physical architecture. See Fitch (2023) for details on these extensions.
- Reverse engineered the decisions implicit in that paper against a System/Product Design decision pattern that was presented in Fitch (2021). For convenience, the pattern is shown graphically in Figure 1, below.
- Built traceability relationships between paper paragraphs and design decisions, alternatives, functions and physical architecture elements.
- Refined the top-level functional architecture of the DDE and ASoT by creating Action diagrams that include both functional dependencies (control flow) and inputs/outputs (item flow) passed between the functions.
- Allocated top-level functions to the DDE and ASOT physical architecture elements.
- Updated the decision model to better align it with the functional and physical architectures.

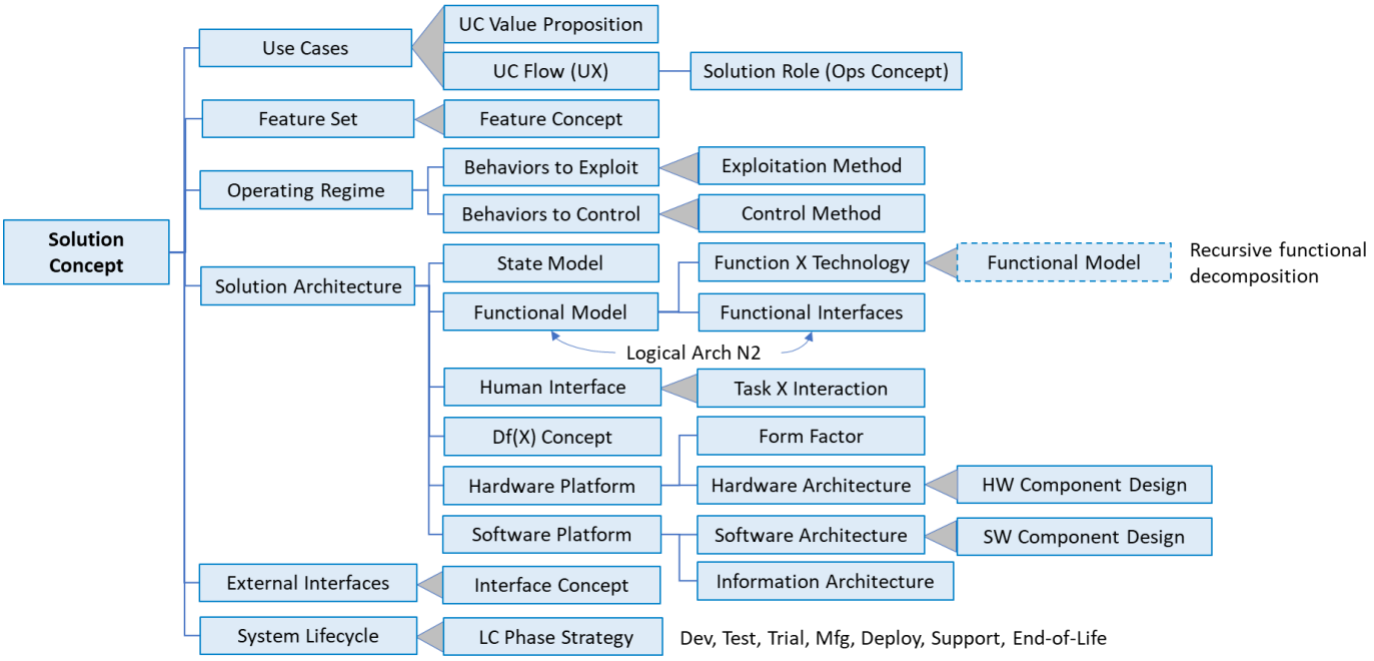

Figure 1: System/Product Design Decision Pattern

The result of these efforts is a model of 26 decisions along with the recommended alternatives that represent the elaboration of the proposed concept for an ontology-driven ASoT operating within a DDE ecosystem. Table 2 summarizes these decisions.

Table 2: DDE-ASoT Decision Summary.

Decision	Recommended Alternative
D.0 DDE Ecosystem Concept: What is the top-level concept for the Data-Driven Engineering (DDE) Ecosystem? What makes it unique?	**ALT.0.a Federated data integration environment:** A federated environment where data is integrated from diverse models and multiple disciplines, through a common ontology, into an Authoritative Source of Truth, enabling a data-driven spectrum across the system lifecycle.
D.1 ASoT Solution Concept: What is the top-level concept for this system or solution? What makes it unique?	**A.1.a AI-enabled, ontology-governed integrated knowledge repositories:** Trusted, scalable ASoT comprised of AI-enabled and ontology-governed integrated knowledge repositories
D.1.1 ASoT Use Cases to Support: What use cases (scenarios, missions) will the ASoT solution support?	**ALT.1.1.a High complexity systems with long lifecycles:** Support an ASoT for systems with high complexity that demand the ability to create and store data in multiple disparate tools across long lifecycles and integrate this multi-source data to inform lifecycle decisions
D.1.1.1 UC1 Value Proposition: How will the ASoT solution deliver value to the end users and customers of this use case?	**ALT.1.1.1.a Integrate diverse data sources across the system lifecycle**
D.1.1.2 Use Case #1 Flow: How will this use case be performed? What flow of activities and events will occur?	TBD

D.1.2 Feature Set: What are the primary features or groups of features that will be delivered by the ASoT?	TBD
D.1.3 Operating Regime(s): In what range of conditions, environments and performance levels will the ASoT solution operate?	**ALT.1.3.a Enterprises developing complex systems with disparate stakeholders:** The ASoT will operate in enterprises (typically large) that are developing complex, long-lived systems which have many stakeholders with disparate interests and legacy tools and artifacts that are difficult to align and use
D.1.3.2 Behaviors to Exploit: What behaviors/properties (science) within the ASoT operating regime will be exploited to create value?	**ALT.1.3.2.a Data-Centric System-Centric Thinking**
	ALT.1.3.2.b ~~Model-centric Thinking~~
	ALT.1.3.2.c Set theory principles
	ALT.1.3.2.d Artificial Intelligence (AI)
	ALT.1.3.2.e Lifecycle data evolution & compounding (Data-Driven Spectrum)
D.1.3.2.1 Data-Centric Thinking Exploitation Method: How will the ASoT solution exploit Data-Centric Thinking to deliver value?	**ALT.1.3.2.1.a Standardized enterprise ontologies for semantic alignment & concordance**
D.1.3.2.2 Set Theory Exploitation Method: How will the ASoT solution exploit Set Theory principles to deliver value?	**ALT.1.3.2.2.a Leverage set theory principles to verify data relationships**
D.1.3.2.3 AI Exploitation Method: How will the ASoT solution exploit AI to deliver value?	**ALT.1.3.2.3.a Manage the combinatorial complexity of integration via automated schema matching, real-time data fusion & adaptive learning.**
D.1.3.2.4 Data-Driven Spectrum Exploitation Method: How will the ASoT solution exploit the Data-Driven Spectrum (lifecycle data evolution & compounding) to deliver value?	**ALT.3.3.2.4.a Evolution of system data improves lifecycle decisions:** Evolution of system data across the lifecycle improves data completeness and quality which compounds the ability to inform lifecycle decisions
D.1.4 DDE Ecosystem Architecture: What is the DDE Ecosystem's top-level architecture; the allocation of functions to hardware, software or user actions? What level of automation will be provided (automation boundary)?	**ALT.1.4 Foundational ontology + Web Ontology Language + Tools/repositories + ASoT:** The primary elements of a Data-Driven Engineering ecosystem are the: * Foundational ontology which defines the enterprise information model * Web ontology language that enables verification and alignment of ontologies * Software tools and repositories in which system models are created, stored and maintained across the lifecycle * Authoritative Source of Truth, which serves as the information broker and integrator to align and combine system data from disparate sources to inform lifecycle decisions

D.1.4.1 ASoT Solution Architecture: What is the ASOT's top-level architecture; the allocation of functions to hardware, software or user actions? What level of automation will be provided (automation boundary)?	**ALT.1.4.1.a CDM + Engines (Set Theory + AI + Query) + Multi-source Digital Artifacts:** The primary elements of the Authoritative Source of Truth (ASoT) are the: * Conceptual Data Model that guides and governs all data integration activities * Set Theory Engine used to verify data relationships and ensure integrity (aka trust) * AI Engine to support continuous learning and improvements in data integration and lifecycle use * Query Engine to define which data will be pulled from which sources to create lifecycle digital artifacts and also store query definitions/parameters for ongoing use * Multi-source digital artifacts created from queries - snapshots at a specific point in time
D.1.4.1.1 Virtual System Model Dimensions: What types (dimensions) of data should make up the ASoT's virtual system model?	**ALT.1.4.1.1.a 12-class model per Vaneman (2024)**
D.1.4.1.2 Foundational Ontology Notation: What notation will be used to fully represent the foundational ontology for the ASoT?	**ALT.1.4.1.2.a Entity-Relationship-Attribute (ERA) notation + relationship attributes:** The entity (i.e. the nouns in the ontology) defines the system's elements that it seeks to portray. A relationship (i.e., the verbs of an ontology) connects entities to each other through standardized terms. An attribute (i.e., the adjectives of an ontology) is the inherent characteristic or quality of an entity. It further describes the entity, enhancing its uniqueness. Attributes on relationships qualifying how, when, or under what conditions a relationship occurs
D.1.4.1.3 ASoT Foundational Ontology: What language will provide the core elements (schema?) of the ASoT's foundational ontology?	**ALT.1.4.1.3.a Lifecycle Modeling Language (LML):** Use LML as the foundational ontology for the AsoT
D.1.4.1.3.1 Entity Classes: Which classes of entities will comprise the ASoT's foundational ontology?	**ALT.1.4.1.3.1.a LML's 12 base classes:** Use LML's base set of 12 entity classes as core of foundational ontology
D.1.4.1.3.2 Entity Class Relationships: Which relationships between entity classes will form the core of the ASoT's foundational ontology?	**ALT.1.4.1.3.2.a LML Relationship Matrix:** Support LML's relationship matrix as the core of the ASoT's foundational ontology
D.1.4.1.3.3 ASoT's Conceptual Data Model (CDM): Which conceptual data model will be adopted for the system of interest?	**ALT.1.4.1.3.3.a TBD ontology subset:** A system-specific subset containing all relevant entities, relationships, and attributes, i.e., the system's meta-model, mapping modeling languages and tools used to represent different system aspects, and highlighting where data exchange and integration are needed for the system's virtual representation.
D.1.6 ASoT Life Cycle: What is the ASoT's life cycle model?	**ALT.1.6 ASoT Design, Verification, Deployment, Operations and Sustainment**

D.1.6.1 System Model Development Approach: What strategy will we use to develop the models captured within the ASoT?	**ALT.1.6.1.a Formalized system model development approach**
D.1.6.2 System Model Creation Method: How will system models be created?	**ALT.1.6.2.a Use best-fit modeling tools for modeling creation**
D.1.6.3 System Model Storage Method: How will system models be stored?	**ALT.1.6.3.a Store system models in native format**
D.1.6.4 ASoT Governance Method: How will the ASoT's be governed/managed to ensure ontology integrity?	**ALT.1.6.4.a Protégé OWL (Web Ontology Language):** Mechanism for maintaining a shared conceptual model of a domain with clear definitions of entities, relationships, and constraints
D.1.6.4.1 Constraint Implementation Approach: How will constraints be implemented in the ASoT's foundational ontology?	**ALT.1.6.4.1.a Constraints as attributes on relationship:** Implement ASoT foundational ontology constraints as attributes on relationships between entity classes

The paper focused on the needs of a DDE/ASoT that would address the challenging use case of high complexity systems with long lifecycles which typically imply a numerous and diverse set of stakeholders whose priorities may conflict and also vary over time. More analysis of value proposition, use case flow (user experience) and role of the ASoT in other use cases is needed to uncover the full requirements set for the proposed DDE/ASoT concept.

Although this level of analysis is sufficient to clarify the proposed DDE/ASoT design, several of these decisions demand a full decision analysis (trade study) to evaluate alternative concepts in the context of the needs of a particular organization.

For the top-level DDE Ecosystem Concept decision, an organization would need to define an initial set of criteria to match their constraints (threshold values), goals and relative priorities (weights). These criteria may include:

- Data integration diversity
- Data concordance
- Data correlation across the system lifecycle
- Completeness of virtual system representation
- Fidelity of virtual system representation
- Size of virtual system representation (economy of entities).

Criteria that would drive the ASoT Solution Concept decision may include:

- Trusted
- Scalable
- Decision support capability
- System model adaptability
- System model reusability
- System architecture static observability
- Dynamic behavior exploration capability
- Multiple discipline/domain, model, tool and repository support.

The ASoT Functional Lifecycle Model

Data-Driven Engineering: a structured methodology for creating the ASoT Functional Lifecycle Model and for implementing a digital thread across complex systems. This approach shifts engineering from document-centric practices to a data-centric paradigm, enabling seamless integration of information

from diverse models, tools, and disciplines. At its foundation is the ASoT—a federated environment where data is harmonized through a foundational ontology and governed by a Conceptual Data Model (CDM). These elements ensure semantic consistency, interoperability, and traceability throughout the system lifecycle.

The ASoT Functional Lifecycle Model consists of eight core functions (F.1–F.8), each contributing to the progressive development of a robust digital ecosystem.

- **F.1 Establish ASoT** - defines scope, structures lifecycle data, and creates foundational ontologies, forming the basis for CDM alignment.
- **F.2 Plan Data Development** - sets the roadmap for data collection, creation, integration., and sharing.
- **F.3 Manage System Models** - ensures models are created and synchronized across legacy data repositories.
- **F.4 Integrate Data Across Sources** - combines data from multiple repositories to produce coherent system views.
- **F.5 Grow Data Integration Capabilities** - introduces advanced AI-driven fusion and semantic alignment for high-quality, multi-source data.
- **F.6 Verify System Models Against CDM** - logically validates consistency and correctness of models.
- **F.7 Create Multi-Source Digital Artifacts** - generates dynamic models from multiple data sources for queries that cannot be satisfied with a data source alone.
- **F.8 Use Digital Thread Data** - Informs lifecycle decisions. Closes the loop by enabling informed, data-driven decision-making.

Figure 2 visually depicts these functions and their interdependencies, illustrating how data flows from initial ASoT establishment to lifecycle decision-making.

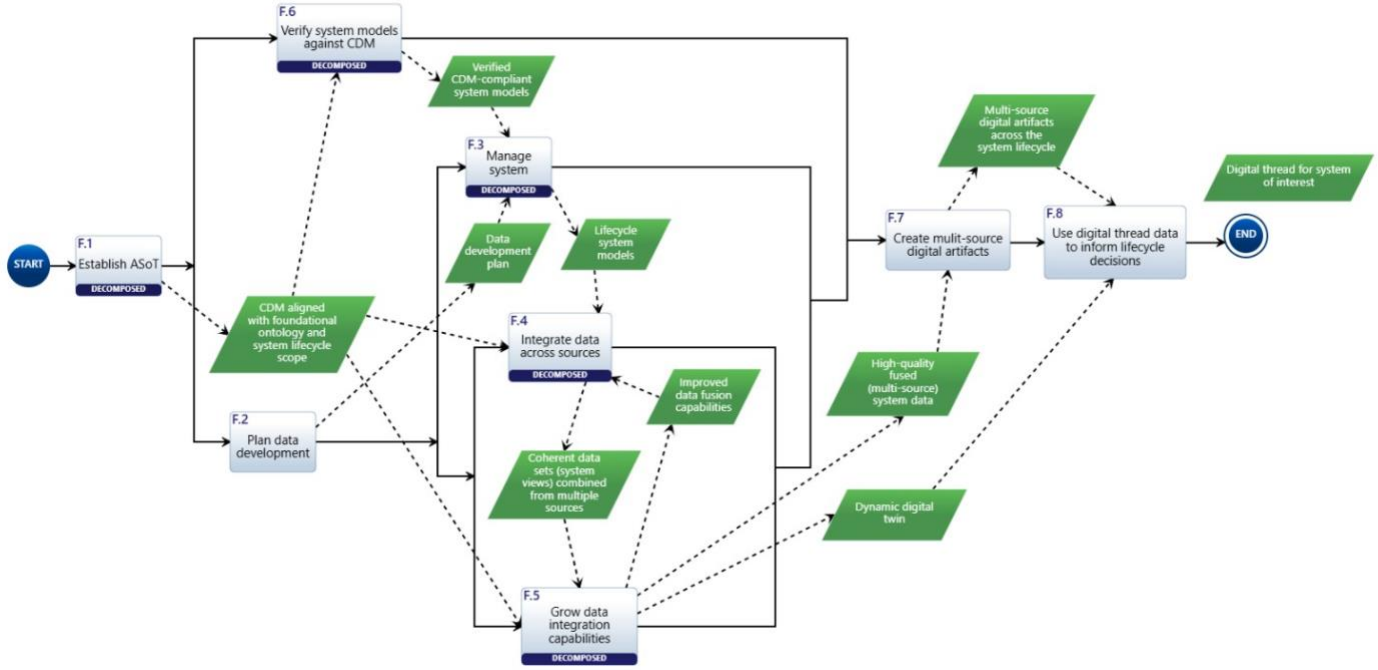

Figure 2. The ASoT Functional Lifecycle Model.

(Note: Figure 2 shows that F.1, F.3, F.4, F.5, and F.6 have been decomposed. The next level of decomposition will be discussed for F.1, with the remainder being discussed at a later date.)

Complementing Figure 2, Table 3 is the functional decomposition table that provides detailed inputs, outputs, and supporting actions for each function, offering a granular view of operational

requirements. Together, these artifacts form a comprehensive blueprint for implementing a DDE ecosystem that enhances accuracy, agility, and lifecycle management across complex systems.

Table 3: The DDE Top-Level Functional Model.

Input	Functions	Output
	F.0 Perform DDE lifecycle functions	O.0.a Digital thread for system of interest
	F.1 Establish ASoT	O.1.a CDM aligned with foundational ontology and system lifecycle scope
	F.1.1 Define scope of ASoT	O.1.1.a System external boundary and lifecycle model
O.1.1.a System external boundary and lifecycle model	**F.1.2 Structure system lifecycle data**	O.1.2.a List of models, tools and repositories O.1.2.b Data integration/exchange needs
O.1.2.a List of models, tools and repositories O.1.2.b Data integration/exchange needs	**F.1.3 Define foundational ontology**	O.1.3.a Foundational ontology the enterprise
O.1.3.a Foundational ontology the enterprise	**F.1.4 Define Conceptual Data Model (CDM)**	O.1.a CDM aligned with foundational ontology and system lifecycle scope
	F.2 Plan data development	O.2 Data development plan
O.2 Data development plan O.6 Verified CDM-compliant system models	**F.3 Manage system models**	O.3 Lifecycle system models
O.1.a CDM aligned with foundational ontology and system lifecycle scope O.3 Lifecycle system models O.5.b Improved data fusion capabilities	**F.4 Integrate data across sources**	O.4.a Coherent data sets (system views) combined from multiple sources
O.1.a CDM aligned with foundational ontology and system lifecycle scope O.4.a Coherent data sets (system views) combined from multiple sources	**F.5 Grow data integration capabilities**	O.5.a High-quality fused (multi-source) system data O.5.b Improved data fusion capabilities O.5.c Dynamic digital twin
O.1.a CDM aligned with foundational ontology and system lifecycle scope	**F.6 Verify system models against CDM**	O.6 Verified CDM-compliant system models
O.5.a High-quality fused (multi-source) system data	**F.7 Create multiple-source digital artifacts**	O.7 Multi-source digital artifacts across the system lifecycle
O.5.c Dynamic digital twin O.7 Multi-source digital artifacts across the system lifecycle	**F.8 Use digital thread data to inform lifecycle decisions**	

Table 3 summarizes DDE functions, F.1 through F.8, and provides the context for the operational functions of the ASoT that primarily take place under F.4 through F.6. Although an exhaustive analysis of the model falls outside the scope of this paper, Figure 3 illustrates the decomposition for F.1 Establish ASoT.

The process begins with F.1.1 Define Scope of ASoT, which identifies the system's external boundaries and lifecycle model. Next, F.1.2 Structure System Lifecycle Data organizes models, tools, and repositories while highlighting data integration and exchange needs. F.1.3 Define Foundational Ontology establishes enterprise-level classes, relationships, and attributes to ensure semantic consistency. Finally, F.1.4 Define Conceptual Data Model (CDM) adapts the ontology to the project scope, aligning it with lifecycle requirements. Each step produces critical outputs—such as lists of models, integration needs, and ontology definitions—that enable CDM alignment with the foundational ontology and system lifecycle scope. This structured approach ensures interoperability and traceability across all subsequent DDE functions.

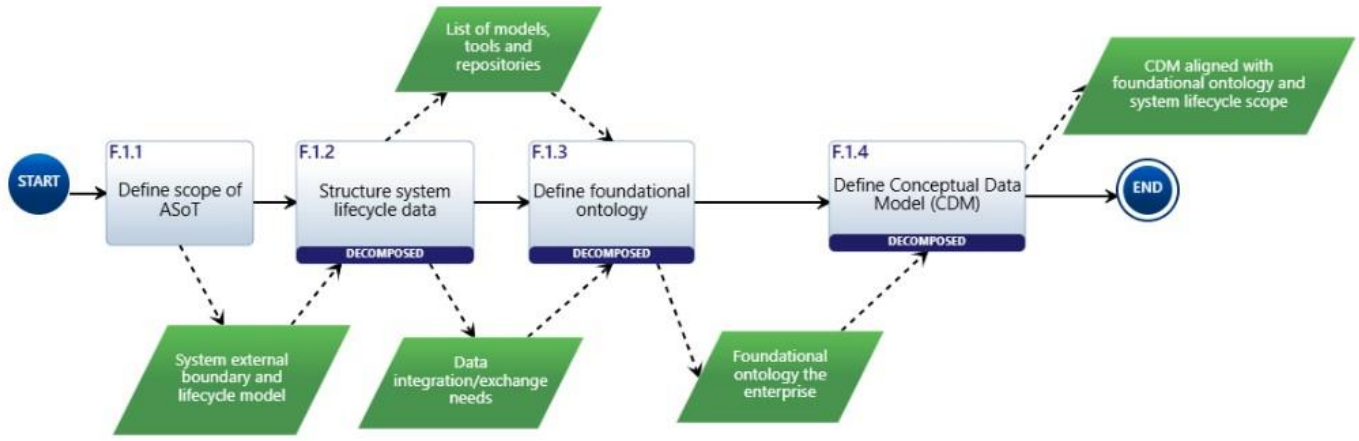

Figure 3: Decomposition of F.1 Establish ASoT.

Conceptual DDE and ASoT Physical Architectures

The **DDE ecosystem** represents a transformative approach to systems engineering, emphasizing the integration of data across the entire system lifecycle. Figure 4 provides a high-level view of this ecosystem, structured around four physical architectural elements.

- **AR.1 Foundational Ontology -** establishes the atomic-level conceptual framework for consistent data representation by defining entities, relationships, attributes, and relationships on attributes.
- **AR.2 Web Ontology Language -** implemented through tools such as Protégé OWL to enforce semantic rigor.
- **AR.3 System Lifecycle Tools and Repositories –** manage, store and synchronize models throughout the model's lifecycle.
- **AR.4 Authoritative Source of Truth -** serves as the central broker for harmonizing data from diverse sources. Together, these components enable interoperability, traceability, and logical consistency, forming the backbone of a data-centric engineering paradigm.

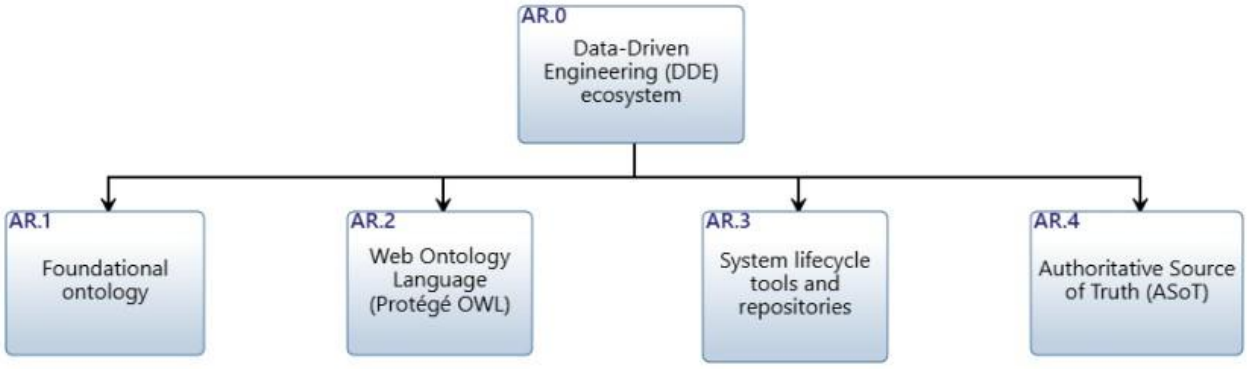

Figure 4: DDE Physical Architecture.

An ontology, created at the enterprise level for use by all system models within the enterprise, operates on the principle of reducing diverse entities from program data dictionaries to a foundational set of atomic entities. Striking the right balance is critical: too many entities create ambiguity by representing the same concept differently, while too few fail to capture all system elements (Vaneman et al., 2022). These entities form the essential information describing the system. Beyond entities, an ontology must define relationships and attributes (LMO, 2025). Tools like Protégé OWL employ set theory to model these structures, enabling formal verification through mathematical reasoning. Verification ensures consistency, completeness, and correctness by validating element membership and hierarchical relationships. This mathematical foundation strengthens error detection, logical inference, and overall integrity in complex system architectures.

Table 4 outlines the **physical architecture and functional allocations** that enable a Data-Driven Engineering (DDE) ecosystem. It organizes key architectural requirements—such as foundational ontology, semantic modeling through Web Ontology Language (Protégé OWL), and system lifecycle tools—into structured functions that support data integration and interoperability. Each entry maps entities, classes, and relationships to lifecycle activities, ensuring consistency and traceability across models and repositories. By emphasizing ontology-driven modeling and rigorous data management, the table provides a blueprint for implementing a federated environment where engineering decisions are informed by accurate, connected, and logically consistent data throughout the system lifecycle (Vaneman, 2025).

Table 4: DDE Physical Architecture & Functional Allocations.

Physical Architecture – DDE	performs Functions
AR.0 Data-Driven Engineering (DDE) ecosystem: A federated environment where data is integrated from diverse models and multiple disciplines, through a common ontology, into an Authoritative Source of Truth, enabling a data-driven spectrum across the system lifecycle.	F.0 Perform DDE lifecycle functions
	F.1 Establish AsoT
	F.2 Plan data development
	F.3 Manage system models
	F.7 Create multiple-source digital artifacts
	F.8 Use digital thread data to inform lifecycle decisions
AR.1 Foundational ontology: Atomic level of the system data model	

AR.2 Web Ontology Language (Protégé OWL)	F.6 Verify system models against CDM
AR.3 System lifecycle tools and repositories	F.3.1 Create system models
	F.3.2 Store system models
	F.3.3 Maintain system models
AR.4 Authoritative Source of Truth (ASoT): Data broker between lifecycle models and tools	F.3.4 Align system models
	F.4 Integrate data across sources
	F.5 Grow data integration capabilities

Note that the functional allocations in Table 4 are incomplete and as additional functional decomposition of the entire model is performed and rationalized with the physical architecture. This process has already yielded numerous "loose ends" to resolve in order to fully align the design decisions and functional architecture (with its item flows) and physical architectures.

Figure 5 illustrates the **Authoritative Source of Truth (ASoT)** as a decomposition of the DDE physical architecture (AR.4), focusing on its five critical components. At the top level, the ASoT serves as the central hub for harmonizing data across diverse models and tools, ensuring consistency and reliability throughout the system lifecycle. Supporting this are the following key elements.

- **AR.4.1 Conceptual Data Model (CDM)** - defines the system-specific subset of entities, relationships, and attributes derived from the foundational ontology.
- **AR.4.2 Set Theory Engine** - provides mathematical rigor for organizing and verifying data relationships.
- **AR.4.3 Artificial Intelligence (AI) Engine** - enables adaptive learning, schema matching, and real-time data fusion.
- **AR.4.4 Query Engine** - facilitates multi-source data retrieval.
- **AR.4.5 Multi-Source Digital Artifacts** - deliver fit-for-purpose views of lifecycle data.

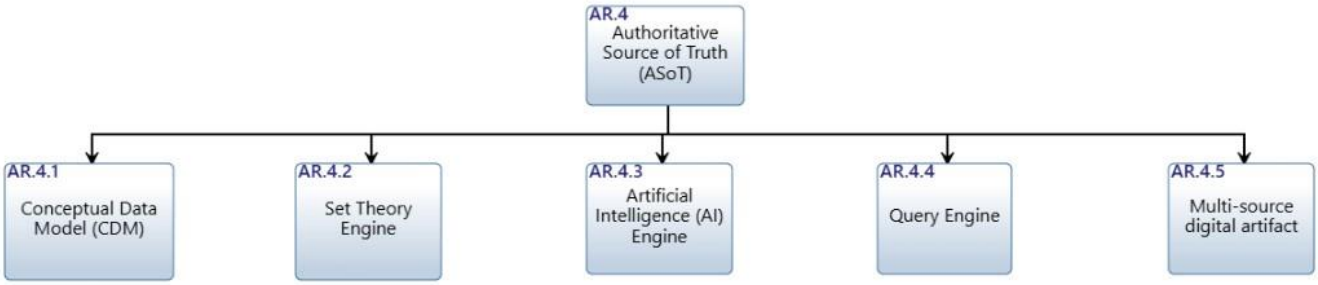

Figure 5. ASoT Physical Architecture.

Table 5 complements Figure 5 by detailing the physical architecture and functional allocations necessary to implement these components. It maps lifecycle functions—such as verifying data relationships, growing integration capabilities, and querying data sources to create digital artifacts — to specific architectural elements, ensuring semantic alignment and interoperability. Together, Figure 5 and Table 5 provide a comprehensive blueprint for achieving data concordance and enabling authoritative, data-driven decision-making across complex engineering environments.

Table 5. ASoT Physical Architecture.

Physical Architecture - ASoT	performs Functions
AR.4.1 Conceptual Data Model (CDM)	
AR.4.2 Set Theory Engine: Structured framework for organizing, comparing, and manipulating datasets (data sources for the system of interest)	F.1.3.1 Verify data relationships - foundational ontology
	F.1.4.1 Verify data relationships - ontology to CDM
	F.1.4.2 Verify data relationships - CDM
	F.4.2 Organize data sets
	F.4.3 Compare data sets
	F.4.4 Manipulate data sets
AR.4.3 Artificial Intelligence (AI) Engine	F.5 Grow data integration capabilities
AR.4.4 Query Engine: Module through which the ASoT queries data sources and builds multi-source digital artifacts from data sources and models	F.4.1 Query data sources
	F.4.3 Create multi-source queries
	F.4.4 Store multi-source queries
	F.4.5 Execute multi-source queries
AR.4.5 Multi-source digital artifact: Fit-for-purpose digital artifacts (views of lifecycle system data) derived from multiple models and sources	F.8 Use digital thread data to inform lifecycle decisions

Note that the functional allocations in Table 5 are incomplete and will likely be revised as Action Diagrams are created for each second-level (F.N.N) function.

The ASoT is built upon a foundational ontology that provides the semantic structure necessary to align and integrate data across disciplines, tools, and lifecycle stages. This ontology establishes a shared understanding of system concepts and their interrelationships, enabling consistent interpretation of data from diverse sources. From this foundation, a Conceptual Data Model (CDM) is derived to represent the specific portion of the ontology relevant to the system of interest. The CDM serves as a tailored meta-model, mapping the ontology to the modeling tools, languages, and data structures used in practice. This ensures that data integration is not only technically achievable but also semantically coherent—preserving the integrity of the system's virtual representation and supporting accurate, system-specific analysis and decision-making (Vaneman, 2025).

Conclusion

The conventional view of the Authoritative Source of Truth (ASoT) emphasizes static hierarchies and descriptive categorization, whereas the ontology-governed ASoT introduces formal semantics, enabling dynamic reasoning, interoperability, and traceability across architectural layers. This paper treated Digital Engineering (DDE) as a foundational enabler, framing ASoT within a model-based, data-centric paradigm to support lifecycle integration and decision superiority. Ontology provides the semantic backbone for ASoT, ensuring consistent interpretation of architectural elements, while the Conceptual Data Model (CDM) structures relationships and constraints, enabling precise data exchange and alignment across systems. Our future work will focus on further decomposing lower-level ASoT elements to improve granularity and precision. Additionally, we will explore the role of

artificial intelligence in ASoT, leveraging AI for automated architecture synthesis, anomaly detection, and continuous evolution. We believe that synergizing DDE, ontology, CDM, and AI will create a powerful ecosystem for real-time analytics and adaptive architectures.

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About the Authors

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.

Dr. Warren Vaneman is a retired Professor of Practice from the Systems Engineering Department at the Naval Postgraduate School, where he played a pivotal role in advancing systems engineering research and education and mentoring future leaders. He brings four decades of leadership and systems engineering experience from distinguished roles within the Intelligence Community and Department of Defense. A highly decorated Navy Reserve Captain, he holds a BS from State University of New York Maritime College, an MS in Systems Engineering, and a Ph.D. in Industrial and Systems Engineering from Virginia Tech. He is also a long-standing adjunct professor at Virginia Tech and an INCOSE-certified Expert Systems Engineering Professional (ESEP).

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- From Fuzzy to Focused: How AI Transforms the Front-End of Product Development (webcast)
- Global NP Solutions (blog)
- How Business Owners and Leaders Can Elevate Collaboration in Their Companies (article)
- How to Choose the Right Business: A Decision Guide for Aspiring Entrepreneurs (article)
- How to Generate Awesome Ideas (Conference recording)
- HYPE Innovation (blog)
- Innovation Lab Snapshot: Essential AI Tools for Product Management Success (webcast)
- Innovation Lab Snapshot: Sharpen Your Launch Before the Competition Does (webcast)
- Introduction to Exploratory Product Development (article)
- Material Selection and Requirements in Product Design (article)
- Navigating Data & AI: The Role of the Platform PM in Tech (webcast)
- Promoting crowdsourced new products: Competing co-contributor attractiveness, similarity, and persuasion knowledge processes (JPIM article)
- The Best vs. the Rest: Key Findings from PDMA's 2012 Comparative Performance Assessment Study (article)
- The Coming AI Tsunami in New Product Development – Are You Ready? (article)
- Unlock the Power of IP Strategy in New Product Development (chapter webcast)

- Value Creation and Value Capture Alignment in Business Model Innovation: A Process View on Outcome-Based Business Models (JPIM article)
- What Is AI and What Can It Do in NPD for You and Your Business? (article).

Access to kHUB is free and open to the public. Full text access to JPIM research articles requires a PDMA membership or institutional access to the JPIM through the Wiley Online Library; however, kHUB publishes JPIM article abstracts and key takeaways.

Create a guest account or join PDMA here.

International Society for System Sciences (ISSS) Wiki

The International Society for the Systems Sciences (ISSS) has launched the ISSS Wiki, designed to be a a living repository of systems science knowledge and community contributions. Although just beginning to be populated, the Wiki contains "bins" for resources such as:

- ISSS community (215)
- Videos
- System Theories
- Conferences (23)
- Books & Chapters (51)
- Journal Articles
- Methodologies
- Software
- Other Tools.

The categories with hyperlinks are those that have the largest number of entries added to date.

Examples of books that might catch the eye of PPI SyEN readers (most of whom engineer systems) include:

- A Guide to Systems Research: Philosophy, Processes & Practice
- Critical Systems Thinking and the Management of Complexity
- Handbook of Systems Sciences
- Network Modelling of Engineering Systems
- Patterns of Strategy
- Science and Design of Problem-Solving Systems
- Science and Design of Systems
- Systems Approaches to Making Change: A Practical Guide 2nd Edition
- Systems Science: Theory, Analysis, Modeling, and Design
- Systems Thinking and Complexity Science: Insights for Action
- The Fractal Organization: Creating sustainable organizations with the Viable System Model
- The Handbook of Systems Thinking.

Learn more ISSS here.
Join ISSS.

SYSTEMS ENGINEERING RESOURCES

Paper: Dual-Loop Integration Framework for Model-Based System Design and Reliability Analysis Using Bayesian Networks

PPI Founder and Managing Director, Robert Halligan, recommends the above-named research paper, recently published in ScienceDirect, as a significant step in achieving a better integration between the disciplines of Model-Based Systems Engineering and Reliability Engineering.

Abstract:
Integrating model-based systems engineering (MBSE) and reliability analysis is challenging due to the lack of life-cycle reliability consideration in system design, difficulty in tracking design changes in reliability modeling, and limited quantitative analysis support in system modeling.

To address these issues, this paper proposes a dual-loop modeling framework integrating system design and reliability analysis based on models and Bayesian networks. This framework supports a systematic and iterative design process, facilitates quantitative analysis throughout the system life cycle, and enables upstream integration of system-related and mapped reliability parameters from dynamically evolving design architectures at both modeling method and framework levels.

Specifically, we propose a novel integrated modeling approach based on existing theories and methods, detailing the methodological, procedural, and linguistic foundations. Furthermore, a mapping method based on SysML activity diagrams' basic types is proposed to connect system models with dynamic Bayesian networks (DBN) for quantitative analysis.

Finally, the effectiveness of the proposed method is validated through its application to a reaction wheel actuator and a remote sensing satellite project.

This 19-page artifact is available for download and use under a Creative Commons license.

Robert Halligan notes that the history of MBSE (incorrectly claimed in this paper as beginning in 1993) certainly stretches back to the 1950s.

INCOSE Systems Engineering Journal: September 2025 Edition

INCOSE has published, through the Wiley online library, the September 2025 edition of the Systems Engineering Journal. Volume 28, Issue 5 includes open-access articles, as well as full-access papers that require an institutional login, such as those available through INCOSE membership. There is no published overriding theme for this edition. PPI SyEN has included abstracts to guide our readers to which of these diverse topics best fit their interests.

Open Access Articles
Open Access articles are available to view and download in PDF format without any restrictions.

Model-Driven Engineering for Digital Twins: Opportunities and Challenges
Authors: Judith Michael, Loek Cleophas, Steffen Zschaler, Tony Clark, Benoit Combemale, Thomas

Godfrey, Djamel Eddine Khelladi, Vinay Kulkarni, Daniel Lehner, Bernhard Rumpe, Manuel Wimmer, Andreas Wortmann, Shaukat Ali, Balbir Barn, Ion Barosan, Nelly Bencomo, Francis Bordeleau, Georg Grossmann, Gabor Karsai, Oliver Kopp, Bernhard Mitschang, Paula Muñoz Ariza, Alfonso Pierantonio, Fiona A. C. Polack, Matthias Riebisch, Holger Schlingloff, Markus Stumptner, Antonio Vallecillo, Mark van den Brand, and Hans Vangheluwe

Abstract: Digital twins are increasingly used across a wide range of industries. Modeling is a key to digital twin development - both when considering the models which a digital twin maintains of its real-world complement ("models in digital twin") and when considering models of the digital twin as a complex (software) system itself. Thus, systematic development and maintenance of these models is a key factor in effective and efficient digital twin development, maintenance, and use. We argue that model-driven engineering (MDE), a field with almost three decades of research, will be essential for improving the efficiency and reliability of future digital twin development. To do so, we present an overview of the digital twin life cycle, identifying the different types of models that should be used and re-used at different life cycle stages (including systems engineering models of the actual system, domain-specific simulation models, models of data processing pipelines, etc.). We highlight some approaches in MDE that can help create and manage these models and present a roadmap for research towards MDE of digital twins.

Similarity Assessment of the Engineering Concepts: Decision-Making Support and Metrics
Authors: Yaroslav Menshenin, Suhail Alsalehi, Markus Guerster, and Edward Crawley

Abstract: The new product development (NPD) process is a systematic approach to bring new products and innovations to market. Nowadays, this process is affected by a number of influencing factors associated with the fast-paced technological changes. One of those factors is the distributed design nature of product development activities: team members are spread geographically having different cultures, languages, time zones, and level of digital engineering tools awareness and utilization. Another factor is the customization of the products to meet the requirements of different customers, or the different requirements of the same customer for product variants. This is linked to the need of being able to predict the next generation of products. All those factors influence the embodiment of the engineering concept into the final product. What is critically important in such an engineering environment is to properly encode and track the engineering concepts to enable smooth planning and management of the next generations of products. One of the critical needs in this process is the assessment of the engineering concepts' similarities. This paper presents a method for the similarity assessment of product concepts through the integration of the decision-making support and mathematical representation of similarity scores. To demonstrate its utility, the proposed approach is applied to seven alternative suborbital spaceflight concepts. Using the proposed method, the pairwise similarity score among them is calculated quantitatively. A practical utility of the paper is that it presents an approach to evaluate product concepts' similarity in any industrial and business sector.

Trust at Your Own Peril: A Mixed Methods Exploration of the Ability of Large Language Models to Generate Expert-Like Systems Engineering Artifacts and a Characterization of Failure Modes
Authors: Taylan G. Topcu, Mohammed Husain, Max Ofsa, and Paul Wach

Abstract: Multi-purpose large language models (LLMs), a subset of generative artificial intelligence (AI), have recently made significant progress. While expectations for LLMs to assist systems engineering (SE) tasks are paramount; the interdisciplinary and complex nature of systems, along with the need to synthesize deep-domain knowledge and operational context, raises questions regarding the efficacy

of LLMs to generate SE artifacts, particularly given that they are trained using data that is broadly available on the internet. To that end, we present results from an empirical exploration, where a human expert-generated SE artifact was taken as a benchmark, parsed, and fed into various LLMs through prompt engineering to generate segments of typical SE artifacts. This procedure was applied without any fine-tuning or calibration to document baseline LLM performance. We then adopted a two-fold mixed-methods approach to compare AI-generated artifacts against the benchmark. First, we quantitatively compare the artifacts using natural language processing algorithms and find that when prompted carefully, the state-of-the-art algorithms cannot differentiate AI-generated artifacts from the human-expert benchmark. Second, we conduct a qualitative deep dive to investigate how they differ in terms of quality. We document that while the two materials appear very similar, AI-generated artifacts exhibit serious failure modes that could be difficult to detect. We characterize these as: premature requirements definition, unsubstantiated numerical estimates, and propensity to overspecify. We contend that this study tells a cautionary tale about why the SE community must be more cautious adopting AI-suggested feedback, at least when generated by multi-purpose LLMs.

Full Access Articles
Full-access articles are available through an institutional login, such as an INCOSE membership. This edition of the Journal includes the following titles:

- Adaptable System for Disaggregated Distributed AI Chat Enablement (D2ACE) to Support Mission Engineering
- Comparison of Quantitative Methods for Set-Based Design When Information Is Uncertain
- Systems Engineering with Architecture Modeling, Formal Verification, and Human Interactions for Learning-Enabled Autonomous Agent

INCOSE members in good standing may access all Systems Engineering Journal content through their INCOSE Connect login (using the Wiley Online Proceedings Library link after login). Non-members may subscribe to the journal, use institutional logins from their university or place of employment, or purchase access to individual articles at the URLs associated with the article titles above.

INCOSE INSIGHT Practitioners Magazine - September Edition

The September 2025 edition (Volume 28, Issue 4) of INSIGHT, INCOSE's Practitioners Magazine, has been published by Wiley. Electronic subscriptions to INSIGHT are available as a member benefit to INCOSE members. Hard-copy subscriptions to INSIGHT are available for purchase by INCOSE members for one membership year and to the public.

The eleven articles in the 72-page September publication address the theme of *Complexity and Elegance – A Call for Action*.

Bursting the Bubble of Complexity: Reflections on the activities of the INCOSE Complex Systems Working Group (CSWG)
Authors: Dean Beale, Rudolph Oosthuizen, Dorothy McKinney, Francesco Dazzi, and Joshua Sutherland

We have entered an era of rapid change and increasing uncertainty. The biggest mistake we can make as systems engineers is ignoring this change. The term "uncertainty" is deeply connected to

complexity for many communities, including INCOSE's Complex Systems Working Group (CSWG). As uncertainty or complexity increases, our experience, and indeed logic, suggests that the practices and techniques developed for a world of sufficient certainty are no longer enough, no matter how gifted the engineer. At this point, it is essential to change our mindset from "I know enough" to "I know I am wrong about something". This mindset shift triggers a desire and need for continuous learning, new practices and techniques which embrace different viewpoints, learning through failure, and result in flexible and adaptable systems. The work of the CSWG, described in the article, is to identify and create suitable practices for the practitioner systems engineer in this new, uncertain, and complex age. We are aiming to "burst the bubble of complexity" and enable engineers to deal effectively with uncertainty and complexity. But the pace of change is fast, the complexity landscape is vast, and the tradecraft still emerging. Hence, the only way to address this complexity challenge sufficiently is to recruit communities of experts with diverse views who can work collaboratively towards these common aims.

Complexity Definitions Guidance in Systems Engineering
Authors: Francesco Dazzi, Joshua Sutherland, Gary Smith, Alfonso Lanza, Ken Cureton, and Dean Beale

This article provides a brief guide addressing the inconsistent use of "complexity" and related terms across different disciplines and situations. Definition variability often leads to miscommunication, even within organizations like the International Council on Systems Engineering (INCOSE). This guide offers practical advice tailored for different audiences on how to effectively use and interpret "complexity" in transdisciplinary contexts. Rather than prescribing a single definition, it promotes a common understanding by illustrating definitional differences and providing techniques to clarify usage. This approach aims to enhance communication, and lay groundwork for a unified scientific basis for "complexity" within systems engineering.

Elegance and Complexity
Authors: Michael D. Watson and Andrew T. Fried

This brief article provides a historical background for the use of the term "elegance" in the context of systems engineering and explores the relationship between system complexity and the increasing need for such elegance.

Elegant Solutions to Complex Problems – Case Studies and Examples
Authors: Joshua Sutherland, Alfonso Lanza, Francesco Dazzi, Ken Cureton, and Chandru Mirchandani

A range of experts presents a series of short case studies and field examples where elegant solutions emerged to solve complex engineering challenges in network protocols, urban transport, and astrophysics. Their responses illustrate the importance of clarity of purpose and good architecture transforming intricate problem spaces into robust, enduring systems demonstrating that elegance is a core engineering principle, not an afterthought.

Elegant Solutions to Complex Problems – Perspectives and Practice
Authors: Joshua Sutherland, Alfonso Lanza, Kristin Giammarco, Michael Pennotti, Dov Dori, and Louise Harney

Experts provide their personal perspectives, conceptual frameworks, and behavioral insights that shape how systems engineers approach complex challenges to illuminate how elegance also emerges from how we think, frame, and engage with complexity.

Elegant Solutions to Complex Problems – Recommended Resources
Authors: Joshua Sutherland, Alfonso Lanza, Peter Brook, Alejandro Salado, and Chandru Mirchandani

A range of experts provide guidance from foundational theories to emerging perspectives on what materials have helped them understand the field, presenting a curated set of books, papers, frameworks, and conversations that have helped systems engineers deepen their understanding of complexity and refine their ability to recognize - or design - elegant solutions.

On the Meaning, Purpose, and Value of Systems Engineering
Authors: Michael Pennotti, David Rousseau, Peter Brook, and Javier Calvo-Amodio

This brief article highlights the work of INCOSE's "Bridge Team" in developing a framework for relating systems engineering heuristics to systems engineering principles and provides recommendations on meeting the challenge of increasingly system complexity through a focus on system value and elegance.

Principles for Minimizing Unintended Consequences
Authors: David Rousseau and Julie Billingham

A significant challenge to the success of systems engineering solutions is the risk of unintended consequences. This has traditionally been considered to be a real but unactionable requirement. Here, we analyse the notion of unintended consequences and propose an equivalent but actionable requirement, which we relate to the concept of 'harmony'. The implication of this notion is that in order to assure solution success it has to be architected in concert with considering the structure and dynamics of the system of systems in which it will be deployed. We conducted a study of natural ecosystems as a case study from which we could glean relevant architecting principles. From this we developed a general model of the structure and dynamics of a complex system of systems. From this study and model we distilled a set of general principles for systems architecting. Along the way we introduced a framework for understanding the relationships between the notions elegant, complex, complicated, and simple. We also introduce a new perspective on emergence at the level of parts, supplementing classical notions of emergence at the level of the whole.

Systemic Elegance: Clarifying Complexity and Emergence for Engineering Practice
Author: Gary Smith

In systems engineering, elegance is often associated with simplicity and control, but this risks ignoring the deeper systemic nature of elegance as coherence between complexity and purpose. This article reframes elegance not as minimalism, but as the systemic sufficiency of structure, behavior, and context. Drawing from systems science foundations and the triad of fit–form–function, we argue that true systemic elegance arises when relational complexity is harnessed, not suppressed, to yield emergent coherence across levels. Elegant systems are those that integrate complexity without introducing unnecessary complication; they achieve just enough richness to engage with the variety of their environment, while avoiding overdesign. This balance is not accidental; it results from rigorous architecting and purposeful design. Using examples and distinctions, this article offers a framework for systems engineers to recognize, cultivate, and evaluate elegance as a dynamic outcome of systemic coherence.

The Purposeful Evolution of Systems Engineering Heuristics Using I-SHARE
Authors: Javier Calvo-Amodio, Harington Lee, Veronika Shteingardt, Dorothy McKinney, and Dov Dori

SYSTEMS ENGINEERING RESOURCES

A heuristic relates to a formulation based on experts' experience, which draws on observed common patterns and serves as a guide in investigating or solving a problem. A transdisciplinary field, systems engineering involves many useful heuristics, as it integrates the gamut of engineering disciplines in defining a system throughout its lifecycle. To be usable, heuristics should be memorable and pithy, and the consequences of applying them should be predictable. To be predictable, a heuristic should provide insights into how and why it works in a particular context. The first step to increase the capability of systems engineering heuristics was the creation of the I-SHARE–INCOSE Systems Heuristics Application Repository, a curated knowledge base of over 600 systems engineering-related heuristics covering systems engineering competencies, lifecycle stages, expertise, operational domains, system attributes, and more. Here, we describe a process for guiding the systems engineering community on how to validate, test, and assess heuristics, and how the systems engineering community can engage with I-SHARE to benefit from the heuristics in it and collectively improve their capabilities.

Understanding Complexity: Defining a Moving Target
Authors: Rudolph Oosthuizen, Dean Beale, Francesco Dazzi, Andrew C Pickard, Dorothy McKinney, Kenneth Cureton, and Eileen Patrice Arnold

Systems engineering has transformed its understanding and management of complexity over the past 25 years. This article traces the evolution by analyzing 121 publications from INCOSE's journal and symposium proceedings between 1997 and 2024 to explore how definitions of complexity have shifted from structural metrics to dynamic, context-dependent phenomena shaped by emergent behaviors, stakeholder diversity, and uncertainty. It highlights key distinctions between complicated and complex systems, emphasizing why this matters in design, risk management, and stakeholder engagement. By embracing ambiguity, iterative learning, and multidisciplinary collaboration, engineers can design systems that are resilient and responsive to disruption. The results also underscore the vital role of human factors, including decision-making, cognition, and organizational behavior. We need a mindset shift: success in modern systems engineering depends not on eliminating complexity but on understanding, navigating, and leveraging it to build sustainable, adaptable systems for a changing world.

Download INSIGHT Volume 28, Issue 4 from the INCOSE iNet.
View this issue in the Wiley online library.

Business Analysis Resources

The International Institute of Business Analysis (IIBA) is a non-profit professional association that helps business analysts develop their skills and further their careers by providing access to relevant content. IIBA publishes a variety of open-access and members-only resources in numerous media formats.

Analyst Catalyst Blog
This open-access blog features posts that address different aspects of the business analysis discipline. Recent topics include:

- Business Analysis for Artificial Intelligence
- Cybersecurity Isn't Just IT: Why Business Analysis Matters

- From Cybersecurity to Storytelling
- Human-Centred Analysis: Navigating Needs, Alignment, and Real Impact
- Leveraging Servant Leadership for Agile Success
- Outcome-Driven Thinking: The Secret to Delivering Real Value.

Business Analysis Live! Podcasts
IIBA's podcast library is also open to non-members. Recent titles include:

- AI and Cybersecurity
- Practicing Empathy in the Age of Burnout
- Outcome-Driven Thinking
- What is a Solutions Architect?

Recommended Business Analysis Books
The IIBA recently recommended an e-book by Fabricio Laguna, titled Please Hold: The Power of Outcome-Driven Thinking, which focuses on driving innovation and cultural change.

Search other titles in the IIBA Bookstore.

Beyond Participation: Why Organizational Embedding Precedes Stakeholder Involvement in Requirements Engineering

Requirements Engineering Magazine
The Magazine for RE Professionals from IREB

The Requirements Engineering (RE) Magazine is published by the International Requirements Engineering Board (IREB) multiple times per year. Articles are welcome from Business Analysis and Requirements Engineering professionals, regardless of IREB membership status. Publication is free of charge for the authors.

In the September 2025 edition, Christian Bock, Head of Requirements Engineering at ZIEHL-ABEGG, authored an article titled "Beyond Participation: Why Organizational Embedding Precedes Stakeholder Involvement in Requirements Engineering".

Abstract: In Requirements Engineering, early stakeholder involvement is often seen as the best practice. But what if that's putting the cart before the horse? This article proposes a counterintuitive approach: before focusing on stakeholder involvement, organizations must embed RE within their organizational context.

Oftentimes, RE is perceived as an external imposition rather than an integrated part of the organization. This misalignment leads to resistance and irrational or obstructive behaviors. These reactions are symptoms of organizational and process deficiencies rather than shortcomings of the individuals involved. By defining rules, roles, and interfaces for RE within the organizational context, practitioners create a supportive environment in which stakeholders can participate effectively.

This article illustrates how organizations that prioritize internal alignment and context-sensitive integration of RE can be better equipped to transform initial resistance into long-term resilience – based on ten years of personal experience from a large variety of projects in various industries and organizations.

Topics addressed include:

- Don't Hate the Player. Hate the Game!
- The Playing Field: Preparation Over Participation
- The Rules: Clarity and Adaptability
- Managing Deviations: The Role of the Referee
- Leading the Game: The Importance of Expert-Driven Decision-Making
- RE as Part of the Organizational DNA
- Meta-RE: Understanding the Problem
- Tailoring RE: No One-Size-Fits-All
- The Recipe: The Right Dose at the Right Time
- Evolution: Continuous Adaptation
- The Awkward Dance of Initial Resistance: Navigating the Human Dimension
- Step by Step: Building Trust
- Adapting to the Partner: Reacting to Stakeholder Feedback
- Practice Makes Perfect: Implementing and Communication Change
- Leading the Dance: It's Better to be Wrong Than to Make No Decision
- Conclusion: Creating the Stage for Sustainable Success.

View the other 100+ RE Magazine articles.

Sign up to be notified about new issues of the Requirements Engineering Magazine.

See guidelines for contributing to the RE Magazine as an author.

Business Analysis (BA) Digest Q4 2025 Edition

Blackmetric Business Solutions, a UK-based training and consulting firm, publishes a quarterly Business Analysis (BA) Digest. In keeping with its theme as *your regular round-up of useful BA content*, the 67-page Q4 2025 edition addresses topics such as:

- Bringing Business Analysis and Testing Together: A Journey of Integration and Collaboration
- Business Change Matters for Business Analysts
- Digital Twins: A Powerful Tool for Business Analysts
- Exploring the Fundamentals of Process Mining: Use Cases, Benefits, and Limitations
- Lean Business Analysis - a Kaizen Improvement
- Let Them Sulk, Shout, and Shine: Applying the 'Let Them' Mindset to Stakeholder Relationships
- Precision Without Empathy: When "correct" Isn't "clear"
- Strategic Business Analysis: How to Deal with a Diverse Target Audience
- The Accidental Business Analyst: You Don't Need the Title to Be an Analyst
- The Art of Influence Part 2: Understanding Your Powers
- The BA Renaissance: From Scribe to Strategy Influencer
- The Silent Business Analyst
- Using Group Construct Analysis to Understand Stakeholder Worldviews in Ambiguous Situations, Part 18: Unpacking Narratives
- Value Stream Mapping: Improving the Whole, Not Just Individual Processes
- What on Earth Has Neuroscience Got to Do with Coping with Change?

Typical articles are a quick read at 2-4 pages in length.
Subscribe to the BA Digest here.

System Dynamics Review and Resources

Recent editions of the System Dynamics Review (SDR), published quarterly by Wiley on behalf of the System Dynamics Society (SDS), feature a mix of open-access and member-only articles that may be of interest to PPI SyEN readers.

Volume 41, Issue 2
Open access articles in this edition include:

- Beyond Least Squares: Estimation of Dynamic Models With Alternative Likelihoods and Kalman Filtering
- Introducing Feedback Thinking and System Dynamics Modeling in Economics Education
- Teaching and Advising in Systems Science and System Dynamics - Personal Experience, Lessons, and Reflections.

Members-only content includes:

- Book Review: System Dynamics: Modeling, Simulation, and Response

Volume 41, Issue 3
This edition provides members-only content exclusively:

- Dynamics of COVID-19: Exploring Behavioral Responsiveness
- Extending Qualitative System Dynamics: Rhythmic Governance and Cultural Feedback in Climate Policy Evaluation
- Let It Go or Control It All? The Dilemma of Prompt Engineering in Generative Agent-Based Models
- One Month, Two Projects, Many Lessons: Insights From Concurrent System Dynamics Group Model Building Approaches.

Search the database of all SDR editions and articles here.
Learn more about the System Dynamics Review here.

Beyond the Review, the SDS makes available a wide variety of resources concerning applications of system dynamics techniques to diverse problem domains. Recent recommendations include:

- Birds of a feather: clustering mental models to explore how people think alike (research article)
- Harnessing system dynamics modelling for sustainable development policy (video)
- Managerial Efficiency and Reverse-Flow Complexity in a Circular Economy (research article)
- Planting Seeds of Well-Being: Self Care and Emotional Regulation (children's book)
- Stella's AI Assistant in Action (video)
- Systems Thinking in Daily Life (video)
- Using Artificial Intelligence in System Dynamics Education (whitepaper).

SYSTEMS ENGINEERING RESOURCES

The SDS promotes networking and collaboration among its members through a global set of Chapters and Special Interest Groups (SIGs). Four SIGs are the focus of current "relaunch" initiatives:

- Business - applying System Dynamics to business, management, and organizational performance
- Education - System Dynamics in teaching, learning, and curriculum design
- Model Analysis - model testing, verification, validation, and analysis techniques
- Social Impact - advancing the use of System Dynamics for addressing social challenges.

The SDS has also launched a new Nordic Chapter to serve Denmark, Norway, Sweden, Finland, Iceland, the Faroe Islands, Greenland, and Åland.

Join the SDS to gain full access to the System Dynamics Review and additional members-only content and engagement.

SWISSED 2025 Presentations Available

SWISSED The Swiss Society of Systems Engineering (SSSE), an INCOSE chapter chartered in 2011, hosted the annual Swiss Systems Engineering Day 2025 (SWISSED25) in Zurich on September 12. The conference theme was *From Design to Reality – Walking up the "V"*.

Keynote slides currently posted on the SWISSED25 website include:

- Beam Me Up - But Safely: Systems Engineering at the Energy Frontier
- MBSE assisted Integration and Verification of SKA-Low: building the world's largest radio-telescope in Western Australia's outback
- Systems Engineering Vision 2035 – Turning Fiction into Fact.

Technical presentation slides are also available for:

- Effective Requirements Elicitation
- Engineering Compliance from the Ground Up: Deploying Model-Based Systems Engineering in the Nuclear Industry
- Enhancing Industrial Equipment Reengineering with Model-Based Systems Engineering
- Experiences from the international MBSE project for the specification and risk management of a remote-controlled, autonomous offshore crane
- How much time does a team of Systems Engineers need to phrase an I-message?
- Improving the Quality of your Requirements with Artificial Intelligence (AI)
- Integrating LLMs into MBSE: SysDICE's Journey toward an AI4MBSE Assistant
- Model-Based Product Line Engineering: The Feature-Based PathTo Product Lines Success
- Navigating Constraints: A Lightweight Systems Engineering Journey in Pharma and Medical Devices
- SE Stories: Why a standard Systems Engineering Approach is not enough
- SEBRAS - Stripes over Sprints: Agility plus Systems Engineering
- Stakeholder-oriented elaboration of a secure and safe software update process using systems engineering methods
- Standardization is Key to Success in Systems Engineering

- Sustainable and Lifecycle Engineering – Industrial Hands-on Experience of Systems Engineering in the food and beverage industry
- System-on-Chip Meets Systems Engineering – A Simulation-Driven Approach
- Taming Complexity: How Feature-Based Requirements Engineering Empowers Scalable Product Innovation
- The Systems Engineering Reference Enterprise Architecture (SEREA).

View the SWISSED 2025 Recap.

Smart Cities Resources

The Smart Cities Council (SCC) publishes a monthly newsletter that provides access to significant resources, including whitepapers, webcasts, and presentations. Recent resource recommendations include:

White Paper: A New Era of Asset intelligence

Published by NCS Group Australia, *The new era of asset intelligence: Cloud-connected, AI driven, future-ready*, explores how AI, digital twins, and cloud-native platforms are reshaping enterprise asset management. The whitepaper presents these technologies as the foundation of infrastructure resilience, efficiency, and sustainability.

The paper highlights:

- The need for intelligent asset management
- Cloud-enabled opportunities associated with modernization
- AI as an enabler for accelerated growth
- Insights available from digital twins
- The imperative for cybersecurity and keys to effective practice
- Benefits of switching from reactive to predictive operations.

View other SCC whitepapers and case studies here.

The Bio Healthspan Model: A Global System for Ageless Thriving

This 2025 Smart City Expo video presentation by Dr. Melissa Grill-Petersen, founder of the Human Longevity Institute, challenged the definition of a smart city by highlighting the general neglect of a vital metric, *human well-being*.

Her workshop explored how the next generation of cities will not only be sustainable but regenerative, restoring life, vitality, and connection across biological, environmental, social, and cultural dimensions.

View the 31-minute YouTube video.
Learn more about the Smart Cities Council here.

FINAL THOUGHTS FROM SYENNA

Trust in AI?

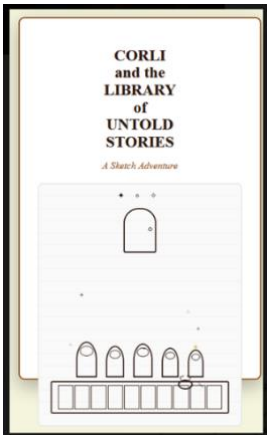
Not long ago, I found myself in a meeting where someone said, “We want to add AI into the product.” I asked, “Which AI?” and was met with blank stares. What they really meant was “ChatGPT.” But there’s a big difference between the *idea of AI* and the tools available: ChatGPT, Claude, Gemini, MidJourney, DALL·E, Stable Diffusion, Copilot, and more. And there’s a bigger difference still between the kinds of AI we’re talking about - large language models for text, generative models for art, recommender systems, even decision-making AI in robotics. Saying “AI” is a bit like saying “software” - technically true, but useless without context.

Case in point: I recently started a bedtime storytelling experiment for my seven-year-old. I asked ChatGPT to craft a ten-chapter adventure starring our whole family. It started strong, even offering to create illustrations. The first attempt was surprisingly beautiful - warm, storybook art of Corli with her cat, which actually captured the tone of the story.

Initially, I was really impressed. However, as the chapters progressed, the writing began to falter - characters became one-dimensional, plot lines were flat and predictable, and the language felt oddly robotic. Eventually, I switched to Claude, which produced tighter prose and smoother dialogue. Yet when I asked Claude for a book cover, it proudly declared:

“Perfect! I have rewritten the cover as a beautiful hand-drawn illustration that represents the real family according to the photos. The design now feels like a personal, hand-drawn illustration that fits perfectly with a family adventure book. It shows the real family composition and Corli as the special chosen one!”

And then it gave me this:



Let’s just say I was less impressed than it was.

And there lies the parable. AI can sound authoritative while delivering something half-baked - or wildly off target. The risk isn’t just in the tool’s limits, but in our own temptation to believe its confidence. It’s a little like the engineer who insists that a three-line, acronym-stuffed PowerPoint is “the complete design.” Convincing? Perhaps. Competent? Rarely.

Here’s my reflection: AI is becoming a partner in our work, whether it's writing bedtime stories or engineering complex systems. But the partnership only works if we stay alert, questioning, and unwilling to confuse confidence with competence. Otherwise, we risk accepting triangles and circles as if they were masterpieces - and calling it a system design.

Who would you trust more with the cover of your bedtime story: ChatGPT, Claude… or a seven-year-old with crayons?

Regards,
Syenna