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SE Evolution: Bridging Gaps for Progress

PERSPECTIVES ON RISK MANAGEMENT
Extracting new value from past research

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EMAIL: PPISyEN@PPI-Int.com

EDITORIAL STAFF

Editor
John Fitch

Editor-in-Chief
Robert Halligan

Managing Editor
René King

PRODUCTION STAFF

Marketing Manager
Benjamin Bryant

Graphic Designer
Matthew Wong

Marketing Coordinator
Rebeca Carneiro

Publishing Assistants
Trudy King
Shalani De Silva

PUBLISHER

PROJECT PERFORMANCE INTERNATIONAL

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

Tel Brazil: +55 12 9 9780 3490
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 July edition of our PPI SyEN Newsjournal! We're excited to bring you the latest updates and insights from the world of systems engineering.

Starting with the exciting news of the INCOSE Academic Equivalency Agreements, updates from SERC, and the INCOSE Q2 highlights, each showcases the steps that these organizations are taking to advance academic, research-oriented, and practical applications of systems engineering.

Read about the System Dynamics Society and its recognized sponsors for 2023, acknowledging the invaluable contributions of organizations and individuals to the dynamic field of system dynamics, a practical tool for systems thinking. Learn about updates to OMG Specifications, LemonTree Product Family, and the Object Management Group's approval of SysML v2 beta specification, promising to enable next-generation systems modeling and sophisticated engineering solutions. Updates to the Systems Engineering Tools Database highlight the continuous growth of the number of tools and vendors on this platform.

Collaboration and networking are key to expanding our expertise as professionals, and so we bring to you details of a Model-Based TEMP Strategy & Integrated Decision Support Key Workshop and a Call for Submissions for the AI4SE & SE4AI Research and Application Workshop. Don't miss the chance to engage with professionals and gain valuable knowledge at the Western States Regional Conference, IEEE VIS 2023, and Capella Days 2023.

This month's edition also features a thought-provoking feature article: 'PPI SyEN Perspectives on Risk Management' by PPI's John Fitch, exploring crucial research questions about risk categorization, non-deterministic behavior representation, and the relationship between different models.

We wrap up with recommended resources from PDMA kHub and the insightful Agility in the Future of Systems Engineering article from Insight Practitioners Magazine. Finally, hear from Syenna on her thoughts on the power of the Compound Effect.

We hope you find this edition informative and inspiring. Stay tuned for more news and developments in systems engineering in the August edition of PPI SyEN, where we will showcase highlights from the just-past INCOSE IS 2023!

Regards,

René

Managing Editor, PPI SyEN

SYSTEMS ENGINEERING NEWS **4**
Recent events and updates in the field of systems engineering

CONFERENCES, MEETINGS & WEBINARS **16**
Events of relevance to systems engineering

FEATURE ARTICLE **24**

PPI SyEN Perspectives: Risk Management 24
By John Fitch (PPI Presenter and Principal Consultant)

SYSTEMS ENGINEERING RESOURCES **35**
Useful artifacts to improve your SE effectiveness

FINAL THOUGHTS FROM SYENNA **40**

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Project Performance International (PPI) seeks top-notch SE Professionals worldwide to meet the skyrocketing demand for our training and consulting. Opportunities exist for online and in-person delivery in most regions. A rigorous qualification process applies; this itself is career-boosting.

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PPI Systems Engineering Newsjournal (PPI SyEN) seeks:

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

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

SYSTEMS ENGINEERING NEWS

Recent events and updates in the field of systems engineering

INCOSE Academic Equivalency Agreements

INCOSE has announced that Academic Equivalency agreements have been approved for courses at two USA universities, Southern Methodist University (SMU) and the University of Maryland Global Campus (UMGC). Students who excel in university courses which have been assessed to have Academic Equivalence (AcEq) are allowed to bypass the certification knowledge exam when applying for Associate Systems Engineering Professional (ASEP) and Certified Systems Engineering Professional (CSEP) certification. The assessments that these students received through their university coursework have been recognized by the INCOSE Certification Program as an equivalent alternative to the standardized knowledge exam developed by INCOSE.

To participate in this program, a university needs to be a member of the INCOSE Corporate Advisory Board (CAB) or the local INCOSE chapter equivalent. There are no additional fees linked to securing Academic Equivalence for CAB members. Universities that are members of local chapter affiliates have a low-cost path to participate in the Academic Equivalency program. Academic Equivalency coursework may be offered in any language.

Learn more about the INCOSE Academic Equivalency process here and in the Certification Blog. Read the INCOSE press release.

System Dynamics Society Recognizes 2023 Sponsors

In the run up to the 2023 International System Dynamics Conference (ISDC 2023), scheduled for 23-27 July in Chicago, Illinois, USA, the System Dynamics Society (SDS) has been recognizing the contributions of its many sponsoring organizations for their partnership in advancing the practice and global reach of system dynamics. PPI SyEN echoes that recognition and encourages our readers to check out these organizations and their capabilities, knowledge and resources in this field.

Ventana Systems, Inc.

Ventana Systems has sponsored the SDS and the annual Conference for multiple years. Ventana is a Champion Sponsor for ISDC 2023. Ventana helps organizations in complex environments make better decisions through a combination of high-quality models and advanced treatment of data. Ventana's solutions include:

- Vensim®: The software of choice for thousands of analysts, consultants, and researchers for building high quality, quantitative simulation models. Vensim integrates the tools for developing, testing, communicating, and distributing models. Capabilities include stock and flow and causal loop diagramming, textual model construction, immediate visualization of simulation results, Monte Carlo sensitivity analysis and many more. Vensim is available worldwide in a range of editions. The fully functional Personal Learning Edition is used by thousands of current and former students and is free for academic/personal use.

- Ventity®: Complementary software to Vensim to address problems with fixed arrays, enabling dynamic structural changes and/or large-scale disaggregation.
- Ventana Consulting: Ventana's primary focus is strategic modeling for corporations and government and building public sector models that improve system performance and enable cross-organizational communication and conflict resolution.

isee systems

isee systems is a multi-year conference supporter and SDS sponsor. The company provides dynamic modeling software that empowers users to take a big picture approach to complex problems, make effective decisions, avoid unwanted outcomes, and anticipate the large-scale impacts of various actions. For over thirty years, isee systems has helped thousands of professionals, researchers, and students see their world from a new perspective. Its flagship products, Stella Architect and Stella Professional, support users in diverse domains such as business, education, research, energy, health, agriculture, manufacturing and conservation.

ISDC 2023 presenters who build their models in Stella may publish their models on the isee Exchange™ where fellow presenters and attendees can discover and explore their work.

Credit Human

Credit Human is a Champion Sponsor for ISDC 2023 and sponsors the Environment and Resources Thread. Credit Human backs up their commitment to the global environment by the energy-efficient design of their headquarters and by offering a lending program to help people finance solar panels to increase the energy efficiency of their homes.

Learn more about SDS sponsors.

Updates from SERC

The Systems Engineering Research Center (SERC) updates from June 2023 included highlights from multiple research events and initiatives. Here is a sample:

Research Workshop: Information Models and Ontologies to Enable Digital Engineering
On 23-24 May 2023, the SERC and MITRE sponsored an in-person research workshop on Information Models and Ontologies to Enable Digital Engineering. This workshop gathered 66 participants, including key stakeholders and experts from government, federally funded research development centers (FFRDCs), University Affiliated Research Centers (UARCs), industry, and academia. The participants focused on promising approaches to design and implement ontologies and existing bodies of knowledge to support the development of ontologies.

The workshop sought to grow the capability for semantically rich design reasoning across abstraction levels and disciplinary domains. Specific objectives of the workshop were to:

- *Understand the current state of practice and research.*
- *Identify a small number of key research questions to address.*

The workshop highlighted a need to convene smaller, focused groups to work together on three topics:

- *Foundations for applied computational ontology development, evolution, and use across real*

DoD programs.
- *Defining and describing the value of applied computational ontologies to Digital Engineering Practice.*
- *Critical dimensions for operationalizing applied computational ontologies and transitioning them to scale.*

Read the full workshop report.

Applying Systems Engineering to Acquisition
On 10-11 May 2023, numerous SERC experts shared their insights at the 20th Annual Acquisition Research Symposium *in Monterey, California, hosted by the U.S. Naval Postgraduate School (NPS), a SERC collaborating university.*

Topics addressed included:

- *Exploring Program Archetypes to Simplify Digital Transformation (*David Long, Nicole Hutchison*)*
- *Digital Engineering Enhanced T&E of Learning-Based Systems (*Peter Beling, Laura Freeman, Jitesh Panchal, Paul Wach*)*
- *Decision Making for Additive Manufacturing in Sustainable Defense Acquisition (Dan DeLaurentis)*
- *Model-based Approach in Defense Portfolio Management: Data Preparation, Analysis, and Visualization of Decision Spaces (Cesare Guariniello)*
- *Joint All-Domain Command and Control (JADC2) Opportunities on the Horizon (Dinesh Verma, Philip Antón, Roshanak Nilchiani)*
- *Calculating Return on Investment (ROI) in a Department of Defense (DoD) Context (Robin Dillon-Merrill)*
- *An Integration Framework for Digital Transformation of DoD Systems Engineering and Acquisition (Tom McDermott)*
- *A Reference Architecture for a Policy Test Laboratory (Zoe Szajnfarber, William Rouse, Alejandro Salado)*

Read the full article.

Additional Research Reports
Three additional research reports were highlighted in the latest SERC research update:

- Digital Transformation in Acquisition: Using Modeling and Simulation to Advance the State of Practice*. Explores how to convert knowledge gained through digital transformation into effective workforce training.*
- Systems Engineering Modernization Policy, Practice, and Workforce Roadmaps *Outlines an integrated approach to implementation of systems engineering modernization within weapon systems acquisition.*
- SE Capstone Marketplace 2022-2023*. Develops the next generation of systems engineers by annually connecting students with subject matter experts in the DoD and other government agencies to resolve context specific problems.*

Read the research report roundup.

Other SERC related news
The research update also included additional SERC news items:

- An Interview with Dr. Nicole Hutchison, Stevens Institute of Technology *– Profiles in Systems*

Engineering.

- Good Reads about Systems – *Recommended readings from SERC leadership, researchers, and community.*

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

INCOSE Q2 Highlights

The 2Q2023 edition of the INCOSE Members Newsletter included highlights from a variety of strategic and technical initiatives and activity reports for chapters around the world. Here is a small sampling of such activities.

A Message from the Executive Directory, Steve Records
The new INCOSE Executive Director announced the launch of a new strategic planning process that will be kicked off by a member survey.

Open INCOSE Board Positions
INCOSE is seeking volunteers to fill a variety of open positions on the Board of Directors:

- President-Elect
- Chief Information Officer
- Treasurer
- Director for Outreach
- Sector Director for Asia-Oceania

Volunteer here.

INCOSE Certification Update
With the publication of the Fifth Edition of the INCOSE Systems Engineering Handbook (SEH) in July 2023, efforts are underway to beta test and refine the certification exam to match the new handbook content. For the remainder of 2023, INCOSE is offering a hybrid examination on the content that is comment to V4 and V5.. Learn more here. Under a 2023 trial program, applicants for Expert Systems Engineering Professional (ESEP) certification may demonstrate their technical leadership and professional development in written form, rather than through oral interviews.

Calling All Systems Panel Discussion Series.
INCOSE has launched a panel discussion series titled Calling All Systems with two events conducted thus far:

31 March - The Future of MBSE.
Barclay Brown, INCOSE's Chief Information Officer, chaired a panel composed of six thought leaders in the field of MBSE, who discussed topics such as:

- What is the answer to "what is MBSE?" in say five or ten years?
- MBSE as multi-disciplinary approach to engineering
- How AI can empower (or even revolutionize) SE and MBSE
- How MBSE will change with the advent of SysML v2
- How MBSE will enable the fulfilment of the SE Vision 2035

View on the INCOSE YouTube channel.

11 May - Product Line Engineering: Are You Missing a Piece in Your Digital Engineering Puzzle?
Dr. Barclay Brown chaired a panel composed of four thought leaders in the field of Product Line Engineering (PLE), who explored the role of PLE in completing the Digital Engineering puzzle.

Engineering enterprises are steadfastly advancing into the new age of Digital Engineering, with digital transformations, digital twins, digital threads, digital assets, model-based systems engineering, digital simulations, and more. A recent study showed that the number of product and system configurations in a product line - or system family - is largely viewed as the leading source of engineering complexity. Feature-based PLE according to the recently released ISO 26580 standard is the modern digital engineering approach that significantly reduces this leading source of engineering complexity.

View on the INCOSE YouTube channel.

Diversity, Equity & Inclusion (DEI)
The INCOSE DEI team reported on a workshop conducted during the 2023 International Workshop, titled *Modeling Cognitive Diversity Across the System Lifecycle*. The focus of the workshop was how to best tap the unique abilities of neurodivergent individuals without classifying individuals as neurodivergent or neurotypical.

In April, the Empowering Women Leaders in SE (EWLSE) initiative conducted a workshop during the EMEA WSEC Conference 2023 held in Seville, Spain in April and supported Society of Women Engineers' (SWE) conference in Bengaluru, India.

Sector and Chapter Updates
A small sample of the second quarter highlights from INCOSE sectors and chapters include:

- Korea (KOSSE): Conducted the 2023 Korea SE Spring Symposium in June, exploring the topic, *Future Industry, Global Urban Ecosystem*.
- EMEA Sector: Provided an overview of the EMEA WSEC 2023 event held in Seville, Spain in April. Noted that this conference included participants from 22 nations, speaking more than 25 languages.
- Nordic SE (NoSE): Twenty individuals participated in the Nordic Systems Engineering Tour held in Oslo, Norway in May. See program here.
- UK: Preparing for ASEC 2023 to be held in Liverpool, UK on 21-22 November. Released a Japanese translation of *Don't Panic! The Absolute Beginners Guide to MBSE.*

Working Group and Initiative Updates
Various working groups and initiatives reported their progress, including:

- Digital Engineering Information Exchange Working Group (DEIXWG): The Standards Framework (SF) team is forming an ISO working group to define standards for digital engineering concepts and vocabularies. The Digital Viewpoint Model (DVM) team is validating the DVM Concept Model. Both product areas are set to publish technical papers in 2023.
- Information Communication Technology Working Group (ICTWG): Participated in the International Wireless Communication Expo (IWCE) 2023 that was held in March in Las Vegas, Nevada, USA.
- Professional Development Portal: Adding more user capabilities (new supporting pages, advanced search, and My Bookshelf functions) in preparation for the Full Operational Capability (FOC) V1.0 planned for the International Symposium 2023.
- Virtual Community: Focused on enhancing existing Virtual Community options and creating new capabilities. Applying SE disciplines to develop these services.

SYSTEMS ENGINEERING NEWS

For details on these items and more topics of interest, download the full INCOSE Q2 2023 Member Newsletter if you are an INCOSE member; if not, consider becoming one!

Object Management Group (OMG) Specification Updates

The Object Management Group® (OMG®) is an international, open membership, not-for-profit technology standards consortium representing government, industry, and academia. OMG has spearheaded the development of over 250 standards. Recent updates include the following:

- Precise Semantics for Uncertainty Modeling (PSUM), 1.0 beta (April 2023)
- Risk Analysis and Assessment Modeling Language (RAAML), 1.0 (April 2023)
- FACE Profile for UAF (FACE), 1.0 (April 2023)
- DDS Extensions for Time Sensitive Networking (DDS-TSN), 1.0 beta (April 2023)
- Automated Source Code Resource Sustainability Measure (ASCRSM), 1.0 beta (April 2023)
- Decision Model and Notation (DMN™), 1.5 (June 2023)
- Command and Control Interface for Navigation Systems (C2INAV), 1.2 (June 2023)
- Alert Management Service (ALMAS), 1.3 (June 2023)
- APIs for Knowledge Platforms (API4KP), 1.0 beta 2 (June 2023)

View the OMG® Specifications Catalog to search for other standards.

Learn more about OMG®.

LemonTree Product Family Grows

LieberLieber's LemonTree product family continues to expand since its launch six years ago. When introduced, the primary function of LemonTree was to compare and merge different versions of system models. LemonTree's 3-way comparison algorithm takes into account the graph structure of the models and thus allows an accurate comparison between two versions. Recent modernization of the data access layer has created a new technical core for LemonTree that enables on-going development of the product family.

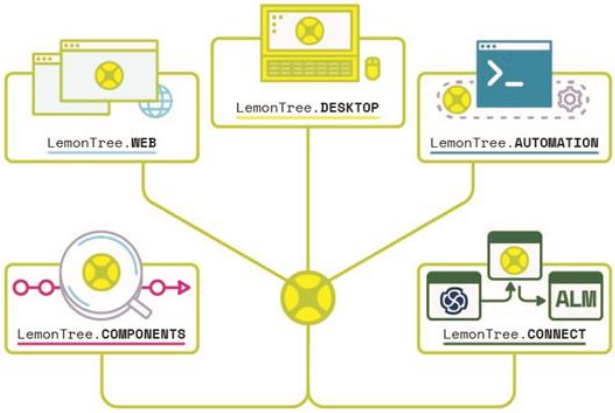
Use cases for LemonTree include:

- Version management of models with state-of-the-art versioning systems
- Build management – Continuous Integration of models
- Change management and reviews of models
- Release Management for Models in Product Line Development

Current LemonTree products include:

- LemonTree.Desktop: Diff/Merge functions.
- LemonTree.Web: Functionality like LemonTree.Desktop, available as web application via browser.
- LemonTree.Automation: use in the context of a build server pipeline (without GUI).
- LemonTree.Components: Allows the division of a model created with Enterprise Architect into different sub-models or components.

- LemonTree.Connect: Synchronization of ALM tools (Codebeamer, Polarion) and Enterprise Architect.



Investigate the LemonTree product family. Download the LemonTree 3.3 overview.
Learn more about LieberLieber.

Object Management Group Approves SysML v2, Beta Specifications
Object Management Group SDO
Mon, July 10, 2023 at 11:00 PM GMT+10·7 min read
New specifications enable next-generation systems modeling

BOSTON, MA, July 10, 2023 (GLOBE NEWSWIRE) -- Today, international technology standards organization Object Management Group® (OMG®) announced it approved the Systems Modeling Language (SysML) version 2 beta specifications. These include: the Kernel Modeling Language (KerML) specification version 1.0 beta, the Systems Modeling Language (SysML) specification version 2.0 beta, and the Systems Modeling Application Programming Interface (API) and Services specification version 1.0 beta.

The specifications enable next-generation systems modeling with improved precision, expressiveness, consistency, usability, interoperability, and extensibility over SysML version 1. The submission concluded five years of development, resulting in the three specifications and an open-source pilot implementation to validate them. The SysML v2 Submission Team, with co-leaders Sandy Friedenthal and Ed Seidewitz, included representatives from more than 80 organizations.

“SysML v2 enables the modeling of increasingly complex systems as part of the evolving practice of model-based systems engineering,” said Friedenthal. “Our team had tremendous talent from various domains, including end-users, academia and researchers, and tool vendors.”

SysML v2 extends KerML to include concepts for modeling systems with deeply nested hierarchies of structure, behavior, requirements, and cross-cutting relationships. It also enables developers to specify analysis and verification cases. “KerML defines a new metamodel to provide the foundation for SysML v2,” said Seidewitz. “Its formal semantics specified as first-order logic, with 4D semantics of temporal and spatial extent, provide a new level of expressivity and precision.”

SysML v2 provides complementary textual and graphical representations of the underlying model, facilitating improved system understanding. A standard API and associated set of services to navigate, query, and update the model enables interoperability with other tools and software applications throughout the life cycle of system development.

OMG anticipates final adoption of the three specifications in 2024. OMG specifications address middleware, modeling, and vertical domain frameworks. All OMG specifications are available from the website.

SysML v2 Tool Vendor Announcements

- **CATIA R&D Cyber Systems Vice-President, Dassault Systèmes, Frédéric BOURCIER -** "We are witnessing a strong adoption of Model Based Systems Engineering by the Industry to imagine next generations Cyber Systems. SysML v2 will accelerate this trend. We, at Dassault Systemes, through the work with the Object Management Group, are closely collaborating with the SysML Submission Team (SST) to define the specifications. We are actively investing in SysML v2 with CATIA Magic to provide Virtual Twin Experiences for cyber systems modeling and simulation leveraging the next generation SysML."
- **IBM Sustainability Software, Sky Matthews, CTO, Engineering Lifecycle Management and Distinguished Engineer -** "As design complexity continues to increase, the role of systems engineering becomes ever more critical to the development of sustainable products and systems. IBM looks forward to supporting the effort driven by the OMG, and leveraging our experience in integrated engineering lifecycle management to deliver a SysML v2 solution that can advance the realization of digital engineering of complex systems."
- **Imandra, Jamie Smith, VP of Product Management -** "SysML v2 is an important step forward for Model Based Systems Engineering. Its rigorous formal semantics empowers us at Imandra to integrate our symbolic AI tools enabling formal verification and automated reasoning for SysML v2 models at scale."
- **IncQuery, Ákos Horváth, CTO -** "IncQuery is proud to have been part of the SysML v2 effort. As our next step of this exciting journey, we will enable our flagship family of products, the IncQuery Suite to commercially support SysML v2 in various ways, including model quality checks and validation reports, bridges for version migration and documentation generation, all integrated with current and future generations of the OpenMBEE platform. Follow us into the future of MBSE!"
- **Intercax, Manas Bajaj, PhD, Co-Founder and Chief Systems Officer, OMG Systems Modeling API & Services FTF Co-Chair, Submission Lead, RFP** - **"**SysML v2 language and API & Services are foundational for enterprise-scale digital engineering. Syndeia, our digital thread platform for model-based engineering, includes production support for Systems Modeling API & Services. Users can build live digital threads integrating SysML v2 models with models/data in enterprise applications, such as PLM, CAD, ALM, Simulations, Projects, and V&V. Intercax is excited to lead and support the development of Systems Modeling API & Services and SysML v2 language at OMG and bring cutting-edge digital thread capabilities for SysML v2 to the market in the Syndeia platform."

- **Mgnite Inc**., **Hisashi Miyashita, CEO -** "Mgnite has made significant contributions to the standardization of SysMLv2, particularly in visualization, through the pilot implementation. We strongly believe that SysMLv2 should be recognized as the next-generation MBSE standard. By leveraging these results, we are preparing to launch our product, called Mg, which aims to enhance modeling productivity and facilitate seamless integration with various tools. We are truly honored to be part of the excellent teams driving these fundamental innovations in MBSE."

- **PTC, Patrick Ollerton, Product Manager -** "PTC has been an active participant in the planning and development of OMG's new standard for MBSE, SysML 2.0. In support of this important industry milestone, PTC Modeler 10 and future releases will include capabilities to enable companies to design, verify and maintain complex, safety critical systems using SysML 2.0."
- **Qualtech Systems, Inc. (QSI), Deepak Haste, Senior Director of Engineering -** "As a member of the SysML v2 Submission Team (SST), QSI is excited at the release of the SysML v2 beta specifications. QSI, an industry-recognized vendor for integrated diagnostics/prognostics tools and fault management (FM) solutions, is committed to adopting SysML v2 as the main conduit of interoperability between systems engineering (SE) and QSI's TEAMS fault management (FM) tools. Given that QSI's TEAMS toolset is used by multiple NASA centers to provide diagnostic capabilities and reliability assessment, NASA has recognized the potential of using SysML v2 to facilitate fault resilient architectures in the early design stages of complex systems such as the Space Launch System (SLS) and the Lunar Gateway."
- **Siemens, Dale Tutt, Vice President of Industry Strategy, Siemens Digital Industries Software -** "With SysML v2 based solutions, customers will be able to develop their products in a true multi-domain environment – mechatronic, electronics and software systems – that will help them develop new products faster." Refer to Siemen's statement of how SysML v2 fits into the future of MBSE.
- **Sparx, J.D. Baker, Sparx Ambassador and OMG Architecture Board Member -** "Sparx Systems has been closely following the development of SysML v2. Now that the specifications are in Finalization, Sparx Systems will work to provide Enterprise Architect users with the specified capabilities."
- **Tom Sawyer Software, Janet Six, Ph.D., Senior Product Manager -** "Tom Sawyer Software is excited about the approval of the SysML v2 beta specification. This presents a unique opportunity for us to continue serving the needs of the engineering community with our graph visualization capabilities and contribute to its continued development."
- **Vitech, Daniel Nguyen, SysML v2 Lead -** "Vitech is excited for the release of the SysML v2 beta specifications and implementing it in our evolving product portfolio. The benefits to industry include new capabilities such as the global inclusion of time-based variability, textual syntax, and a standard API for model interchange and interoperability. Vitech looks forward to releasing a conformant SysML v2 implementation that is built on top of our semantically precise natural language architecture that guarantees model consistency and data integrity."

About OMG

The Object Management Group® (OMG®) is an international, open membership, not-for-profit technology standards consortium representing government, industry, and academia. OMG Task Forces develop enterprise integration standards for a wide range of technologies and an even more comprehensive range of industries. OMG's modeling standards enable robust visual design, execution, and maintenance of systems, software, and other processes. Visit www.omg.org for more information.

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CONTACT: Karen Quatromoni Object Management Group SDO 978-855-0412 Karen@omg.org

Updates to SE Tools Database (SETDB)

The universe of systems engineering tools is very large and continuously expanding. The Systems Engineering Tools Database (SETDB), developed by PPI in partnership with INCOSE, tracks that expansion. Recent SETDB updates, including both new tools and updates to existing tools, include:

Vendor: Apptio

- ApptioOneMX: A family of tools that establish repeatable and accurate planning, budgeting and forecasting processes while benchmarking against peers for continuous optimization and planning of IT spending.
- AptioOne: Unifies financial and operational data into a model built on the industry-standard taxonomy of cost categorization. Utilizing sophisticated allocation rules along with focused metrics and KPIs, it helps answer strategic questions about investments and accelerate budgeting and forecasting.
- ApptioOne Plus: Unlocks the resources to accelerate business strategies by streamlining applications and operations and accelerating planning cycles. It deepens business unit partnerships with a collaborative approach to investments based on cost transparency.
- ApptioOne Demand: Enables the capture of aggregated service demand in order to right-size resource planning and maximize investments. By delivering precise unit rate analysis in a simple and clear format, ApptioOne Demand increases predictability while improving organization agility.
- ApptioOne Benchmarking: Provides self-service peer comparisons of your IT spend over time, enabling an ongoing process for tracking performance, validating decisions, and identifying areas for improvement.
- ApptioOne Billing: Enables comprehensive service invoicing through common ERP solutions to better recover costs, understand service value, and strengthen consumer-provider relationships across an organization.
- Targetprocess: Software platform intended for teams for adopting and scaling Agile in all its forms. It assists programs with aligning the development resources to business outcomes and to plan and track value delivery for projects and products.

Vendor: Critical Logic, Inc.

- IQM Studio: The technology at the heart of our Integrated Quality Management process that's comprised of our IQM Modeling and IQM Scripting features.

Vendor: Dassault Systemes

- Dymola: Based on open Modelica language, Dymola is a solution for the modeling and simulation of integrated and complex systems within automotive, aerospace, robotics, and more. It has a unique multiple-engineering capability that enables physical models from different domains to be simulated.

Vendor: Eclipse Foundation AISBL

- Capella: A comprehensive, extensible, and field-proven open source MBSE tool and method to successfully design systems architecture. Capella relies on Arcadia a field-proven model-based methodology that covers each engineering phase.
- DARC Viewpoint (Cybersecurity Assets & Threats Modeling Analysis): Add-on to support effective co-engineering between systems and cybersecurity engineers teams when performing the following tasks: Identify assets and trust boundaries; Identify threats; Characterize security needs.
- Filtering: An open-source add-on to filter Capella models.
- Property Values Management Tools (PVMT): This open-source add-on allows end-users to easily define their own specific properties on Arcadia concepts, value these properties for each element, and automatically change the graphical aspect of model elements in diagrams.
- Python for Capella: Python4Capella allows you to interact with your Capella model using Python. You will be able to create Python scripts to read and write from/to your Capella model.
- Requirements Viewpoint: This open-source add-on allows importing a set of requirements from a ReqIF file (Requirement Interchange Format / OMG Standard) to Capella.
- System to Subsystem Transition: This open-source addon is a System to SubSystem Transition. It initializes a new Capella project from an existing model. This transition extracts suitable model information from a selected Capella Component and manages top/down update propagation.
- XHTML Documentation Generation: This open-source addon enables the end-user to generate an HTML website from a Capella project (e.g: In-Flight Entertainment (IFE)).

Vendor: ESTECO spa

- modeFRONTIER: The leading software solution for simulation process automation and design optimization.
- VOLTA: VOLTA is an innovative enterprise platform for Simulation Process and Data Management (SPDM) and Design Optimization.

Vendor: Method Park by UL Solutions

- Stages: Supports your process journey from initial modeling to integrated process execution at a large scale. Compliance management and feedback capabilities keep your transformation on track and secure its success. Helps you manage complexity with proven process modelling practices.

Vendor: Obeo

- Team for Capella: enables simultaneous authoring of Eclipse Capella models by your team members.
- Cloud for Capella: With Cloud for Capella, benefit from a pre-installed Capella environment that is already integrated with useful add-ons.
- Publication for Capella: Connect Eclipse Capella with Requirements Management Systems.
- SysML Bridge for Capella: Automatically transforms Capella models in SysML (and vice versa) according to rules that can be adapted to your context.

Vendor: Synopsis Inc.

- Silicon Lifecycle Management (SLM): SLM is a family of products that improve silicon
- operational metrics that is built on a foundation of enriched in-chip observability, analytics and integrated automation. Monitors enable deep insights from silicon to system. Data is gathered at every opportunity for analysis and feedback.
- PrimeSim SPICE: A high-performance SPICE circuit simulator for analog, RF, and mixed-signal applications. PrimeSim SPICE offers a unique multi-core/multi-machine scaling and heterogeneous compute acceleration on GPU/CPU delivering faster runtime with sign-off accuracy.
- PrimeSim HSPICE: PrimeSim HSPICE is the industry's most popular and trusted for comprehensive and accurate circuit simulation that offers chip foundries-certified MOS device models with state-of-the-art simulation and analysis algorithms.

Vendor: UNICOM Systems, Inc.

- UNICOM® Finance: provides streamlined consolidation and budgeting, insightful analysis and forecasting, and valuable, flexible reporting in one easy-to-use, web-deployable package.

Vendor: Vector Informatik GmbH

- PREEvision: Model-based electric/electronic (E/E) development environment that supports the ever-increasing sharing of data within vehicles and to systems outside of the vehicle and supports the entire E/E development – from architecture design all the way through to the final wiring harness.

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

Access the SETDB website.

"

If theory and practice do not coincide, either the theory is wrong, or the practice is wrong. Look at results to reach a conclusion.

Robert Halligan

CONFERENCES, MEETINGS & WEBINARS

Model-Based TEMP Strategy & Integrated Decision Support Key Workshop

Registration is open for the Model-Based TEMP Strategy & Integrated Decision Support Key Workshop to be held in Marina Del Rey, California, USA on 2-3 August 2023.

Abstract:
The United States (US) Department of Defense (DoD) and its supporting industry, research, and academia partners have proposed using Digital Engineering (DE) methods and tools to update traditional systems engineering (SE) and test and evaluation (T&E) practices to improve acquisition outcomes and accelerate traditional processes.

One critical element of the T&E process is the development of the Test and Evaluation Master Plan (TEMP), in which the program office, systems engineers, and testers come together to document an adequate test and evaluation strategy that spans major program milestones. DE provides opportunities to enhance the TEMP by directly incorporating data and models into the process of documenting the test strategy and program.

A new core element of the TEMP is the Integrated Decision Support Key (IDSK) and Evaluation Matrix family of related tables (e.g., requirements, evaluation measures and metrics, key program decisions, test events, etc.). The IDSK is a single table linking programmatic decisions to the test data required to support them. The Evaluation Matrix is a table linking high level system performance metrics to the test data required to support them.

This in-person workshop will explore Digital Engineering, TEMPs, IDSKs to identify best practices, new methods and tools, and build consensus on where digital transformation will have the largest impact on T&E processes and documentation.

Workshop objectives:
Gather the T&E community from across the DoD, industry, and academia to discuss current state of capabilities, research gaps, and synergies, and develop a common vision for digitally transforming T&E practices. Presentations will include demonstrations of tools and practices. Topics will include:

- IDSK examples for T&E Across the Acquisition Lifecycle
- Approaches to Model-Based IDSK
- Best Practices in Digital Transformation
- Linkages between legacy system performance, modeling, performance assessment, and decision-support data/information
- IDSK application across the Acquisition Lifecyle and integration of Digital Twins

Register here.

Call for Submissions: AI4SE & SE4AI Research and Application Workshop

The USA Systems Engineering Research Center (SERC) will host the AI4SE & SE4AI Research and Application Workshop on 27-28 September at The George Washington University in Washington, DC. The theme of this workshop is *Balancing Opportunity and Risk: The Systems Engineer's Role in the Rapid Advancement of AI-Based Systems*.

The Call for Submissions seeks abstracts from government, industry and academia for presentations and panels to explore the exciting advancements and challenges in the field of artificial intelligence (AI) and systems engineering (SE). Topics of interest fall into five tracks:

- SE4AI: Leveraging systems engineering principles and methodologies to develop robust and efficient AI systems.
- AI4SE: Application of AI in systems engineering processes, enabling enhanced decision-making, optimization, validation, and verification.
- Human-AI Teaming: Collaboration between humans and AI, exploring how to maximize synergistic potential while addressing ethical and social implications.
- Trustworthy AI: Critical aspects of safety, reliability, and ethical considerations in developing and deploying AI systems.
- Digital Engineering & SE Workforce Development: Evolving role of digital engineering and its impact on the systems engineering workforce, fostering skill development and adaptation in an AI-driven landscape.

Abstracts are due by 8 August. All abstracts must be cleared for public release with unlimited distribution (Distribution A); participation is limited to U.S. citizens.

Download the Call for Abstracts for submission details.

Registration Open for INCOSE Western States Regional Conference

Registration is open for the INCOSE Western States Regional Conference (WSRC 2023) that will be held in Richland, Washington, USA over 14-16 September 2023. The theme of this conference is *Energy – Information – Sustainability*.

The initial program highlights the three technical tracks that comprise the theme:

- Energy: Cross-Domain Solutions, Systems Reliability & Resiliency, Systems Engineering & Agile, Human Systems Integration, Operational Technology (OT), Clean energy
- Information: Information Communications Technology (ICT), Systems Engineering/Education, SE in Early-Stage Research and Development, Artificial Intelligence (AI) opportunities and risks, Case studies (experience of success and failure)
- Sustainability: Cyber Security, Innovation, Prototyping and deployment, Machine Learning models and uses in SE, Energy management

Register here.
Learn more about WSRC 2023.

IEEE VIS 2023 - Visualization and Visual Analytics

The IEEE will host the Visualization and Visual Analytics (VIS 2023) conference in Melbourne, Victoria, Australia on 22-27 October. VIS 2023 will convene an international community of researchers and practitioners from universities, government, and industry to exchange recent findings on the design and use of visualization tools.

The keynote speakers for VIS 2023 will be Dr. Drew Berry, WEHI Australia, and Anders Ynnerman, Linköping, University Sweden, presenting on *Visualizing the Chemistry of Life* while demonstrating state of the art visualization technologies.

Keynote Abstract by IEEE:
The keynote presentation will take you on a journey through the creative storytelling and technical challenges of bringing multi-scale visualizations to giant-sized fulldome screens. Our immersive 360-degree film, 'Chemistry of Life', launched in 2023, presents an ultra-high resolution stereo 8K experience that explores the life around us from what we experience every day to the hidden microscopic realms of the molecular. The production takes you on a journey into your inner universe, combining advanced scientific visualizations to bring you into the dynamic, molecular world we all carry within us. We explore the powerhouses of cells, mitochondria, and learn how chemical processes connect us to all other life forms on Earth. Throughout this presentation, we will discuss the technical and artistic challenges we faced, as well as the scientific research that informed our approach. Our hope is that this film will inspire a deeper appreciation for the world around us and encourage us all to continue exploring and learning about the mysteries of our universe.

Fifteen workshops, many recurring annually, are currently planned to provide informal settings to discuss emerging topics:

VIS4DH: 8th Workshop on Visualization for the Digital Humanities
The VIS4DH workshop brings together researchers and practitioners from the fields of visualization and the humanities to discuss new research directions at the intersection of visualization and (digital) humanities research.

VISxAI: 6th Workshop on Visualization for AI Explainability
The role of visualization in artificial intelligence (AI) gained significant attention in recent years. With the growing complexity of AI models, the critical need for understanding their inner-workings has increased. Visualization is potentially a powerful technique to fill such a critical need. The goal of this workshop is to initiate a call for “explainables” / “explorables” that explain how AI techniques work using visualization. We believe the VIS community can leverage their expertise in creating visual narratives to bring new insight into the often-obfuscated complexity of AI systems.

TopoInVis: Workshop on Topological Data Analysis and Visualization
The IEEE VIS Workshop on Topological Data Analysis and Visualization aims at being an inclusive forum for the fast dissemination of the latest results in theory, algorithms, and applications of topological methods for the interactive and visual analysis of data. This workshop is a remodeling of the established TopoInVis workshop series, with the goal of being more diverse (in terms of applications) and inclusive (in terms of communities), with a clear will to open to other members of the visualization community potentially interested in topological methods, or experts in topological methods from other communities willing to experiment with interactive and visual applications.

VAHC: 14th Workshop on Visual Analytics in Healthcare
The Workshop on Visual Analytics in Healthcare is the premier research event exploring the

application of data visualization and visual analytics to biomedicine. VAHC 2022 will bring together medical experts, leading scientists, and visionaries to discuss opportunities and challenges in using visual analytics techniques to help patients, clinicians, public health researchers, and others leverage the power of complex health datasets.

NLVIZ Workshop: Exploring Research Opportunities for Natural Language, Text, and Data Visualization
Natural language processing (NLP) has evolved as a promising field for visual analysis and communication. The applications of NLP for supporting various aspects of the visual analysis workflow include helping readers take away key information from charts or dashboards, supporting interaction modalities that help people naturally "ask" questions of their data, generating data summaries and insight reports, and exploring ways to enrich the semantics of data, among others. With data-driven communication being more important than ever, how do we treat text and language as first-class citizens in helping people see and understand data? How do we couple language and charts to make the data more accessible to a variety of audiences with different needs, capabilities, and skills? As the field of NLP matures, computers now have an increased capability of interpreting language and engaging in conversations with people. But can NLP techniques and interactive visualizations work in concert to support an analytical conversation? As the platforms and channels for exploring data go beyond the desktop to chat interfaces, augmented and virtual reality environments, mobile, and large displays, how do we better understand user intent, modalities, and context to make these interactions more delightful and meaningful?

Addressing these questions calls for research at the intersection of human-computer interaction, information visualization, and NLP, three fields with natural synergies but rather infrequent meetings. This workshop will assemble an interdisciplinary community that promotes collaboration across these fields, explore research opportunities and challenges, and continue to establish an agenda for NLP research specifically for data visualization.

Visualization for Social Good
Data is an inescapable part of our lives: it guides commerce, government, and technology, and increasingly determines what lives we can (or cannot) live. Data visualization has a special place within this emerging, data-driven, order: as a tool to inform or persuade mass audiences, guide or enlighten the specialist, or give a voice to the unheard. We therefore pose the question: how can visualization, and visualization research, help us build the worlds we want? This theme, building just and equitable futures, is the motivation behind the third edition of our recurring workshop at IEEE VIS: Visualization for Social Good. Our workshop series has been successful not only at showcasing high-quality socially-minded visualization research from diverse voices, but also in starting important conversations around the role of data visualization as a force for good in society at large. We invite you to join our workshop and growing community on Visualization for Social Good, to navigate conversations about the role of data in human dignity and flourishing.

Visualization for Pandemic and Emergency Responses Workshop (Vis4PandEmRes)
There have been many VIS R&D activities for supporting COVID-19 pandemic responses, many of which have not yet become public knowledge. This workshop will enable VIS researchers and practitioners to share their experience, knowledge, and reflection and offer their insight and foresight about the role of VIS in pandemic and emergency responses. It will also allow the VIS community to compile one or more archivable collections of records about various VIS activities around the world during the COVID-19 pandemic.

alt.VIS 2023
Often the most transformative ideas and challenges come from unexpected and serendipitous sources. Yet, conferences are not often perceived as a place for non-traditional, controversial, or outré

work. We propose to continue the success of the last two year's "alt.VIS'" workshops that borrowed from the long-running and successful "alt.chi" model from the ACM SIGCHI conference. This venue will once again provide an avenue for surfacing creative or critical work that would otherwise not find a home through the standard VIS conference review process.

Sixth Workshop on Visualization for Communication (VisComm)

The VisComm workshop brings together practitioners and researchers from several fields to address the questions raised by the rapidly growing communicative uses of visualization, from internal research and analysis to news graphics to interactive dashboards to standalone static representations in blogs and social media. These questions span audience, application, evaluation, understanding, and practice. To encourage participation from communities that do not typically attend IEEE VIS and write academic papers, we will accept short papers, briefs on works in progress, visual case studies, and recruit program committee members from those communities.

EnergyVis 2023: 3rd Workshop on Energy Data Visualization

The energy sector is witnessing significant technological progress, primarily driven by the growth of renewable energy, distributed energy resources, and smart grid technologies. This rapid evolution is generating increasingly large, complex data that present substantial challenges for energy systems planning and operations. More research is needed to develop new and innovative visualization methods that can handle the increasing complexity of energy systems and provide diverse stakeholders with the necessary insights to make informed decisions about the future of energy. The EnergyVis 2023 workshop aims to bring together scientists, researchers, and practitioners from the energy and visualization domains to critically assess and discuss energy data visualization in the context of the evolving energy sector. The workshop's main objectives will be to seed the development of a publishable report on the state-of-the-art and grand challenges in energy data visualization and to develop stronger international collaborations for this important area of multidisciplinary research. With the rapid evolution of energy systems, visualization experts have an essential role in enabling stakeholders to better understand and manage these increasingly complex systems. By expanding the reach of EnergyVis to the broader visualization community at IEEE VIS, we hope to continue the momentum of the past workshops and build a community of experts capable of tackling the visualization challenges of modern energy systems.

EduVis: Workshop on Visualization Education, Literacy, and Activities

This half-day workshop focuses on visualization education, literacy, and activities. It intends to bring together scholars to share research and experience and discuss novel activities, teaching methods, and research challenges. The workshop aims to serve as a platform for scholars within and beyond the visualization community such as education, learning analytics, science communication, psychology, or people from adjacent fields such as data science, AI, and HCI. It will include presentations of research papers and practical sessions with hands-on activities. In addition, the workshop will allow participants to discuss challenges they face in data visualization education and outline a research agenda of visualization education, literacy, and activities.

5th Workshop on Urban Data Visualization (CityVis) - Focus: The Role of Data Governance

With the growth and increasing density of urban areas, new technologies are emerging and data is becoming an essential asset to modern cities. Visualization as a tool for analysis, exploration and communication has become a driving force in the task of unravelling the complex urban fabrics that form our cities. In this workshop series, we want to critically assess this notion and ask how can data and data visualization be used to serve and better understand or even organize urban processes? We are particularly interested in multidisciplinary perspectives, especially on the human-centric component of urban visualizations. In the second workshop at IEEE VIS 2019, we explored roles of

citizens in urban visualizations and outlined goals and challenges. Based on these findings, we propose to focus discussions in this 5th workshop on the critical role of urban data governance and its interplay in data and data visualisation: its production, dissemination and use.

MERCADO: Multimodal Experiences for Remote Communication Around Data Online
MERCADO is a half-day workshop on the topic of new multimodal experiences for remote communication and collaboration around data. We aim to gather researchers working in data visualization, human-computer interaction (HCI), and computer-supported collaborative work (CSCW) who are interested in multimodal, synchronous, and remote or hybrid forms of communication and collaboration within organizational and educational settings.

VisxVision: Workshop on Novel Directions in Vision Science and Visualization Research
Interdisciplinary research between vision science and visualization aims to provide a better scientific understanding of how people interpret visualized data. By studying the cognitive processes involved in visual perception, visualization researchers can gain insight into better-adjusting visualizations to meet user goals. Topics from vision sciences, such as memory, ensemble coding, numerical cognition, color perception, and pattern recognition, can be mapped directly to common challenges encountered in visualization research. At the same time, interacting with visualization researchers exposes vision scientists to novel challenges and research questions in their own field. Building on the growing interest in work at this intersection from both the vision science and visualization communities, this 3rd biennial workshop at IEEE VIS 2023 aims to facilitate collaboration between the vision science and visualization communities by bringing in new researchers, discussing innovative discoveries, and sharing cutting-edge research methods and proposals. Through a multi-stage format, the workshop provides a platform for diverse voices to be heard and new collaborations to be formed.

(Vis + Prov) x Domain: Workshop on Visualization and Provenance Across Domains
The provenance-related research interest is growing rapidly within the visualization community. This is evidenced by a dedicated provenance paper track in IEEE VIS 2022, a large number of provenance-related publications in many visualization venues, and several provenance-related workshops at IEEE VIS such as Machine Learning from User Interaction for Visualization and Analytics (MLUI), Workshop on TRust and EXpertise in Visualization (TREX), and Workshop on Visualization for AI Explainability (VISxAI). Provenance is also an established topic in several other fields, for example data lineage in database community, interaction log for user studies in Human-Computer Interaction, and workflow history for e-Science. Recently, it gained growing research attention with the recognition of the important of reproducible science.

Watch here for more VIS 2023 program details, e.g., tutorials and capstone speakers.

Register here.

Call for Proposals: Capella Days 2023

The annual free online gathering of the Capella (MBSE tool) and Arcadia (MBSE method) community, Capella Days 2023, is scheduled for 14-16 November 2023. Capella Days brings together the creators of Capella/Arcadia, providers of Capella add-on and services, and MBSE experts and industrial users.

A Call for Proposals has been issued, seeking feedback from industrial users concerning their application of Capella. Topics of interest for these online presentations include:

- MBSE challenges
- Arcadia methodology adoption
- Capella deployment
- Lessons learned.

The early submission deadline is 1 September; final submission is due on 15 September. The final program will be announced on 2 October.

Learn more.

Call for Presentations: The Challenges of New Advanced Simulation Techniques

The Iberia chapter of NAFEMS has issued a Call for Presentations for the Challenges of New Advanced Simulation Techniques conference to be held in Madrid, Spain on 16 November 2023. The conference is free of charge for experienced experts, engineers, developers, and practitioners in the advanced simulation field.

Presentations are sought on next-generation simulation capabilities and related challenges, solutions, case studies, etc. to stimulate open discussion that provides guidance and best practices for future engineering innovation. Related topics include:

- Collaborative conceptual modelling (multi-disciplinary, inter modelling, etc.),
- Computational challenges (ubiquitous computing, big data, Internet of Things, cloud computing, supercomputing, etc.),
- Digital twins (validation, optimization, data collection/generation/interaction, predictive systems, etc.),
- Uncertainty (tools and methods, management, risk, decision-making processes, etc.),
- Model reuse (tools, effectivity, robustness and reliability, management, etc.).

The deadline for abstract submission is 16 September.
Download the abstract template. Email abstracts to gino.duffett@nafems.org.

Learn more about the NAFEMS engineering, modelling, and simulation community.

PDMA - 2023 Fall Body of Knowledge Training

The Pittsburgh (Pennsylvania, USA) chapter of the Product Development Management Association (PDMA) will host an eight-week professional development training program that covers the fundamentals of product management and innovation These in-person sessions will run on Tuesday evenings from 12 September through 31 October. Expert product development practitioners and talented educators will be teaching seven key areas of study of the PDMA Body of Knowledge, including:

- Strategy
- Market Research
- Portfolio Management
- Product Innovation Process
- Culture, Teams, Leadership

- Product Innovation Management
- Product Design and Development Tools

In addition to instructor-led discussions, students will use real-world situations during each class to learn about the fundamentals of product management, product development, and innovation. Opportunity will be provided to apply tools, methodologies, and strategies to company projects, product lines, and product challenges for a more meaningful learning experience.

Learn more and register (Deadline 1 September).

PDMA members receive discounted pricing. Non-members receive a one-year basic membership in PDMA as part of their course fee.

Join PDMA.

PPI RESOURCES

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

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

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

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

Systems Engineering Goldmine: https://www.ppi-int.com/se-goldmine/
A free resources with over 4GB of downloadable information relevant to the Engineering of systems and a searchable database of 7,800+ defined terms. You can expect the content of the SE Goldmine to continue to increase over time.

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

PPI SyEN Newsjournal (actually a substantial monthly SE publication): https://www.ppi-int.com/systems-engineering-newsjournal/
You're already reading our monthly newsjournal! However click on the link to access the history of 100+ monthly newsjournals containing excellent articles, news and other interesting topics summarizing developments in the field of systems engineering.

PPI SyEN Perspectives: Risk Management

by John Fitch

Project Performance International

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Authored for PPI SyEN

Introduction

The one hundred twenty five previous editions of PPI's SyEN Newsjournal have contained a wealth of knowledge, insights and perspectives on how to successfully engineer systems. Periodically, we find it useful to revisit a relevant topic, compile the insights of prior contributors, look for recommended principles and practices, identify open questions, and align prior know-how with current systems engineering research and trends.

Risk Management has been a frequent PPI SyEN topic across the years with over forty "mentions" and four feature articles. This article will attempt to highlight valuable Risk Management concepts from past PPI SyEN entries and compare and contrast these concepts to extract new value. This analysis will be organized in sections as follows:

- Risk Management from the Perspective of Systematic Thinking
- PPI Core Ideas
- Definitions
- Prior Articles
- Conflicting Ideas
- Common Principles
- Risk Management Standards
- Risk Management Resources to Investigate
- Risk Management Questions - Worthy of Research

Risk Management from the Perspective of Systematic Thinking

The author entered the field of systems engineering through a "side-door" known as "systematic thinking" or "rational process". A Kepner-Tregoe Problem-Solving and Decision-Making course in 1981 was the introduction to four human thinking patterns:

- Situation Appraisal (SA) – to sort out issues
- Problem Analysis (PA) – to identify and confirm root cause
- Decision Analysis (DA) – to choose a course of action
- Potential Problem Analysis (PPA) – to protect a plan or design

The premise of the systematic thinking processes is that every thinking task performed by a knowledge worker may be mapped to one of these four patterns; they are the universal building blocks by which humans resolve concerns through analysis, i.e., the use of their minds. The author's forty-plus years of professional experience in systems engineering, engineering management and consulting have supported this hypothesis and provided no compelling counter-examples. A quick

overview of these processes and how they led to the discovery decision patterns has been provided in the article, *Introduction to Decision Patterns* in PPI SyEN Edition #107 (December 2021). Of the four processes, Potential Problem Analysis (PPA) is most relevant to our current topic. PPA is a future-focused cause-effect thinking pattern that takes the results of design decision-making (whether a technology, an architecture or project plan), anticipates ways that the solution/plan may fail and proactively mitigates those potential problems. It is the author's conviction that the PPA thinking pattern forms the common core of engineering processes such as Risk Management, Failure Modes and Effects Analysis (FMEA) and Safety/Hazard Analysis and the systems engineering would well served if that commonality was built into system modeling languages and tools.

PPA begins with the development of an Action/Plan Statement that makes explicit the result(s) or outcome(s) that must be protected from potential problems, aka risks.

"Deliver ProductX by September 2024 in-budget and in-compliance with Specification ABC."

The Action/Plan Statement clarifies the definition of stakeholder value that must be protected from Murphy's Law.

PPA practitioners then decompose the plan into a set of steps (or the design into a set of solution elements) and repeatedly ask the question, "What could go wrong with Step N (or Element M or Interface P)?" Each step/element may have its own definition of success that must be protected. Potential problems are captured as problem statements in adjective-noun format (e.g., late material, scratched screen, excessive RF noise emissions, loss of critical staff member, etc.) to emphasize the threat posed to the intended outcomes of the design or plan. A detailed description of the potential problem in IF:THEN format clarifies the potential threat.

Potential problems may be categorized in multiple ways, but all, regardless of category, may be prioritized on a common relative scale based on their potential impact on design/project success. The priority of a potential problem is determined by assessing its Probability (likelihood of occurrence) and Seriousness (magnitude of potential negative impact on stakeholder value).

Having taught these rational processes to hundreds of technical professionals, it's not surprising that they became the core elements of a systems engineering process (consisting of 11 standards and guides and associated training workshops) that the author developed and delivered in the early 1990's for a U.S. defense contractor. A Guide for Risk Management and Guide for Technical Performance Measurement (TPM) put a systems engineering "shell" around a rational process core.

PPA doesn't stop with risk identification and prioritization; the process includes a very strong emphasis on proactive risk mitigation. Risk mitigation rigor is informed by risk priorities. Regardless of risk priority, three types of risk mitigation actions may be developed:

- Preventive Action - reduces the probability of the risk by acting on its likely causes.
- Contingent Action - reduces the seriousness/impact of the risk by acting on its effects.
- Monitoring Action - detects the emergence of the risk and triggers pre-planned contingent actions in a timely manner.

TPM is fundamentally a technical risk monitoring system put in place to trigger formal and pre-defined contingent actions before it's "too late".

Figure 1 illustrates how these types of mitigations interact with the cause-effect chain to interrupt or weaken the failure cascade that could lead to disaster, e.g., loss of system, loss of business viability or loss of life.

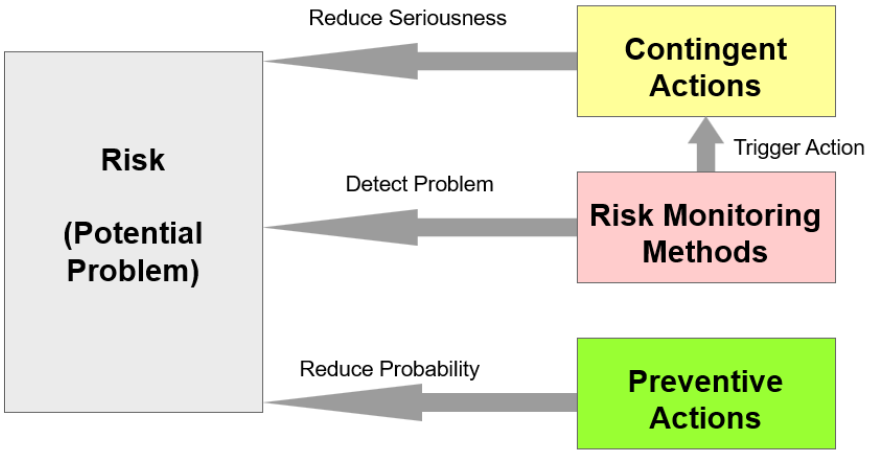

Figure 1 – Types of Risk Mitigation Actions

In an engineering context, risk mitigation methods may:

- Modify the physical design of the system directly (add or change elements or interfaces)
- Modify the project plan that develops, deploys and supports the system (add or change tasks, task dependencies and resourcing)
- Create new requirements that trigger changes to multiple design decisions.

PPA has traditionally been performed in batch mode, at key project milestones or whenever significant changes to a plan or design have been proposed. However, the author strongly recommends a continuous decision-centric approach to PPA/Risk Management in which:

- The majority of potential problems are discovered as part of the Decision Analysis process, associated with promising alternatives.
- Risks (and opportunities) are used as part of the decision-making "equation".
- The risks associated with the chosen alternative in any decision are immediately added to the program risk database at the point of decision.
- Risk mitigation tasks are added to the project plan.
- Risk mitigation requirements are added to the system requirements model.

For more on how decisions relate to risks and risk mitigation see the article, *Decision Patterns – So What?* In PPI SyEN Edition #111 (April 2022).

It should be noted that there is a Potential Opportunity Analysis (POA) process in symmetry with PPA, but focused on the question, "*What could go better than expected?*".

As typically performed, PPA is a simple linear association of a potential problem with a project step or physical solution element in which no complex network of interacting potential problems is developed.

PPI Core Ideas

Here are some quotes and questions (with answers) concerning risk offered by PPI founder, Robert Halligan. These entries summarize PPI's essential philosophy toward risk management.

Quote: "The principles of risk management are straight-forward. Implementation is a little tricky."

Question: Is the objective of systems engineering to reduce risk?

Answer: *An* objective of systems engineering to reduce risk. *The* objective of systems engineering is to

maximize value delivery to the applicable (primary) stakeholders.

Question: What is the role of success criteria valuation in project risk management?

Answer: The answer to this question lies in the nature of risk – risk is an expected loss with respect to a valued outcome. If there is certainty that all valued outcomes will be achieved, there is no risk. If a certain outcome has no value (positive or negative), there can be no risk with respect to that outcome.

And so, *performing project risk management starts with an understanding of the value of outcomes sought from a project, then continues by assessing the risk with respect to achievement of those outcomes*, collectively (overall risk) and/or individually (e.g. cost risk, schedule risk, risk to capability). Unless stakeholders are totally risk averse (which never occurs), project risk management must also be concerned with opportunity – an expected gain with respect to (i.e. beyond) a valued outcome.

Opportunity may justify taking risk. In fact, if the opportunity exceeds the risk, a course of action that pursues the opportunity should be taken, unless resources are finite and there is an alternative course of action for which the beneficial difference between opportunity and risk is even greater. All of the above is fundamentally driven by what is important in terms of outcomes, and how important!

Outcomes may be expressed in two forms. The first is requirements – outcomes that must be achieved. These are sometimes called thresholds. There is, of course, always risk with respect to satisfying requirements. The second is goals – outcomes that are to be pursued but not necessarily achieved. These are sometimes called objectives. With a reference of just meeting requirements, any potential outcome which adds value by complete or partial achievement of a goal represents an opportunity.

Accordingly, to assess and effectively manage risk, both requirements (threshold of acceptability) and goals (targets beyond the threshold of acceptability) must be valued. It is appropriate to value each requirement by the amount of damage done if that requirement were not met. Objective methods exist for this purpose, e.g. the Compromise Impact Value method.

It is appropriate to value goals by the relative value of each improvement from threshold of acceptability to goal, together with the function describing the amount of value added as an outcome improves from the threshold of acceptability (requirement) level to the goal level. The values of achievement towards multiple goals must be expressed in common units and combined.

The building of a system or project effectiveness model achieves this summation, normally using Multiple Attribute Utility Theory (MAUT).

And so, this value information feeds directly into assessment of the amount of risk. Risk is linearly proportional to the value of an outcome. Double the value, the risk is doubled.

PPI SyEN notes the parallels between PPA's Action/Plan statement (which highlights the expected outcomes of the design or plan to be protected) and Robert Halligan's focus on the value of project outcomes as the starting point for risk management.

Definitions

Various definitions of risk have been captured in past PPI SyEN editions.

Source: Merriam Webster Dictionary

- Risk: (noun) Possibility of loss or injury.
- Risk: (verb) To expose to hazard or danger.

Source: Oxford English Dictionary

- Risk: a possibility of meeting danger or suffering harm

Source: Occupational Health & Safety Advisory Services (OHSAS) and many others

- Risk: the product of the probability of a hazard resulting in an adverse event, times the severity of the event.

Source: ISO 31000:2009, "Risk management - Vocabulary"

- Risk: Effect of uncertainty on objectives.

To the author, these definitions highlight three different perspectives:

- Consistent with the PPA usage described earlier, a risk (a discrete potential problem entity in answer to a "what could go wrong?" question) may be thought of as a condition or event that represents the potential for lost value.
- Risk effects (expected negative value in the eyes of the stakeholders) may be quantified by a mathematical relationship between the probability of a discrete potential problem and the seriousness (severity) of that problem.
- The overall impact of multiple risks (as sources of uncertainty) on project/system objectives may be calculated using the probability/seriousness values for all discrete potential problems associated with a plan or design.

Each of these three perspectives on the definition of the term, *risk* will be seen in the previously-published PPI SyEN Risk Management articles that are summarized below.

Prior Articles

PI SyEN authors have addressed Risk Management from a diverse set of backgrounds and experiences. Not surprisingly, they find common ground and also have some unique and sometimes conflicting ideas.

The Missing Link – Risk Identification - PPI SyEN 58 (October 2017)

By David Hall and Laurie Wiggins

This article highlights the importance of the *Risk Identification* process, which is universally understood as a key component of an effective risk management framework in all risk management standards, guides, and process descriptions. Hall and Wiggins believe that:

- No document or solution provides sufficient guidance for identifying a risk management baseline.
- Risk identification as it is practiced today is a subjective, ad hoc, non-comprehensive, and non-repeatable process.
- These process deficiencies result in continuing failures and overruns in all types of product and service development and modification programs.

The remainder of the article summarizes an improved approach to risk identification to address these concerns based on an analysis of over 500 programs.

The article begins with a significant question:

"Why is risk management the only Systems Engineering (SE) process that does not require a baseline to be developed?"

Conclusions drawn from Risk Identification Analysis include:

- The widespread belief that each program has a unique set of risks is false; every program inherently has the same risks (technical, enterprise, operational, management, organizational, and external) as every other one. It is the specifics of the risks that vary.
- The common risks areas listed above provide a comprehensive method that can be used to develop a risk management baseline for all programs.
- Risks need to be "weighted" in terms of frequency of occurrence and program impacts (detrimental effects).
- Risk status (for each type of risk) should be assessed against a set of nominal levels to reduce subjectivity.
- Program complexity factors (program cost, personnel effort, program duration, number of technologies/disciplines involved, and influencing factors) cause the relative weighting of the risk areas to change.
- These principles in combination form the basis for a risk identification tool, Program Risk ID (PRID).

Analysis of sixty risk guides and documents identified multiple risk identification techniques that are recommended:

- Brainstorming
- Lessons Learned
- Failure Scenarios / Failure Modes and Effects Analysis (FMEA)
- Work Breakdown Structure (WBS) / Work Plan
- Subject Matter Experts (SME's) and Program Personnel
- Stakeholders
- Probabilistic Risk Assessment (PRA)

The concern with most of these techniques is that they start over from scratch for each new program. The proposed antidote to this behavior is the use of the risk pattern identified during the Risk Identification Analysis. This pattern is captured as a three-level hierarchy (Risk Area, Risk Category, Risk) that includes 218 specific risks. For example:

- Risk Area: Operational
- Risk Category: System Maintenance
- Risk: Personnel Training and Experience

Pilot use of PRID on a U.S. defense program supports the proposed risk identification and mitigation benefits of using this pattern.

PPI SyEN notes that the URL provided for Program Risk ID is no longer active, so we can draw no conclusions as to the current status or availability of this tool for risk identification usage.

PPI SyEN doesn't find it surprising that risks can be mapped to a pattern and that such a pattern can be helpful in improving the completeness and efficiency of the risk identification process. What is unclear from this article is whether using the pattern defines each risk with sufficient specificity to aid in the development of effective risk mitigations.

PPI SyEN observes that FMEA, which is typically thought of as a reliability engineering technique, is considered one of recommended risk identification methods. This view aligns with the conviction that the future-focused cause-effect model created in PPA can serve as the common core of multiple risk management techniques.

Schedule Compliance Risk Assessment Methodology (SCRAM) - PPI SyEN 68 (August 2018)

By Angela Tuffley

This article proposes the use of the Schedule Compliance Risk Assessment Methodology (SCRAM) as a framework for mitigating schedule risk on system development programs. SCRAM "is a structured, repeatable engineering-focused review used to identify the root causes of issues and risks to schedule and to recommend remedial actions." As of the time of this article was published, SCRAM had been applied successfully on at least 32 Australian and complex international defense projects.

The proponents of SCRAM highlight the following characteristics of the methodology:

- Minimally disruptive
- Independent
- Non-attributional
- Transparent
- Non-advocate

A typical SCRAM engagement reviews both the customer and contractor and provides evidence-based results in less than four weeks. SCRAM reviews are delivered by certified assessors who use a structured framework called the Root Cause Analysis of Schedule Slippage (RCASS) model to quantify schedule compliance risk.

The results of a SCRAM review enable leaders to understand the impact of identified root causes and may forecast the probability of achieving critical milestone dates. Leaders of the F-35 Joint Strike Fighter testified to the benefits of using SCRAM on that program.

SCRAM is supported by a product suite that includes:

- SCRAM Schedule Risk Management Assessment Guide (best practices)
- SCRAM Assessor Guidebook
- Managing Schedule Risk training
- SCRAM Assessor training and certification process

For additional background information on SCRAM read:

- An Overview of the Schedule Compliance Risk Assessment Methodology (SCRAM)
- SCRAM – Schedule Compliance Risk Assessment Methodology

PPI SyEN notes that the RCASS model includes a root cause pattern that goes beyond merely estimating risk probabilities and impacts directly; it evaluates the typical causes that contribute to schedule slips and calculates the overall probability of missed milestones from these details.

Bridging the Gap between Systems Engineering and Program Management via a Risk-Aware Framework – PPI SyEN 74 (February 2019)

By Scott Stribrny

This article presents a Risk Aware Framework in the form of a case study that highlights how a company used this framework to improve cost, schedule and strategic business performance. Stribrny defines risk as the potential of loss resulting from a given action, activity and/or inaction.

Stribrny strongly couples risk with the decision-making process with statements such as:

- *"The purpose of risk management is to make decisions"*
- *"Making the right decision means performing risk analysis"*
- *"The goal of any of these methods is to help the decision-maker choose a course of action, given a better understanding of the possible outcomes that could occur"*

Three elements are deemed essential to successful risk management:

- A repeatable process with defined steps and artifacts supported by applicable methods and tools.
- Widespread access to adequate knowledge sources to support the process.
- Functional behavior including human interactions, motivators, perceptions, communication, decision-making processes, and risk tolerance.

The case study looked at risk management practices at Rockwell Collins (Collins Aerospace), highlighted seven key questions asked and answered as part of the risk management process, and emphasized the importance of communication among the participants in the process.

The Risk Aware Framework identifies four classes of risk: Programmatic, Organizational, Economic and Technical (POET) and typical drivers for each class.

Eight new functional behaviors are recommended:

- Manage risk as an asset.
- Treat decision making as a skill.
- Create a pull for risk information.
- Seek diversity in perspectives and information sources.
- Minimize uncertainty in time, control, and information.
- Recognize and minimize bias in perceiving risk.
- Plan for multiple futures.
- Be proactive.
- Make timely, well-informed decisions and commitments.
- Reward those who identify and manage risks early, even if the risks become problems.

Organizational memory is presented as the fundamental challenge to risk aware management. Stribrny counsels:

"The greatest challenge may be finding the courage to candidly answer the question, "Are we ready to hear the ruthless truth about the risks of our system engineering decisions?"

PPI SyEN echoes the integral relationship between risk management and decision-making and the emphasis on the cultural mindset and "soft skills" associated with the recommended organizational behaviors.

What Constitutes a Systems Approach to Risk Management? - PPI SyEN 81 (September 2019)

By Dr. Gavan Lintern

This article questions the progress that systems engineering practitioners have made in applying risk management disciplines to large-scale socio-technical systems, using the failures of the Deepwater Horizon oil rig in 2010 and the Fukushima Dai-Ichi nuclear power station in 2011 as examples.

Lintern argues for a systems approach to risk management and highlights the capabilities and limitations of various commonly-used risk analysis techniques including:

- Root Cause Analysis / Ishikawa (Fishbone) method
- Human Factors Analysis and Classification System
- Accident Analysis (AcciMap)
- Systems Theoretic Accident Modelling and Processes

Lintern also cites the "*lack of any robust design strategy for responding to systemic issues*" as a "glaring deficiency" in risk management frameworks.

Three formative, but generally-overlooked ideas (based on Jens Rasmussen's Risk Management

Framework), are elaborated as worthy of further consideration in the search for a systems approach:

- The Generic AcciMap and ActorMap
- Functional-Relational Modeling
- An Ecological Information System (that supports both causal and functional reasoning).

As the systems engineering community moves towards ever more comprehensive and integrated models of systems (and the thinking behind them), the ability to capture a multi-dimensional digital thread that includes causal, functional (and state and decision-making) logic using a common language and in a trusted repository seems to be of increasing relevance and importance.

Conflicting Ideas

Lintern's article casts some doubt on the efficacy (or at least the systemic completeness) any risk management framework within the scope of his analysis. However, because he did not specifically review the capabilities and effectiveness of PRID, SCRAM or the Risk Aware Framework, we can't state with confidence how the general framework deficiencies that he has observed might apply in these three instances.

Some differences between PRID, SCRAM and Risk Aware Framework may be summarized as follows:

- PRID alone proposes an extensive and universal pattern for risk identification. From-scratch, ad-hoc analysis is the enemy to be defeated because it fails to establish a risk management baseline for the program.
- PRID emphasizes risk identification much more than mitigation.
- SCRAM focuses more narrowly on risks to schedule, but goes deeper into causal analysis behind schedule slips. Its RCASS model goes beyond risk identification, using cause-effect relationships to quantify schedule risk.
- SCRAM is performed by certified assessors and involves both the customer and contractor (solution developer) equally in the assessment process.
- The Risk Aware Framework is focused on the integration of risk management with enterprise decision-making and highlights numerous "soft skills" and aspects of culture that drive the effectiveness of the process.

Common Principles

There is general agreement among the authors (and PPI's core position) on the following principles and practices:

- Risks should be prioritized by their impact on stakeholder value delivery, the expected value of which may be computed based on two factors: probability of occurrence and potential impact.
- Both PRID and Risk Aware Framework see value in and offer risk categorization patterns, which share some common elements.
- People, process and technology are all recognized as valuable contributors to effective risk management, albeit with a different mix across the methods.
- Risk management frameworks must be adapted to organizational contexts; while some principles and practices may be universally valuable, they can't be successful if applied in a rote fashion. Context matters.

Risk Management Standards

Various standards and their evolution have made the pages of PPI SyEN.

- ISO 31000 - Risk Management - PPI SyEN 34 (July 2011)
- ISO/IEC/IEEE 16085 Systems and Software Engineering — Life Cycle Processes — Risk Management - PPI SyEN 58 (October 2017)
- ISO/IEC/IEEE 16085 (Risk Management) Has Been Updated - PPI SyEN 99 (March 2021)

Readers are encouraged to investigate the latest versions of these documents.

Risk Management Resources To Investigate

Various risk management resources have been highlighted in past PPI SyEN editions.

Books and Papers:

- Analytical Methods for Risk Management: A Systems Engineering Perspective by Paul R. Garvey - PPI SyEN 15 (December 2009)
- Systems Thinking for Sustainability and Supply Chain Risks by Abhijeet Ghadge, Samir Dani, and Roy Kalawsky - PPI SyEN 33 (July 2011)
- System Safety Engineering and Risk Assessment: A Practical Approach (Chemical Engineering) by N. J. Bahr – PPI SyEN 50 (December 2012)
- Megaproject Management: Lessons on Risk and Project Management from the Big Dig by Virginia A. Greiman - PPI SyEN 64 (April 2018)
- The Strategic Management of Large Engineering Projects: Shaping Institutions, Risks, and Governance by Roger Miller and Donald R. Lessard - PPI SyEN 66 (June 2018)
- Risk Management for Project Driven Organizations: A Strategic Guide to Portfolio, Program, and Project Management Organization Success by Andy Jordan - PPI SyEN 71 (November 2018)
- Risk Up Front: Managing Projects in a Complex World by Adam Josephs and Brad Rubenstein PPI SyEN 91 (July 2020)

Organizations:

- INCOSE Risk Management Working Group (RMWG) – PPI SyEN 21 (June 2010)
- Society for Risk Analysis Australia New Zealand - PPI SyEN 82 (October 2019)

Risk Management Questions - Worthy of Research

Review of prior PPI SyEN risk management content triggers some interesting research questions for further exploration:

- How do the various risk categorization schemes proposed align or complement one another, e.g., technical, enterprise, operational, management, organizational, and external vs Programmatic, Organizational, Economic and Technical (POET)?
- If decisions give birth to risks through the alternatives chosen, how can decision patterns and risk patterns be integrated?
- How should non-deterministic behavior be represented within risk models in order to complement deterministic cause-effect relationships.
- How are causal models, functional models and state models related to each other? How might risks be represented as the failure states of a system?
- How do the requirements for Rasmussen's Ecological Information System differ from what is currently supported in leading system modeling languages and MBSE tools?
- How might the findings above influence the implementation of risk management knowledge within modeling languages and tools? What is the leanest possible information metamodel that can capture all of the dimensions of risk management discussed herein?

PPI SyEN invites the reader to pose additional questions for consideration. If you know something, say something and contribute to this dialog.

References

Over fifty relevant references and information sources may be found across the four feature articles analyzed herein. See the original articles for details.

About the Author

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

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

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- A Framework for Understanding Emerging Consumer Needs
- Aligning Product Portfolios with Strategic Plans
- Building Resilience as We Navigate Change
- Deliberate Differentiation
- Find Pearls and Drive More Innovation in Your Portfolio
- Four Steps to Product Management Excellence for B2B Companies
- Ideation Techniques: Conceptualizing New Products
- Mastering InnovationOps
- Pathways to Achieving Innovation
- Portfolio and Portfolio Management
- Steve Jobs: A Product Developer's Perspective
- TED Talks Related to Product Design & Development Tools
- The Back End of Innovation: The Neglected Stepchild of NPD
- The Barnacle Theory: Please Don't Foul the Hull
- Use Design Thinking to Solve Problems and Become a Catalyst for Innovation
- Working Styles for Product Team Success

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INCOSE INSIGHT Practitioners Magazine - Agility in the future of systems engineering

The June 2023 edition (Volume 26, Issue 2) of INSIGHT, INCOSE's Practitioner Magazine published by Wiley, has been released. Electronic subscriptions to INSIGHT are available as a member benefit to INCOSE members. Hard-copy subscriptions to INSIGHT are available for purchase by INCOSE members for one membership year, and to the public.

The focus of this issue is *Agility in the future of systems engineering*. Contents of this 68-page document includes:

Setting Current Context for Agility in the Future of Systems Engineering
by Rick Dove

Agility in the future of systems engineering (FuSE) is one of the topic areas under the INCOSE FuSE initiative. A roadmap for near-term improvement, presented at the 2021 INCOSE International Symposium, offered nine strategic concepts appropriate and ready for further movement toward standard practice. Initial work in that direction enticed several practitioners and researchers to address selected concepts in this special issue of the INCOSE INSIGHT publication. The purpose of this lead-off article is to provide a contextual backdrop for the articles that follow.

Systems Engineering Agility in a Nutshell
by Rick Dove, Kerry Lunney, Michael Orosz, and Mike Yokell

Systems engineering must necessarily have the agility to anticipate and effectively respond to an increasingly dynamic and uncertain environment. Agile systems engineering, agile software engineering, and agile any-kind-of engineering share common goals and leverage common agility-enabling strategies. This article succinctly describes eight strategic aspects with application discussions at the systems engineering level.

The Supra-System Model
by Tom McDermott, Kelly Alexander, and Richard Wallace

This article presents an initial set of concepts resulting from research by the Office of the Undersecretary of Defense for Research and Engineering (OUSD/RE) and the Systems Engineering Research Center (SERC) under an initiative called "systems engineering modernization" (SEMOD). This article discusses the "supra-system model," which evolved as a different view of systems engineering lifecycle activities across the entire life of an engineered system. This view promotes systems engineering as a continuous process that is 1) iterative across the full life of a system and 2) managed through a digital transformation centered on data and models. This article also discusses the value of "shared and authoritatively managed data and models" in the lifecycle of future systems. These together present a modernized view of systems engineering where "seamless and efficient transfer of data and models" will support practices that are "more agile and responsive to changing stakeholder needs."

How Large Scale Agile Can Operate Systems Engineering in the Future
by Laurent Alt and Mikaël Le Mouëlli

The significant shift happening today towards more connected, more automated, and more

autonomous systems is bringing software inside all systems, and at the same time agile practices. Our experience of large-scale agile deployments in companies building or operating complex systems in automotive and aerospace shows that, whereas both approaches can easily coexist in isolated teams within the same company, major problems arise when coordinating them at the leadership level, where they are perceived as antagonist, and create misalignments, friction and quality issues. In this article, we propose to describe why it is important to make agile and systems engineering work together, how to do it, and how this impacts how we see value, systems, digital twins, and leadership. The following concepts of the FuSE agile roadmaps are addressed:

- Agility with long lead time components and dependencies
- Agility across organizations boundaries
- Orchestrating agile operations.

Model-Based Systems Engineering as an Enabler of Agility
by Sophie Plazanet and Juan Navas

Model-based systems engineering (MBSE) with agility can help systems engineering programs which deal with both increasing complexity and frequent changes in environment and usages, shorter time-to-market, uncertainty of the needs, and more sophisticated industrial schemes. Agile approaches originated in software engineering can be extended and tailored to a certain extent to complex systems engineering and particularly to MBSE. Main benefits of agility are provision of a minimum viable product as early as possible in the schedule, early capture of changes of needs, enabling to deliver a system answering to the real needs, and securing of the value proposal. It includes also potential reduction in rework of the final system through regular customer feedback throughout development (left shift for the defect correction with early exposure), and efficiency of the use of resources. Concerning MBSE, the use of models as a single source of truth for completeness and consistency is useful to share and secure the design by improving communication within engineering teams and the building and support of the development strategy, and to help to automate some tasks such as model exchange and synchronization. In addition to the benefits of each approach, combining them may help to:

- Organize and synchronize the development and validation effort of one or multiple engineering teams.
- Faster impact analysis including trade-off studies/options and hence a faster reaction to evolutions in expectations and constraints, that is, the agility of systems.
- Show regularly “end to end” value to the customer and other stakeholders.

Agile MBSE: Doing the Same Thing We Have Always Done, but in an Agile Way with Models
by Matthew Hause

Agile systems engineering is not new. Work has progressed on this for many years to the point that criteria have been established regarding best practice as well as a means of quantifying adherence. The future of systems engineering (FuSE) initiative is reexamining how agile systems engineering fits into the FuSE (Willette et al. 2021). As model-based systems engineering (MBSE) is also a FuSE theme, it is only proper to look at how agile systems engineering and MBSE complement and enable each other. This article examines some of the aspects of MBSE – specifically the Systems Modeling Language® (SysML) – and show at how an agile approach to MBSE can help with the concepts of stakeholder engagement, continual integration, and dynamic learning and evolution. For reasons of space, the article will only provide minimal definitions and explanations of the basics of MBSE, agile, and SysML and as these are well known concepts.

FuSE Agility as a Foundation for Sound MBSE Lifecycle Management

by Barry Papke, Matthew Hause, and David Hetherington

Over the past several years, numerous industries have increased their adoption of the systems modeling language (SysML®) and model-based systems engineering (MBSE) as a core practice within their engineering lifecycles. However, the introduction of SysML and MBSE methodologies has not yet yielded many of the originally envisioned benefits. System models are becoming larger and more complex and many large MBSE projects continue to experience problems with model integration, repository performance, and model lifecycle management. The root cause is the failure to recognize the MBSE digital environment as a complex engineering information processing system that requires the same rigor and development processes as the system-of-interest (SoI) it is designing. This article describes how three future of systems engineering (FuSE) agility foundation concepts (system of innovation, effective stakeholder engagement, and continuous integration) directly address some of the problems seen in adoption, deployment, and sustainment of the MBSE digital environment as an SoI.

An Agile Systems Engineering Process for Stakeholder Needs Identification and Solution Concept Design
by Lymari Castro

This paper presents a case study where an agile systems engineering process was used to identify stakeholder needs to design an improved cross-organizational proposal development process during the proposal formulation phase of a program. The agile systems engineering process leveraged the incremental application of design thinking techniques to engage the stakeholders and identify the care-abouts of an organization during proposal formulation in support of a change management effort. The goal of the change management effort was to design solutions that increased collaboration and engagement across the various internal and external stakeholders without changing the overarching corporate proposal development process. The identified solutions broke existing organizational silos and changed the dynamics of the organization impacting over 1,200 employees. The case study relates to the future of systems engineering (FuSE) concepts of stakeholder engagement and agility across organizational boundaries.

Applying Agility for Sustainable Security
by Larri Rosser

Systems engineering faces ongoing challenges due to the pace of change in technology and needs as well as the complexity, resilience, and adaptability demanded of solutions. System security needs and challenges are a prominent factor in the increasing demands placed on solutions and the systems engineers who design and develop them. The adoption of program level agile execution is one strategy for addressing these escalating challenges. In this article we describe how the broadly adopted technical processes from the ISO/IEEE/IEC 15288:2015 standard can be executed using agile methods to realize a large complex solution. In addition, we provide specific recommendations for executing these processes in a manner that enables systems to be sustainably secure – that is, to retain the desired level of security throughout the life cycle.

Agile Programs Need Agile Reviews
by Larri Rosser

Current technical oversight approaches used for government programs (for example, stage-gate reviews) are not agile - their expectations are not aligned with agile development cadences, and they are not adequately responsive to continuous unpredictable change. This article explores ways to provide insight and responsive forward looking actionable guidance for agile projects in the context of government and defense programs. It proposes a general oversight approach that produces minimal drag and disruption and keeps pace with agile product development.

SYSTEMS ENGINEERING RESOURCES

Project Lifecycle Development for a Next Generation Space Suit Project
by Michael A. Cabrera and Steve Simske

A hypothesis for an optimized, project lifecycle development method was formulated by understanding (i) the project environment of implementation, (ii) applicable, current state-of-the-art frameworks, and (iii) eliciting feedback before, during and after testing from those individuals participating in the lifecycle development framework. While traditional waterfall methods have their place, high uncertainty projects instigate exploratory work and as such, agile implementations were created to allow projects to quickly adapt (PMI 2017). In the context of dynamic environments and niche products, NASA is no stranger. Understanding the current state of the project and current state-of-the-art facilitates an approach that allows for well-established techniques in the way of lean and agile to benefit project development. Additionally, these inclusions may help expose knowledge gaps in the current state-of-the-art and also lend credibility to approaches derived to help close those gaps. This article describes the modified agile concept (MAC) and its multi-disciplinary approach to a sampling of various lean and agile methods integrated alongside traditional, waterfall methods (such as a hybrid model) to support the hypothesized project lifecycle development. This approach was developed as part of a case study with a design and test team responsible for building test stations to qualify components of the life support system on the next generation space suit. This article will outline exclusively the scrum and lean methods in the MAC with a cursory overview on kanban development supporting the MAC.

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FINAL THOUGHTS FROM SYENNA

Most months, Syenna has a tongue-in-cheek story for you, often carrying an important lesson within a humorous tone. However, for this month, she wants to strip back the humor and talk about the truth about progress. In an age where immediate gratification is the expected norm due to attributes of the zeitgeist, such as sensationalized wins of cryptocurrencies and the carefully selected posts we see on social media, it's essential to recognize the significance of consistent, small actions over time when it comes to development, whether professionally or personally. If you study any of your idols in a space that you care about, one thing will resonate among all the stories you come across: small actions taken consistently over time can yield remarkable progress over the course of say, a decade. In this article, we will explore how daily actions can contribute to significant growth and how engineers can harness this power to excel in their careers. Inspired by the book titled "The Compound Effect: Jumpstart your Income, Your Life, Your Success" by Darren Hardy, here is how to leverage one of the most pervasive concepts in the world—the power of compounding.

1. Embrace the Habit of Lifelong Learning

The foundation of any successful engineer's growth is a commitment to lifelong learning. Rather than expecting overnight mastery of new skills or technologies, prioritize consistent, small steps towards acquiring knowledge. Over the course of a year, these small increments can lead to a vast expansion of your expertise.

2. Set Clear and Achievable Goals

Break your long-term objectives into smaller, manageable goals that can be tackled on a daily basis. These mini-goals will serve as stepping stones on your professional journey. As an engineer, your goals might include mastering skills like modeling with SysML, completing certifications, enhancing your leadership or management skills, or acquiring a host of other valuable abilities.

3. Engage in Regular Practice

Practice is the cornerstone of skill development. Engineer a daily routine of challenges or tasks that require applying your skills. The consistent repetition and refinement of your abilities will lead to significant improvements and honed expertise over the years.

4. Seek Feedback and Embrace Failure

Constructive feedback is invaluable for growth. Foster an environment where feedback is encouraged and welcomed. It's essential to learn from both successes and failures. By iteratively addressing weaknesses, you can make daily adjustments that lead to gradual, long-term growth.

5. Cultivate a Growth Mindset

Embrace challenges as opportunities for growth rather than avoiding them out of fear of failure. Over the span of a decade, a growth mindset can lead to a resilient and adaptable engineer, unafraid of taking on ambitious projects and pushing the boundaries of their capabilities.

6. Build a Professional Network

Networking isn't just about attending events or conferences occasionally. Nurture your professional

connections by making it a daily habit to engage with colleagues, mentors, or industry peers. Building meaningful relationships over time can lead to collaboration, knowledge-sharing, and potential career opportunities that contribute to your long-term success as an engineer.

7. Emphasize Work-Life Balance

A successful professional development journey is not just about long hours at the office. It's crucial to maintain a healthy work-life balance to sustain your motivation and focus. Engaging in hobbies outside of work can have a significant impact on your productivity and well-being over the years.

The road to becoming an accomplished engineer is not a sprint but a marathon. By adopting a mindset of continuous improvement and focusing on small, consistent actions each day, you can witness substantial progress over the span of several years. With dedication and persistence, you will transform into a highly skilled and sought-after engineer.

"Small daily improvements over time lead to stunning results." - Robin Sharma

Regards,

Syenna