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From Insights to Action: A Systems Approach to Driving Innovation

A Rapid Immersion in Systems Thinking - Part 4

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PPI SyEN

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WELCOME

Dear PPI SyEN Readers,

I am delighted to introduce the 135th edition of PPI SyEN, which is dedicated to our theme, "From Insights to Action: A Systems Approach to Driving Innovation." In this edition, we highlight several notable developments that reflect the ongoing dynamism in the field of systems engineering. We celebrate the 20th anniversary of INCOSE's SEP Certification Program, an important milestone that underscores the enduring value of systems engineering certification. Additionally, the Modelica Association continues to make strides in simulation technology, while the PDMA Global Student Innovation Challenge 2024 highlights the ingenuity of our future engineers.

Our conference and webinar section features a myriad of events, from the Smart Cities Events in May to the INCOSE International Symposium (IS2024). Each gathering is designed not only to disseminate knowledge but also to inspire and facilitate the practical application of that knowledge in areas such as autonomous robotic exploration and cyber-physical human systems.

In our Feature Articles section, John Fitch continues with the fourth installment of 'A Rapid Immersion in Systems Thinking.' This series equips us with the tools to practically apply systems insights in solving real-world problems.

Our Systems Engineering Resources are designed to support your journey from understanding to application. Whether it's through engaging with generative AI in the OMG Journal of Innovation or enhancing ethical decision-making in engineering, each resource facilitates a pathway from insight to action.

Finally, Syenna uses a tongue-in-cheek approach to discuss the role of trusted AI in systems engineering, a pivotal area where insights are rapidly becoming integral to practice.

As you delve into this edition, I encourage you to think about how you can transform the insights provided into innovative actions in your own work. Enjoy the read, and as always, your feedback and contributions are highly valued.

Warm regards,

René

Managing Editor (on behalf of the PPI SyEN team)

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 Q1 2024 Highlights

The Q1 2024 edition of the INCOSE Members Newsletter looks forward to a year of growth in capabilities and global collaboration, while recapping the 2024 International Workshop and celebrating important milestones. A summary of various highlights is provided below.

Leadership Notes

Rolf Hartmann, the new INCOSE President, penned a welcome message that introduced his vision and priorities for his two-year term. Some of these include:

- Continued strategic growth toward Vision 2035 through initiatives such the Future of Systems Engineering (FuSE).
- Deeper member participation in INCOSE working groups and initiatives, hopefully indicated by the record attendance at the 2024 International Workshop (IS2024).
- Fostering a "*One INCOSE*" spirit.
- Amplifying INCOSE's global presence and influence, evidenced by INCOSE joining the World Federation of Engineering Organizations (WFEO) and the return of the International Symposium to EMEA after years of pandemic-influenced disruptions.

Steve Records, INCOSE Executive Director, echoed similar themes in his Q1 message:

- "We will be intentional.
- We will be global.
- We will be aligned as One INCOSE."

Strategic Plan

David Long, INCOSE Director of Strategy, reported on progress in developing a new INCOSE strategic plan. Through a series of surveys, events and analyses, the Strategic Planning Committee has defined four guiding objectives and initial actions to support these goals:

- Become the World's Trusted Authority in Systems Engineering
- Grow INCOSE and the Systems Engineering Community
- Develop the Systems Engineering Workforce
- Strive for Operational Excellence.

The planning committee is incorporating member feedback to the draft strategic plan and hopes to define year-one tactics and begin plan execution by mid-2024.

Members may find more details at the INCOSE Content Library by searching for "The Future of INCOSE" from IW2024.

Working Group Awards

INCOSE has recognized the outstanding efforts of a select few of its more than fifty working groups and initiatives through its 2023 working group awards:

- 2023 Collaboration Award: Project Management-Systems Engineering (PM-SE) Integration Working Group
- Outreach Award: Joint Translation Working Group of the German and Swiss Chapters
- Systems Engineering Vision Award: Competency Working Group
- Sustained Performance Award: Requirements Working Group
- Product of the Year: Systems Engineering Handbook Fifth Edition and Systems Engineering Competency Assessment Guide
- Service of the Year: Professional Development Portal

SySTEAM Initiative

The SySTEAM initiative, from its beginning in 2021, has progressed as an international, interdisciplinary volunteer group of diverse individuals, united by a shared interest in systems engineering/systems thinking and a desire to support SySTEAM's mission of "*improving education for all students, everywhere*". The initiative has been expanding its portfolio of activities beyond the development of its competency framework and educational resources to enable individuals to serve as advocates and champions of SySTEAM principles. A volunteer review program has been launched that matches SySTEAM community volunteers with systems education resources that are ready for review and beta testing.

Individuals interested in support INCOSE SySTEAM effort may join the SySTEAM Discord community.

Leadership Changes and Reflections

The Q1 2024 newsletter contained numerous updates on leadership and board members positions, as well as reflections based on the experiences of transitioning leaders including Marilee Wheaton (President), Serge Landry (Asia-Oceania Sector Director), Don Boyer (Associate Director of Engagement), Honor Lind (Communications Director), Richard Beasley (Services Director), Andy Pickard (Chief of Staff), Michael Watson (President Elect), Mike Dahlberg (CAB Chair) and Bernardo Delicado (new Outreach Director).

Sector and Chapter Updates

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

- AFIS, the French INCOSE chapter, held its annual congress from 16-18 January in Paris with over 220 participants learning from eight keynote speakers and a diverse range of technical presentations and round table discussions.
- NORSEC, the INCOSE Norway chapter, in collaboration with University of South-Eastern Norway (USN) has been regularly holding Systems Engineering Study Groups (SESG) to exchange experiences between people who are aspiring systems engineering practitioners. Preparations are continuing for the Kongsberg Systems Engineering Event (KSEE2024) to be held on 12-13 June.
- JCOSE, the INCOSE Japan chapter, held the Japan Symposium 2024 in Yokohama on 21 February. Keynotes were delivered to the hybrid audience by David Hetherington and Steve Records.
- The Canada chapter saw significant growth in 2023 with a 17% increase in membership, hosting of 11 technical events and receiving a Silver Chapter award. Recordings are

available for Q1 2024 events including Leveraging AI in Systems Engineering and Strategic Insights: INCOSE Canada's 2023 Retrospective and Vision for 2024.

- The Cleveland-Northern Ohio (C-NO) chapter led a SySTEAM initiative aimed at delivering an engaging, interactive systems thinking event for local high-school students.
- The Huntsville Regional chapter (HRC) participated in Alabama's Future Cities Competition in January.
- The New England chapter, working with Worcester Polytechnic Institute (WPI), contributed to a special program on Systems Engineering as part of an Engineering Ambassadors Network program.

Working Group and Initiative Updates

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

- Leveraging the INCOSE-TUS Model for Smart City Development in Darkhan, Mongolia
- Tools Integration & Model Lifecyle Management (TIMLM): Connecting the Dots to Enable Model-Based Systems Engineering (MBSE) Interoperability for Cross-Company Collaboration
- Requirements Working Group Update
- SysML v1 to SysML v2 Transition Guidance Project

Download the full (100-page) INCOSE Q1 2024 Member Newsletter for details on these and other topics.

Modelica Association News

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

Conferences and User Meetings

The proceedings of the International Modelica Conference 2023 are available from Linköping University Press.

The 16th OpenModelica Annual Workshop organized by the Open Source Modelica Consortium was held successfully in Linköping, Sweden, on 5 February 2024. View the program and presentations here.

Modeling practitioners are encouraged to start planning for their participation in upcoming Modelica conferences:

- American Modelica Conference 2024, on 14-16 October in Storrs, Connecticut, USA.
- Asian Modelica Conference 2024, on 21-22 November in Seoul, South Korea.
- International Modelica Conference 2025 on 8-10 September 2025 in Lucerne, Switzerland

SYSTEMS ENGINEERING NEWS

Modelica Vendor News

Modelica vendors highlighted numerous new capabilities:

- orchideo easySSP v1.2.11 is now available with new styling, a dark mode, 2-factor authentication and enhanced Model Editor and Trace features.
- Wolfram System Modeler 14 has been released; improved capabilities to analyze models using uncertainties, to perform automatic unit validation & inference, and to distribute libraries.
- The 2024.1 release of Modelon includes a new feature for workspace sharing and updated Excel Add-in capabilities. Significant enhancements and additions to models are available for Energy and HVAC, Aerospace, and Automotive. The Modelon INNOVATE conference/workshop is planned for 10-11 October in Copenhagen, Denmark.

News from Libraries

Numerous Modelica libraries have expanded their capabilities. See details here.

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

PDMA Global Student Innovation Challenge 2024

The Product Development Management Association (PDMA) has announced the opening of the Global Student Innovation Challenge (GSIC) 2024. Submissions will be accepted through 1 June.

The goal of the Global Student Innovation Challenge is to drive engagement and grow relationships between students, academia, and industry professionals. Specific objectives for this university-level competition include:

- Leveraging students' passions to learn product development methodologies and frameworks through developing product solutions to real world problems.
- Promoting best practices in product innovation.
- Partnering with professors and industry professionals in the development of the next generation of highly skilled innovators and product leaders.

University student teams who develop an original concept for a product, service, software, or a combination of the three, will develop a submission detailing the unique value proposition, evidence of demand, and mockup or embodiment of product. Designs for products, services or software of any type are welcome. Students are welcome to expand on the academic work for their theses or capstone projects as the basis of their entry.

Finalist teams will have the opportunity to present their concepts, prototypes, and mockups at PDMA's Inspire Innovation Conference & JPIM Research Forum on 14-17 September in St. Louis, Missouri, USA.

See more details here. Submit projects through EasyChair.

Submissions Record for International System Dynamics Conference

The System Dynamics Society (SDS) reports that over 500 submissions have been received for its annual International System Dynamics Conference (ISDC 2024) that will be held on 4-8 August 2024. The in-person portion of this hybrid event will take place in Bergen, Norway. The theme of ISDC 2024 is "*Bridging Perspectives for New Insights*".

The SDS attributes the record number of submissions to the growing global interest in System Dynamics and the commitment of the System Dynamics community to advancing the field.

Learn more about ISDC 2024.

Tom Sawyer Software Perspectives 13.0 Beta Release

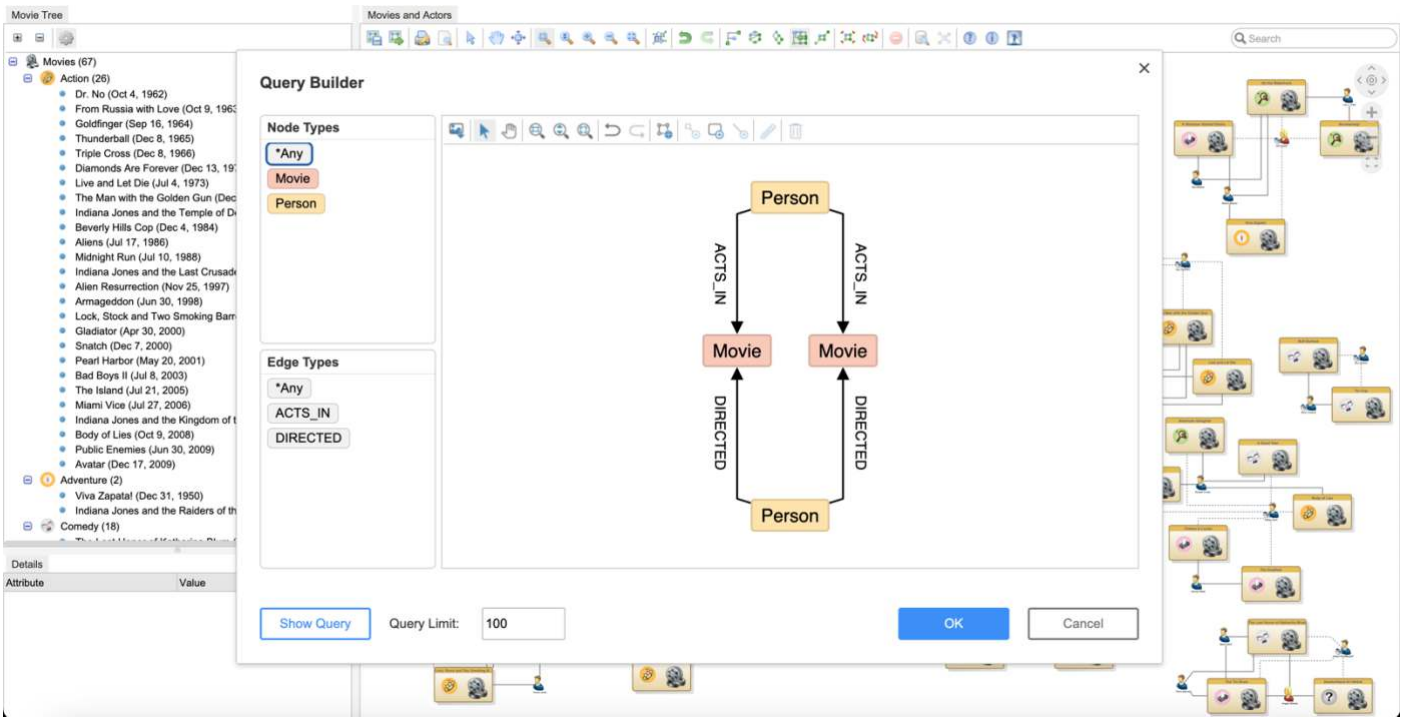
Tom Sawyer Perspectives is a low-code graph visualization and analysis development platform. The recent 13.0 Beta release of Perspectives provides a preview of several significant enhancements, including:

New Look-and-Feel with React-based Web Client Framework

The new React-based web client framework for Perspectives 13.0 delivers a modern look-and-feel to Perspectives applications for an improved user experience. The Generate Web Application Code feature supports the creation of web applications based on React.

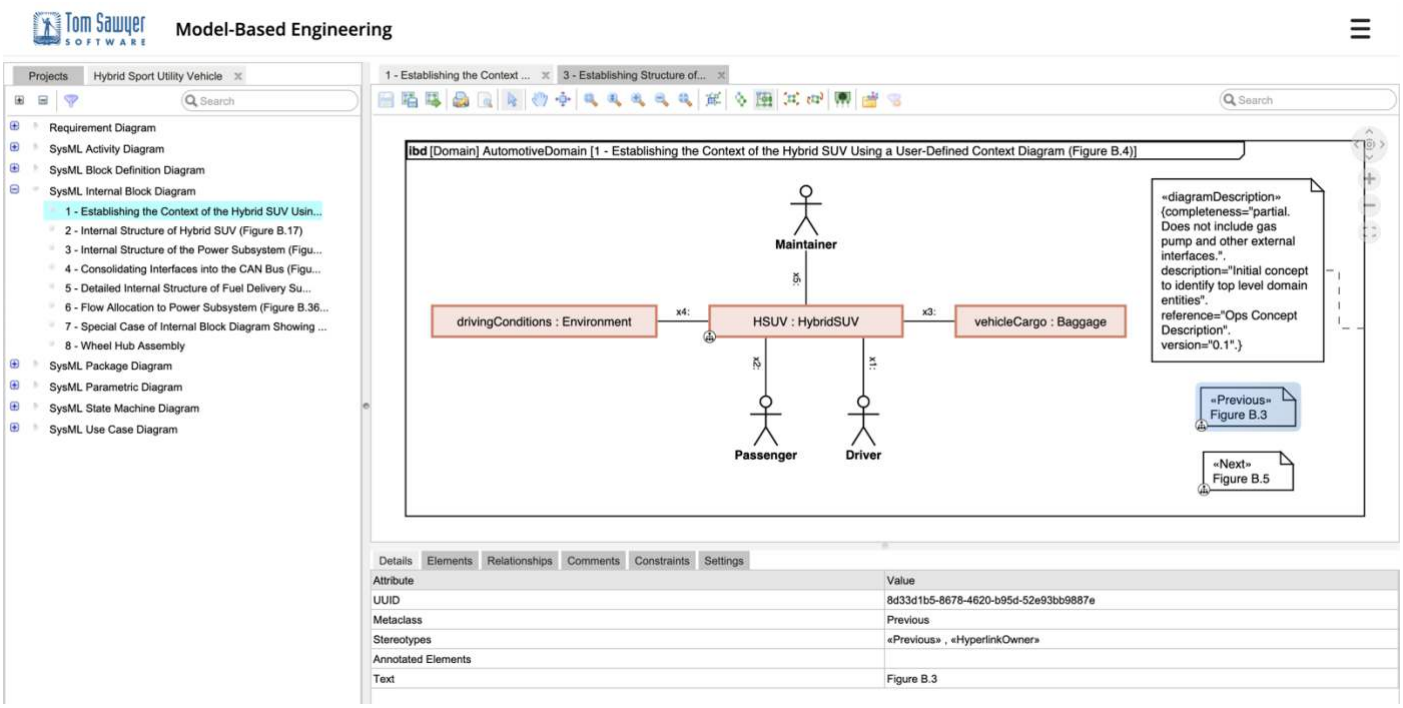
Visual Query Builder with Advanced Pattern Matching

The Query Builder within Perspectives has been enhanced to enable users to search for graph patterns through an intuitive graph visualization—without the need to know the Gremlin or Cypher query languages. Query patterns that are based on the database schema can help users to quickly uncover insights and explore their data.



Resource Description Framework (RDF) Commit
The Perspectives RDF Integrator now supports CRUD operations yielding an improved user experience when interacting with the database and providing increased efficiency and flexibility.

Diagram Navigation in Tom Sawyer Model-Based Engineering
Users may exploit links that were previously established in Teamwork Cloud or MagicDraw to seamlessly move between Model-Based Engineering diagrams.



For additional details on the 13.0 Beta release, see the Perspectives release notes.
Watch a video introduction to the 13.0 Beta release here.
Visit the Tom Sawyer Software blog for interesting articles that address the application of knowledge graphs to a variety of use cases:

- Exploring Knowledge Graph Use Cases
- The Power of Knowledge Graph Visualization Tools
- Growing Pains: Learning from SysML v1
- Automating Swimlane Diagrams
- Graph Visualization and Analysis Best Practices for Unstructured Data

Learn more about Tom Sawyer Software solutions.

INCOSE Celebrates 20 Years of SEP Certification and a Special Discount for CTI's INCOSE SEP Exam Prep course

This year marks a monumental milestone for the International Council on Systems Engineering (INCOSE) as it celebrates the 20th anniversary of its Systems Engineering Professional (SEP) Certification Program. Launched to elevate standards of systems engineering excellence, the program has significantly exceeded its initial goals by fostering professional growth and setting a global competency benchmark in the field.

Since its inception, the SEP Certification Program has certified over 4,000 professionals—including 1,629 Associate Systems Engineering Professionals (ASEPs), 2,409 Certified Systems Engineering Professionals (CSEPs), and 344 Expert Systems Engineering Professionals (ESEPs) as of January 1, 2024.

As INCOSE reflects on two decades of defining the systems engineering profession, it encourages professionals at all career stages to become part of this esteemed group of certified SEPs. SEP certification serves as a valuable asset for those starting their career or looking to bolster their expertise, acknowledging their skills, knowledge, and professional dedication.

In celebration of this significant anniversary, Certification Training International (CTI) is delighted to offer a 20% discount* to participants who register for a public offering of CTI's INCOSE SEP Exam Prep Course before June 30th using the code INCOSE20. The discount is available for courses through the end of 2024, but payment must be made by June 30th for the discount to apply.

CTI's INCOSE SEP Exam Prep course is meticulously designed to prepare candidates for success in achieving SEP certification. Suitable for both early-career engineers and seasoned practitioners, the course not only prepares participants for the INCOSE Knowledge Exam but also enriches their understanding of systems engineering principles and processes.

As we honor 20 years of enduring learning, professional growth, and accomplishments, CTI looks forward to the bright future of the SEP Certification Program as it continues to adapt to the field's evolving challenges and opportunities. Celebrate this milestone with us and embark on your certification journey with CTI's INCOSE SEP Exam Prep course at a significantly discounted rate for a limited time only.

**This special offer cannot be used in conjunction with other discounts*

Updates to the SE Tools Database (SETDB)

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

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

Vendor: Beijing Zhongke Fengchao Ltd

- MetaGraph: The multi-architecture modeling tool MetaGraph 2.0 is an architecture modeling and analysis tool.

Vendor: Dassault Systemes

- Reqtify: Requirements management tool intended for use by teams for managing requirement, traceability and impact analysis across different systems, programs and project levels across the entire hardware and software development lifecycle.

Vendor: Logical Decisions

- Logical Decisions®: Evaluates choices by considering many variables at once, separating facts from value judgments, and explaining your choice to others. Logical Decisions uses techniques from the field of decision analysis to help you make more effective decisions.

Vendor: Pivotal Labs

- Pivotal Tracker: Project management tool intended for software development teams for planning and tracking development against a backlog of stories. A shared backlog makes priorities clear so a project team can stay organized by visually determining scope, priority and changes.

Vendor: PragmaDev

- PragmaDev Studio: A set of tools used to specify and design communication systems. It features design and testing support for multiple design phases.
- PragmaDev Process: A simple and powerful tool that aims at helping business process modelers to verify their models. It integrates a BPMN editor, executor and explorer.

Vendor: Siemens Teamcenter

- Teamcenter Model Based Systems Engineering: MBSE (model-based systems engineering) is a critical part of Teamcenter product lifecycle management (PLM). MBSE with Teamcenter, brings together multi-domain product development – mechanical, electrical, and software - along with considerations like cost, reliability, and manufacturability.
- Teamcenter Integrated Requirements Engineering: Captures and manages requirements and enables you to allocate (trace) them to downstream functional, logical and physical architectures - all while generating the reports, documentation, and dashboards to manage the requirements process.

Vendor: SPEC Innovations

- Innoslate: Innoslate, the first web-based MBSE tool, was developed by SPEC Innovations to support the entire system or product lifecycle. This cloud or on-premise application simplifies system or product development while reducing time-to-market, cost, and risk.

Vendor: Statistical Design Institute

- Apogee: The statistical analysis, allocation and optimization engine of the SDI Toolset. Apogee works with mathematical functions Y=f(X) that you create freeform in Excel workbooks. Apogee then provides statistical capabilities for assessing and improving the variation of the responses.
- Apogee: Monte Carlo: Monte Carlo analysis is a powerful way to assess the magnitude and shape of response variation caused by the variation of the parameters. It approximates each response distribution by randomly generating single values for each of the input parameters, and computing a value for each response.
- Apogee: Sensitivity Analysis: Sensitivity analysis assess the magnitude of response variation caused by the variation of the parameters, identifies key drivers of response variation. The response mean and standard deviation are computed using the input parameter means and standard deviations and low-order partial derivatives.

- Apogee: Allocation: Allocation identifies the amount of parameter variation that will improve a response's variation to a desired level. Driver values are used to help guide the parameter standard deviations in sensible directions.
- Apogee: Optimization: Optimization searches for new parameter values that will drive multiple response values to desired targets. This is accomplished by defining a range of feasible values for each parameter (continuous, integer, or discrete) and by defining constraints and goals for the statistics of each response.
- SDI Tools v4 TRIPTYCH: Provides support for documenting and clarifying the requirements, generating ideas, and selecting design alternatives.

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.

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

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

P006-939	Eindhoven, the Netherlands CEST 8:30 (UTC +2:00) In-Person	10 Jun – 14 Jun 2024
P006-940	Las Vegas, USA PDT 8:00 (UTC -7:00) In-Person	17 Jun – 21 Jun 2024
P006-941-1	Asia SGT 6:00 (UTC +8:00) PPI Live-Online™	24 Jun – 28 Jun 2024
P006-941-2	Oceania AEST 8:00 (UTC +10:00) PPI Live-Online™	24 Jun – 28 Jun 2024
P006-942	London, United Kingdom BST 8:30 (UTC +1:00) In-Person	29 Jul – 02 Aug 2024
P006-943-1	North America MDT 8:00 (UTC -6:00) PPI Live-Online™	29 Jul – 02 Aug 2024
P006-943-2	South America BRT 11:00 (UTC -3:00) PPI Live-Online™ *(Exclusive to South America)*	29 Jul – 02 Aug 2024
P006-944	Las Vegas, USA PDT 8:00 (UTC -7:00) In-Person	05 Aug – 09 Aug 2024
P006-945-1	Asia SGT 6:00 (UTC +8:00) PPI Live-Online™	19 Aug – 23 Aug 2024
P006-945-2	Oceania AEST 8:00 (UTC +10:00) PPI Live-Online™	19 Aug – 23 Aug 2024
P006-946-1	Europe CEST 9:00 (UTC +2:00) PPI Live-Online™	23 Sep – 27 Sep 2024

CONFERENCES, MEETINGS & WEBINARS

Smart Cities Events in May

The Smart Cities Council (SCC) hosts, supports, or recommends a variety of global events that address the challenges of urban development. Two such events are planned for May 2024.

Smart City Expo USA: New York, NY USA, 22-23 May

SMARTCITY EXPO USA

This U.S. edition of the Fira Barcelona Smart City Expo World Congress is hosted in partnership with the City of New York, the African American Mayors Association, and the National League of Cities.

In addition to a diverse range of leadership talks, the event will host educational sessions in multiple tracks that offer solutions for urgent issues facing cities:

- Infrastructure & Design
- Energy & Sustainability
- Mobility & Transportation
- Frontier Technologies
- Law, Policy & Finance
- Safety & Civic Engagement

Download the draft program agenda. Register here.

Smart Cities Week Aotearoa: Auckland New Zealand: 27-28 May

The Smart Cities Council of Australia and New Zealand, in partnership with Spark NZ, is hosting Smart Cities Week Aotearoa in Auckland New Zealand on 27-28 May. *Aotearoa* is the Maori name for New Zealand.

The event will include workshops, master classes, panel discussions, demonstrations and use case presentations on topics including:

- Healthcare
- Transport and Mobility
- Data
- Built Environment
- Enabling Technologies: Digital Twins, IoT, AI
- Energy, Resources and Environment
- Governance and Economy
- Living and Inclusion
- Safety and Security
- Tourism
- Circular Economy / Getting to Net Zero
- Resilience and Disaster Preparedness

Register here.

Check back for more upcoming Smart Cities events.

ISACA 2024 CMMI Conference

ISACA is a global professional association and learning organization with 170,000 members who work in digital trust fields such as information security, governance, assurance, risk, privacy, and quality. ISACA is committed to the advancement of digital trust by empowering IS/IT professionals to grow their skills and knowledge in audit, cybersecurity, emerging tech and more. In support of this mission, ISACA is hosting its 2024 Capability Maturity Model Integrated (CMMI) Conference in Phoenix, Arizona, USA on 8-10 May.

Keynotes talks for this in-person event include:

- Building Trust in Distrustful Times (Neil Pasricha)
- Awkward and Upward: How Awkwardness Can Be Your Greatest Asset for Taking More Professional Risks (Henna Pryor)

Conference tracks (domains) include:

- CMMI Adoption – V3.0 Experiences and Transition
- Frameworks; Models; Standards; and Methodology Integration
- Highly Regulated Projects
- Performance and Quality Measurement Results

A sample of the topics included in the conference agenda include:

- CMMI Performance Solutions Ecosystem - What's in it for the C-Suite?
- CMMI V3.0 Early Adoption Panel
- Crawl, Walk, Run: The Incremental, Low-stress Path to High Maturity Using CMMI
- Driving Innovation and High Performance in Government Contracting with CMMI
- Process Change Management in a High Maturity Organization
- Reducing Attack Vectors and Vulnerabilities Using the CMMI-Security Best Practices
- The Impact of AI: Amplifying Human Capabilities
- Transitioning from Customer Experience (CX) to Total Experience (TX) Leveraging CMMI Ver 3.0

Learn more.
Join ISACA.

CONFERENCES, MEETINGS & WEBINARS

INCOSE LA Webinar: Pushing the Boundaries of Autonomous Robotic Exploration of Planetary Bodies

The INCOSE Los Angeles chapter will be hosting a hybrid presentation on 14 May featuring Dr. Issa Nesnas, a principal robotics technologist at the Jet Propulsion Laboratory and associate director at Caltech's Center for Autonomous Systems and Technologies. Dr. Nesnas will speak on *Pushing the Boundaries of Autonomous Robotic Exploration of Planetary Bodies*. The in-person venue will be the Aerospace Corporation in El Segundo, California, USA.

Abstract:
Over the past two decades, several autonomous functions and system-level capabilities have successfully been demonstrated and used in deep-space operations. In spite of that, spacecraft today remain largely reliant on ground in the loop to assess situations and plan next actions, using pre-scripted command sequences. Advances have been made across mission phases including spacecraft navigation; proximity operations; entry, descent, and landing; surface mobility and manipulation; and data handling. But past practices may not be sustainable for future exploration. The ability of ground operators to predict the outcome of their plans seriously diminishes when platforms physically interact with planetary bodies, as has been experienced in two decades of Mars surface operations. This results from uncertainties that arise due to limited knowledge, complex physical interaction with the environment, and limitations of associated models.

In this talk, Dr. Nesnas will share advances in the architecture, development, and deployment of autonomous systems for space applications, highlighting recent advances in entry descent and landing, rover navigation, and extreme terrain mobility. He will also describe progress toward future architecting of autonomous system and summarize anticipated needs based on recommendations from the Planetary Science and Astrobiology Decadal Survey.

Learn more and register here.

Business Analysis (BA) & Beyond EU - Events in May-June

As part of the International Institute of Business Analysis™ (IIBA®) global events series, various European chapters of the IIBA are hosting the 2024 BA & Beyond conference at multiple sites in Denmark, the Netherlands, Belgium, and Luxembourg between 28 May through 6 June. The theme of this in-person conference is "*Connect – Interact - Act*" to highlight how engagement among business analysis practitioners can lead to tangible actions and results.

Conference sites and their dates include:

- 28 May – Denmark
- 30 May – The Netherlands
- 3-4 June – Belgium
- 6 June - Luxembourg

Talks will cover classic BA techniques and skills and their use in meeting today's challenges, plus

presentations on new and related tools, techniques, skills, and approaches. A sample of the topics to be addressed include:

- BA tools & techniques that stand the test of time
- Matching new approaches and technologies with legacy processes and systems
- The role of the business analyst in digital transformation, design thinking, innovation, data science, machine learning, …
- AI beyond the hype
- Genuine stories of struggles and successes in organizational change

Learn more and register.

Learn more about IIBA.

Transform! @ InfoComm 2024

The Object Management Group (OMG) is sponsoring a new conference that spotlights the convergence of the physical and digital worlds. Transform! @ InfoComm 2024 will focus on innovation that supports organizations in their digital transformation journey. This in-person conference will take place on 12-14 June in Las Vegas, Nevada, USA and will be run in conjunction and co-located with the OMG's Q2 Technical Meeting that will take place from 10-14 June.

The dynamic landscape of innovation across diverse industries will be highlighted by topic areas that include:

- Cybersecurity
- Generative AI
- Augmented Reality
- Digital Twins
- Responsible Computing
- IoT and Edge
- Business Architecture Modeling

Common themes that will be explored across these topics include:

- Data Integration
- Interactivity
- Advanced Computing
- Ethical Considerations

Search the detailed agenda here.

Conference attendees will also receive full access to MIT Horizon Essentials – online libraries, events, and experiences that distill technical expertise into easy-to-digest resources.

Register for Transform! @ InfoComm 2024.

Read the original conference announcement.

Functional Analysis Resonance Method (FRAMily) Workshop

The Functional Analysis Resonance Method (FRAM), an outgrowth of Resilience Engineering, provides a way to describe system outcomes using the idea of resonance that arises from the variability of everyday performance.

FRAM is based on four principles:

- Equivalence of Successes and Failures: Systems go right and wrong in the same way.
- Approximate Adjustments: Socio-technical systems never precisely match their specified conditions, requiring approximate adjustments by actors and resulting in performance variability.
- Emergence: Both failures and normal performance are emergent properties of the whole system. Variability in multiple functions may combine in unexpected ways to produce disproportionate, non-linear consequences.
- Functional Resonance: The variability of multiple functions may resonate, i.e. reinforce each other, and thereby cause the variability of one function to be unusually high. Such consequences may spread dynamically through tight functional coupling. Functional resonance is the detectable signal that emerges from the unintended interaction of the normal variabilities of many signals.

Learn more about FRAM here.

The FRAM community is hosting their *16th FRAMily meeting/workshop* on 3-7 June at Lund University, Sweden. The aim of the workshop is to enable participants to share experiences from research and practice in using FRAM to analyze activities.

Embedded in the FRAMily meeting is the *6th International Workshop on Safety-II in Practice* which will take place on 6-7 June. This workshop provides an opportunity for safety professionals and researchers to debate the strengths and weaknesses of the Safety-II approach and to share ideas for further development of this methodology.

Learn more about the conference. Register here.

Front End of Innovation (FEI 2024) Conference

From 10-12 June, Boston, Massachusetts, USA will be the site of the 21st Front End of Innovation (FEI 2024) conference. The theme of FEI 2024 is "*Supercharge Innovation: Corporate Changemakers Unite*". Participants will have the opportunity to learn from thought leaders across diverse roles (corporate innovators, R&D executives, product designers, transformation team leaders, etc.) and multiple industries.

Keynote talks and panel sessions for FEI 2024 include:

- Lessons Learned from Actual Humanity-Centric Innovation (panel session)

- Prompt Engineering & Innovation Evolution (Sanjana Paul, Earth Hacks)
- The Front End of Universal Interaction (Kate Carruthers, University of New South Wales)
- Net Zero Emissions Competition (panel session)
- Gen Z Focus (panel session)
- Brunch with the Bots (panel session)

Topics to be addressed in over 80 planned presentations include:

- Attaining Enterprise Collective Intelligence from AI & Tacit (Human) Organizational Knowledge
- Gamified Corporate Start-Up Venturing
- Driving Forward from Sustainability to Circular Economies
- Driving Innovation with Direct Insight from Gen Z
- Generative AI Use Case Facilitated Networking
- Hands-on Interactivity with Next Generation Technology

Presentation tracks include:

- Strategy & Transformation
- Process
- People & Culture
- AI, Data, Analytics & Insights
- R&D, Product Development, Design
- Customer 2024 / Future Trends

Search the detailed agenda for topics of interest.

Learn more about FEI 2024. Download the conference brochure.

Register for FEI 2024.

INCOSE International Symposium (IS2024) Preliminary Program - Book of Abstracts

The preliminary technical program for the INCOSE International Symposium (IS2024) is now available online, along with the IS2024 Book of Abstracts. IS2024 is being offered as a hybrid conference to be held from 2-6 July 2024. The in-person venue is the Dublin, Ireland Convention Centre.

PPI SyEN readers are encouraged to search the program for topics of interest. Some early gleanings are shared below.

Tutorials to be offered include:

- Dimensional Analysis. A helpful practice for identifying constraints on a system model developed using ISE&PPOOA MBSE methodology
- Embracing the Social Dimension of Systems Engineering
- Hands-on Journey on Variant Modelling with SysML: Features Models, Methods, SysML v2,

and AI Insights
- Open-Source System Modeling with Python
- Security as a Foundational Perspective in Systems Engineering: Engineering Trustworthy Secure Systems
- Systems Engineering for a Sustainable Future: Leveraging Emerging Technologies and Systems Modernization
- Use a Framework for SE in Early-Stage R&D to Build Your Bridge that Spans the Chasm Between Research and Engineering

Multiple panel discussions will enliven the conference as seasoned practitioners and thought leaders share their insights and likely debate their differing perspectives:

- Building Cultural Intelligence: The Role of Organizational Culture in Nurturing Leaders in Systems Engineering
- Empowering real world complex problem solving: Socio-technical Applications of Model-Based Systems Thinking (MBST)
- Participatory Methods in SE
- Peace, Love, and Digital Understanding: How system models will bring us all together
- Smart Cities from architecture to application: A socialization of industry best practices
- What works and what does not work in teaching non-Systems Engineers about systems thinking?

IS2024 will conduct six concurrent technical tracks including 200+ papers and presentations. A sample of eye-catching presentation titles may be of interest:

- A Model for Trust and Distrust: The Systems Dynamics Approach
- Accelerating Digital Transformation through MBSE, Multi-physics Simulation and Digital Twin in Industry
- AI Systems Modeling Enhancer (AI-SME): Initial Investigations into a ChatGPT-enabled MBSE Modeling Assistant
- All Decisions Are Reconciliations of Inconsistencies: Preparing for the Digital Thread and Machine Learning
- Architecture of Nature-Based Smart City Introducing BaaS by Utilizing UAF
- Black Hole Cinema: Application of Systems Engineering Methods to Expand and Enhance an Earth-sized Telescope
- Darth Vader's Secret Weapon: Implementing Mission Engineering with UAF
- Designing for Resilience: Integrating Ecology into Engineered Systems
- Evolving Roles in Systems Engineering - Insights from Germany’s Mechanical and Plant Engineering Sector
- Exploring the Notion of Verification Complexity
- Human Frailties: Springboard to Increased Systems Engineering Influence
- Modeling of Uncertainty in System and Enterprise Models
- Projects Doomed to fail before they start - Early Lifecycle Activities are missing
- Safer Complex Systems
- The Importance of being Björn - Experiences from Five Generations of Female Engineers
- Three Dimensions of Precision Digital Engineering
- Using Systems Engineering and Decision Analysis in Descriptive, Predictive, and Prescriptive Analytics
- When Moving Backward Means Moving Forward – Educating Systems Engineers in

Designerly Ways of Thinking

See more details at the IS2024 event web site.

See registration details here.

Call for Submissions: INCOSE Western States Regional Conference (WSRC)

The INCOSE Western States Regional Conference (WSRC 2024) will be held in Albuquerque, New Mexico, USA on 19-21 September 2024. The theme of this hybrid conference is *Building a more secure world through systems engineering*.

The Call for Submissions for WSRC 2024 has been issued, seeking presentations, tutorials, and student posters in a wide range of topic areas:

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

The abstract submission deadline is ***1 May 2024***, with notification of acceptance anticipated by 3 June.

Abstracts should be submitted through EasyChair.

Learn more about WSRC 2024.

Call for Papers: IFAC Workshop on Cyber-Physical Human Systems (CPHS)

IFAC INTERNATIONAL FEDERATION OF AUTOMATIC CONTROL CPHS2024

The International Federation of Automatic Control (IFAC) is hosting the 5th IFAC Workshop on Cyber-Physical Human Systems (CPHS2024) in Antalya, Turkey on 12-13 December 2024. The Workshop will bring together researchers and practitioners to share scientific and technological advances, and to gain a deeper understanding of cyber-physical human systems. The workshop will focus on modeling, design, analysis, control, verification, and certification of CPHS, including theoretical, algorithmic, computational, and experimental aspects, with emphasis on:

- Modeling, analysis, and control of integrated CPH

- Social and societal aspects of CPHS
- Security, privacy, and ethics in CPHS
- Human behavior and teaming of humans and autonomy
- Safety-critical and resilient CPHS
- CPHS applications, including healthcare, transportation, human-space technology, and smart infrastructure.

The Call for Papers for CPHS2024 has been issued with initial deadlines:

- Initial submission: 17 May
- Decision notification: 15 August
- Final submission: 15 September

Regular papers (4-6 pages) and invited sessions (up to six papers with a common theme) are sought.

Authors of selected papers will be invited to submit their contributions to:

- A CPHS book "Cyber-Physical-Human Systems: Fundamentals and Applications".
- A special section on CPHS in the journal Annual Reviews in Control.

Download the Call for Papers flyer.

Learn more about CPHS2024. Learn more about IFAC.

Call for Papers: System Analysis and Modelling (SAM2024) Conference

A Call for Papers has been issued for the 16th System Analysis and Modelling conference (SAM2024) The theme of this conference is *Challenges and Opportunities of Systems Modeling and Analysis in the Era of AI and the Metaverse*. SAM2024 will be held on 23-24 September 2024 at Johannes Kepler University in Linz, Austria and will be co-located with the Models 2024 conference.

SAM2024 provides a forum for participants from academia and industry to present and discuss the most recent innovations, trends, experiences and concerns in modeling, specification, analysis, implementation, and monitoring of complex systems. Languages of interest include:

- ITU-T's Specification and Description Language (SDL 2010)
- Message Sequence Chart (MSC) notations
- UML/SysML
- ASN.1
- TTCN-3
- User Requirements Notation (URN).

Topics of interest include:

- Evolution of languages
- Model-driven development
- System engineering models

- Industrial application and tools

The conference seeks submissions, both academic and industrial, in the following categories:

- Full papers describing original, unpublished results (max 10 pages, including figures, appendices, and references in IEEE format).
- Short papers, describing work in progress (max 6 pages, including figures, appendices, and references in IEEE format).

Important dates:

- Paper submission deadline: 24 June 2024
- Notification of acceptance: 29 July 2024
- Camera-ready version deadline: 19 August 2024

Learn more about SAM2024 Conference and paper submission guidelines.
Learn more about the SDL Forum Society, sponsors of SAM2024.

Call for Presentations: NAFEMS Multiphysics Conference 2024

NAFEMS has issued a Call for Presentations for its Multiphysics Conference 2024 that will take place in the Carlton Hotel, Singapore on 21-23 October. The theme of this conference is *Elevating Precision in Simulation Engineering*. In keeping with that theme, NAFEMS seeks presentations from users, researchers, academics, and developers of multiphysics simulation methods that present their work, exchange ideas, develop the community, and discuss potential challenges.

Presentations on all aspects of multiphysics and coupled simulation are sought, with particular focus on the following areas:

- The potential of Artificial Intelligence (AI) and Machine Learning (ML) to be part of multiphysics simulations.
- Cloud computing and digital twins in multiphysics.
- Maturity, quality assurance, and benchmarking of multiphysics simulations.

View the conference overview and Call for Presentations here.

Presentation abstracts are due by 31 May. Submit abstracts here.

FEATURE ARTICLE

A Rapid Immersion in Systems Thinking - Part 4

by John Fitch

Project Performance International

Authored for PPI SyEN

Introduction

In this fourth article in this series, we continue our coverage of System Archetypes (behavioral patterns) as taught in a set of nine on-demand, self-paced courses offered online by the Waters Center for Systems Thinking. The archetypes include:

- Fixes that Backfire
- Success to the Successful
- Limits to Growth/Success
- Escalation
- Shifting the Burden
- Drifting Goals
- Tragedy of the Commons
- Accidental Adversaries
- Repression and Revolution

In Part 3 of this series, we explored the first four archetypes. This article (Part 4) will complete the review of the archetypes and summarize key lessons from the series.

Readers are reminded that these articles represent a learning "work in process", not an authoritative treatise on systems thinking or system dynamics. The author willingly invites critique that can deepen the understanding of the PPI SyEN readership. Please send such critique to PPISyEN@PPI-Int.com.

Please refer to the Part 3 article in PPI SyEN Edition #133 (February 2024) for an overview of the information that is included in a system archetype.

Archetype #5: Shifting the Burden

The *Shifting the Burden* scenario may exist when a short-term solution to a problem creates a side effect that undermines the ability to implement a fundamental, long-term solution. Both the short-term solution and long-term solution may be viewed as balancing feedback loops that alleviate symptoms, however, the additional time delay associated with the fundamental fix leads to the short-term (symptomatic) solution being implemented first.

This sets up a dominant side effect in which the system becomes dependent on the short-term fix, reducing the focus on and resources allocated to finding and deploying the permanent solution. As a result, the system is "stuck with" the short-term fix forever, even as symptoms continue and worsen as a result of the inadequacies of the short-term fix.

Problem Symptom	Triggers symptomatic solution efforts [s]	Triggers fundamental solution efforts [s]	
Quick fix alleviates symptom & pain [s]	**Symptomatic Solution (quick fix)**		***System becomes dependent on quick fix [s]***
Delayed relief from symptom & pain through long-term fix [s]		**Fundamental Solution (long-term fix)**	
		Moves focus & resources away from fundamental solution [o]	**Side Effect**

Shifting the Burden scenario as an N-Squared Diagram

Examples of the Shifting the Burden dynamic shared in the course include:

- Use of caffeine to fight fatigue, though the dependency on caffeine works against healthy sleep habits – a better method of resolving fatigue.
- Crisis mode efforts on a project that is in trouble in which rewarding heroic behavior (e.g., excessive dependence on overtime) diminishes the focus on careful and realistic resource planning.

The fundamental solution for the Shifting the Burden scenario is to acknowledge the dependency on the quick fix while looking for and attacking the root cause(s) behind the presenting symptoms that cause the immediate pain.

A prime historical example of overcoming the Shifting the Burden dynamic lies in the rise of the Toyota Production System (TPS) as the leading model in automotive manufacturing. [1] Toyota's pursuit of continuous improvement led to rejection of short-term solutions. Rather than expediting production with heroic efforts, Toyota adopted a "stop-the-line" approach as soon as production defects were identified, triggering careful root-cause analysis and the development of a "fix-the-problem-forever" solution. This operating model has become so globally successful that it triggered the growth of Lean methodologies that have spread outside of automotive manufacturing to other product domains and business processes.

Reflections

Skilled use of Problem (Root Cause) Analysis results in a more thorough framing of the problem beyond symptoms and addresses root cause(s) with corrective actions rather than problem effects with adaptive or interim actions (workarounds). The Shifting the Burden pattern is better thought of as a trigger for effective Problem Analysis that asks "Why?" or "What caused the cause?".

Deeper cause-effect understanding makes it possible to attack negative behaviors far "upstream" from the observed, yet painful symptoms.

The Shifting-the-Burden scenario may complement and reinforce the Success to the Successful scenario by rewarding heroic behaviors. This approach leads to misallocation of resources to firefighters rather than problem preventers. People who plan well and execute to the plan are seldom seen as exciting leaders. If the stereotype holds, there is high correlation between people with introverted personalities and people who excel at planning. A fusion of the Shifting-the-Burden and Success to the Successful archetypes may give better insight why and how short-term symptom-focused fixes generally win out over permanent solutions.

Proper focus on fundamental solutions can be promoted with a robust decision management and decision analysis framework. Because the time-delay associated with fundamental solutions makes the quick fix more attractive, system designers should balance the urgent desire for a solution against longer-term performance-focused criteria. Proven criteria patterns associated with a decision pattern can help provide this balance. The author developed a meta-pattern for the criteria for any decision that can be recalled through the mnemonic, C4SP, where criteria may be categorized as:

- Cost
- Schedule
- Performance
- Compliance
- Compatibility
- Consistency

The fundamental solution will more often be chosen if we define a comprehensive and balanced set of evaluation criteria. Long-term factors such as performance, compliance, compatibility, and consistency will tend to overwhelm the contribution of the schedule-focused criteria that favor the quick fix.

Archetype #6: Drifting Goals

The *Drifting Goals* archetype is present when pressure to lower an established system goal wins out over the willingness wait to see if actions that have been taken would have eventually led to goal achievement.

The scenario begins with the recognition that a gap exists between an established system goal and the actual state of the system, i.e., its performance or effectiveness against that goal. The awareness of the gap triggers the perceived need for corrective action to close the gap. If the corrective action takes time to implement and to reduce the gap, that time delay creates pressure to lower the goal, i.e., to reduce the gap by other means. By reducing the gap by reducing the goal, the support for corrective action wanes. The goal-lowering feedback loop becomes dominant and lower performance than originally desired is perceived as sufficient.

Pressure to Lower Goal	Reduces goal [o]			
	Goal	Reduced goal reduces gap [s]		
Gap creates pressure to lower the goal [s]		**Gap**	Gap stimulates corrective action [s]	
			Corrective Action	Action improves system performance [s]
		Imrpoved performance reduces gap [o]		**Actual**

Drifting Goals scenario as an N-Squared Diagram

This behavioral pattern might also be aptly named "Lowering the Bar" or "Settling for Mediocrity".

The fundamental solution for the Drifting Goals dynamic is to develop and exercise patience to allow corrective actions to produce their intended results. This may be accomplished by:

- Accurately assessing the gap.
- Deciding on the most effective set of corrective actions to achieve the original goal.
- Recognizing the inherent time delay between corrective action implementation and expected results, measure accordingly.
- Establishing a stakeholder value model and develop continuous improvement culture.

A relevant example of the Drifting Goals scenario may be the impact on highway safety and occupant survivability associated with deploying more Electric Vehicles (EVs). A typical passenger EV may be as much as 1000 pounds (~500 kg) heavier than an equivalent automobile powered by an internal combustion engine. This mass is also concentrated in the vehicle floor where the battery pack resides; lowering the center of mass and how an errant vehicle might interact with highway barriers (guard rails, cables, or sand-filled deceleration barriers). See *Rethinking Requirements Derivation – Part 2* in PPI SyEN Edition #130 (November, 2023) for a discussion on deceleration barrier design and performance.

In the Drifting Goals scenario an increasing gap may be discovered between the expected (based on history and highway safety design standards) vs actual levels of crash survivability as a result of increased numbers of EVs on the roadways. The government agencies responsible for highway safety will likely generate cost estimates for improvements that will correct the tendencies of EVs to breach barriers, but these corrective actions will require costly fixes to highway infrastructure and years of construction projects to complete. Looking at both the time and expense involved in corrective actions, there will be a strong temptation to lower crash survivability goals at least for a period of time until budgets and construction schedules can keep pace with the new mix of vehicles. If not monitored carefully, jurisdictions may accept the lower survivability standards as the new normal.

Reflections

As taught in the Waters Center course, the Drifting Goals archetype focused on a single goal that was

under pressure to be relaxed because of the delay in implementing corrective actions. A more thorough causal model should include multiple goals, some of which are under pressure and others which might see performance improvement (growth in margin) in the same system design. A separate causal loop model would be required for each system design alternative in order to accurately model these tradeoffs. The scale and complexity of these multi-variable models is a concern, expressed as:

- *How might the Causal Loop Diagram visualization reach its limits when multiple competing value measures are in play?*

Requirement baselines are a proven systems engineering method for taking a snapshot that defines success for a system and providing a basis for controlling changes thereafter. Formal change control may reduce the ability to relax requirements or at least proactively highlight the side effects in doing so.

If progress toward the goal that is at risk in the Drifting Goals scenario can be monitored periodically or at key project milestones, then a Technical Performance Measurement (TPM) methodology should be considered. TPM formally defines planned values for an at-risk parameter and plans the measurement methods and points at which progress will be assessed across a project lifecycle.

The fundamental solution for the Drifting Goals archetype assumes that we can assess the realism of a goal proactively and with reasonable confidence. However the feasibility of a goal apart from the rest of the relevant goals is typically meaningless. Feasibility most often relates to the achievability of a set of requirements and constraints. Stakeholders typically can't answer such questions.

Archetype #7: Tragedy of the Commons

The Tragedy of the Commons pattern may be recognized as a situation where there is a threat of unsustainable use of shared resources by competing parties. Each party, acting in their own best interests, consume a limited resource such that they eventually reach a point of diminishing returns, i.e., their nets gains received from additional resource consumption are reduced relative to their level of consumption. The name of the archetype is derived from the common grazing areas of a medieval English village where overgrazing eventually led to resource depletion and more effort per farmer to extract the needed feed for their livestock.

The archetype consists of simultaneously occurring feedback loops that represent the common activity by multiple parties that use the shared resource for gain. Initially, each party benefits from increased activity (consumption of the common resource), yielding additional resources that "fund" even more activity. The total activity (e.g., grass consumed in the original village commons scenario) is the sum of usage by each party. However, as the total activity increases a resource limit impinges up and drives down the gain (e.g., wool production) that each party derives from resource utilization. The impact of the resource limit on gain per activity is shown as two balancing feedback loops. Once the resource limit is reached, the balancing loops become dominant.

Net Gains for A	***Increases A's activity [s]***					
Increases A's net gains [s]	**A's Activity**	Contributes to total activity [s]				
		Total Activity	Triggers resource limit to constrain gain per activity [o]			
Increases A's net gains [s]			**Gain per Individual Activity**			Increases B's net gains [s]
			Constrains individual activity gains [s]	**Resource Limit**		
		Contributes to total activity [s]			**B's Activity**	***Increases B's net gains [s]***
					Increases B's activity [s]	**Net Gains for B**

Tragedy of the Commons scenario as an N-Squared Diagram

The Tragedy of the Commons Archetype was used a teaching example in the Water's Center Habits Course #10 which explains why and how a systems thinker recognizes the impact of time delays when exploring cause and effect relationships. It is the time delay between each user's independent actions and the buildup of total activity to the resource limit that enables the resource limitation to "kick in" before its effects on the individual user activities is recognized. The "engine" of this dynamic is the fact that the time frame in which individual gains are realized is much, much shorter than the time frame for resource depletion.

A variant of the simple archetype is to include more than two parties/actors and to account for more than a single type of gain. Both of these dimensions increase the total number of reinforcing feedback loops that must be represented in the causal model.
The fundamental solution for the Tragedy of the Commons archetype is to impose limits or regulations that govern the use of the shared resource by all actors. Specific steps include:

- Identifying the common resource and its potential for depletion.
- Educating users of the common resource on its limits and the time delays associated with depletion scenarios.
- Contrasting the short-term rewards of the individual actors with the long-term consequences that will be experienced by all parties.
- Designing interventions so that current actions contribute to long-term solutions.
- Imposing regulations and a resource management framework for the commons.

Reflections
The Tragedy of the Commons archetype appears to provide a fundamental explanation of how a system reaches a "the point of diminishing returns". Although the method by which the resource limit impinges upon the gain per individual activity may vary widely, any such relationship should be able to

be expressed in mathematical terms. However, it is likely that multiple resource limits are present in many real-world situations. Understanding how 2, 3, … N limits act when combined will certainly rapidly increase the complexity of any behavioral model.

Imposed regulations may also trigger the Fixes that Backfire scenario as individuals find ways to circumvent the rules and continue using the resource. Often regulations are crafted to reward the powerful incumbents which triggers the Success for the Successful pattern.

Innovative methods exist to help system designers sidestep resource constraints. Further research might indicate how either the TRIZ [2] or Axiomatic Design (AD) [3] techniques could provide a range of solutions for a system suffering from the Tragedy of the Commons behavioral pattern.

Archetype #8: Accidental Adversaries

The *Accidental Adversaries* scenario represents a situation in which two individuals or groups, who are initially working cooperatively toward a common goal, take actions that unintentionally undermine one another's success. The unplanned disruption implies a lack of understanding of how such actions affect the actions of their partner.

The building blocks of this archetype include:

- Win-win collaboration between two parties.
- A reinforcing feedback loop in which the actions of each party improve outcomes for the other party.
- A balancing loop for each party associated with their own actions and measures of success.
- A reinforcing feedback loop that represents how one party's actions disrupt or negatively affect the success of the other party. This unintended disruptive feedback becomes dominant from time to time and shifts the parties from being collaborators to being adversaries.

A's Success	***Increase actions that benefit B [s]***	Reduce benefit of self-focused actions [o]					
	A's Actions in B's Favor						***Improve B's success [s]***
Improve A's success [s]		**A's Actions to Improve A's Success**	Increase A's obstruction of B [s]				
			A's Unintended Obstruction of B's Success				Decrease B's success [o]
Decrease A's success [o]				**B's Unintended Obstruction of A's Success**			
				Increase B's obstruction of A [s]	**B's Actions to Improve B's Success**		Improve B's success [s]
Improve A's success [s]						**B's Actions in A's Favor**	
					Reduce benefit of self-focused actions [o]	***Increase actions that benefit A [s]***	**B's Success**

Accidental Adversaries scenario as an N-Squared Diagram

The fundamental solution for the Accidental Adversaries dynamic is to identify and deepen the understanding by both parties of what triggers the shift from collaboration to competition. If the cause of that shift can be isolated and prevented or reduced in its impact, then cooperative efforts may remain highly productive.

Too many cooks in the kitchen

The author's first-hand experience with the Accidental Adversaries archetype can be found in our kitchen during preparations for a holiday feast consisting of 20+ family members. The author's role as kitchen "grunt" includes retrieving ingredients and equipment, decluttering the kitchen working space and deploying eating equipment and prepared food to the table(s). The author's spouse wears the chef's hat and kitchen boss apron. The scenario plays out first as a reinforcing beneficial feedback loop:

- The chef provides plan of action; sequences food preparation tasks to cause all parts to converge just in time for the start of the meal. The anticipation of amazed looks and thankful hungry family members motivates the chef toward excellence.
- The plan provides needed guidance to the grunt, improving the quality of grunt-performed functions. Note the plan also keeps the grunt away from food slicing tasks to prevent injuries and related delays associated with medical first aid. But the grunt delights in the support role of making the chef happy and successful.
- The grunt gathers raw materials, equipment and utensils as directed by the chef.
- The chef's efficiencies soar in food preparation tasks through the presence of the right materials at the right time and place.
- The happy chef's enthusiasm is contagious; the grunt redoubles efforts, further improving the chef's productivity. The kitchen is a happy place, buzzing with activity and progressing toward the common goal.

However, the author's kitchen neither has unlimited working space, nor supports a well-designed unidirectional flow of meal preparation activities. This creates the potential for multiple working obstructions as meal preparation progresses. Decluttering the workspace of the build-up of detritus associated with each component (leftover supplies, utensils, vessels and working surfaces that require clean-up) amplifies the potential for physical collisions and sometimes impedes the chef's freedom of movement. Of particular note is the grunt's propensity to declutter too well, too efficiently and too soon, leading the chef to eventually exclaim:

- *Where's the _____ utensil?*

To which the grunt can only reply:

- *Oops! I put it in the dishwasher.*

At this point, the chef thinks (or communicates with body language or alternative wording):

- *"My normally effective actions aren't working well in the presence of what you are doing to help me!"*

At this point, the two parties wonder:

- *How did my helpful and well-intentioned mate become my adversary in this process?*

And the grunt is banished to the family room with bruised feelings.
At this point, the grunt should remember System Thinking Habit #7:

- *A Systems Thinker recognizes that a system's structure generates its behavior.*

The grunt's obstruction of the chef's success was clearly unintended; it was the result of poor system design (space allocation, layout, and workflow) that coupled (negatively) the performance of the grunt-assigned vs chef-assigned tasks.

Reflections

To resolve the Accidental Adversaries scenario, the parties must identify and deepen their understanding of what triggers the shift from collaboration to competition. In the case of the holiday kitchen example, the unintended obstruction of the chef by the grunt didn't arise immediately. It was only when the physical constraints of the system and the volume of concurrent preparation tasks grew that the "sign" on the coupled collaborative efforts shifted from positive to negative. In casual loop language, the reinforcing obstruction feedback loop became dominant over the cooperative behavior loop.

The sensitivity (or coupling coefficient) between the actions of each party is a result of the overall system physical design. Negative (value-destroying) coupling could be overcome by:

- Separating processes in space or time, e.g., enlarging the kitchen to avoid obstructions or adjusting the timing of preparation tasks.
- More detailed planning of task sequencing to prevent conflicts between the actors.
- Increasing the supply of common resources to eliminate sharing.
- Redesigning the logical and physical process flows to eliminate collisions.

In every case, these changes would be the result of a better design decision-making process that considers the shared (and unique) objectives of each actor. The Accidental Adversaries situation assumes some level of goal congruence, but that doesn't imply or demand 100% alignment. There will be tradeoffs that balance the competing goals of the actors, but hopefully the shared goals of the parties will be sufficient to find a common solution.

Because the fundamental solution for this archetype depends on reducing or eliminating functional coupling, finding such solutions may be helped by the use of TRIZ or Axiomatic Design techniques. Alternatively, the events or conditions that trigger obstructions between the parties may be identified during conceptual design by performing a joint risk assessment (aka Failure Modes and Effects Analysis) and asking:

- *How might the performance of task N by Actor 1 lead to the failure of a task performed by Actor 2?*

Mitigation strategies for such risks would likely point to actions that decouple functions, as identified above.

As described in the Waters Center course, the Accidental Adversaries archetype focused on a two-party model. It is likely that real-world scenarios need an N-party model to fully uncover significant coupling. If the proverb, "*Many hands make light work*" is to be true, then better coordination is need such that the "*Too many cooks*" realities don't prevent effective co-working toward shared goals.

Archetype #9: Repression and Revolution

The *Repression and Revolution* scenario may exist when the official policies of a governing body *are perceived as repressive, and members of an oppressed group join to act defiantly. The archetype behavior proceeds as follows:*

- *The established government perceives a threat, leading to the repression of the opposition.*
- *Repression deters the opposition, reducing their numbers and decreasing the threat (balancing feedback).*
- *Repression adds to the legitimacy of the opposition (reinforcing loop).*
- *The opposition grows in numbers which further increases its legitimacy.*
- *The opposition's actions grow in number and intensity, potentially leading to the overthrow of the current governing authority or to the restriction of its power.*

Threat to Establish Government	Triggers repressive actions [s]		
	Repression	***Increases the legitimacy of the opposition [s]***	Decreases opposition membership [o]
		Legitimacy of Opposition	***Increases opposition membership [s]***
Increases threat to the government [s]		***Increases the legitimacy of the opposition [s]***	**Opposition Members**

Repression and Revolution scenario as an N-Squared Diagram

Reflections

The fundamental solution to the Repression and Revolution scenario is to replace repressive forms of control with a search for shared goals. This archetype assumes that there has been a breakdown in the ability to identify and gain consensus on a common value model between the government and the opposition. Many of the solution concepts for the Fixes that Backfire, Success to the Successful, Limits to Growth/Success, and Escalation archetypes appear to be valid in this situation.

What differs between the Repression and Revolution scenario and other archetypes is the degree of adversarial relationships and the willingness to "divorce" to force the other to accept certain outcomes.

Other archetypes where resource competition exists may morph into Repression and Revolution across the Escalation scenario "bridge".

Repression represents the extreme end of a continuum of stakeholder consensus that influences the ability to reach common decisions. However, even the best decision-making techniques can't guarantee that such consensus is achievable, given a set of resource and time constraints and the starting points of the parties.

The Changes in Perspectives system thinking habit may be useful, but perhaps not sufficient in such cases. Innovation workarounds such as those suggested by TRIZ or Axiomatic Design may also be

helping in "reducing the temperature", but these are likely better applied upstream in the preceding scenarios, before escalation of the conflict to the level at which repression is deemed necessary.

Conclusions

This series of four articles has attempted to summarize the precepts and practices of systems thinking (ST), as presented by the Waters Center's excellent courses on habits, tools, and system archetypes. These precepts and practices have been restated from the perspective of experienced systems engineering (SE) practitioners, with distinctions highlighted between the ST/SE mental models. The authors recognize the limitations of a small sample size (one ST and two SE viewpoints) but hope that their efforts will increase the dialog between the broader ST and SE communities.

ST habits were found to be highly complementary with SE principles and practices, though SE methodologies and modeling languages tend to be more tightly integrated in support of end-to-end processes and more precise in the level of system detail captured and visualized. Additional research is needed to fully compare the information meta-models and viewpoints for ST and SE.

System archetypes represent behavioral patterns that emerge from system structure. System structure is created through decisions. Decisions follow patterns. [4, 5] There is value in further research to understand the Decision Pattern -> Solution/Design Pattern -> System Archetype/Behavior Pattern derivation traceability thread.

There appear to be many ways that the nine system archetypes could be combined to create comprehensive models of complicated or complex systems. An initial N-Squared Diagram showing the connections identified in this series is shown below. Future research is warranted to identify how these nine behavioral building blocks fit together to form higher-level patterns or to identify gaps in these archetypes.

Fixes that Backfire			Resistance from opponents of the fix			Short-term fixes increase resource competition		Growth in opposition size & intensity
	Success to the Successful		Resource competion			Successful exercise power as regulators		Increased gap between Haves & Have Nots
		Limits to Growth/Success	Resource competion					Increased competition between parties
Poorly considered short-term actions			**Escalation**				Increased sensitivity to obstructions	Increased action tempo and scale
		Rewards for heroic behaviors		**Shifting the Burden**				
					Drifting Goals			
Short-term fix to resource depletion	Regulations reward the successful		Resistance to regulations			**Tragedy of the Commons**		
			Switch from collaboration to competition				**Accidental Adversaries**	Damaged relationships
			Increased level of opposition					**Repression and Revolution**

Potential Archetype Interactions as an N-Squared Diagram

The behavior patterns represented in the system archetypes are the result of physical, resource or interface constraints derived from the physical solution concepts. These constraints cause functional interactions and performance-related coupling in any system. SE techniques to address these challenges include:

- Achieving goal consensus among stakeholders by defining a value model early in the development process.
- Decoupling of functional and performance requirements through innovative design techniques such TRIZ and Axiomatic Design.
- Improved coordination between multiple system actors.
- Better definition of planned and unplanned interfaces between system elements over the entire system life.

SE methods, particularly those related to design decision-making, can provide the level of rigor needed to perform system design tradeoffs that maximize the value delivered to stakeholders within system constraints. Causal models from the ST and System Dynamics (SD) communities can provide qualitative and quantitative data on the expected behaviors of system design alternatives to inform these design decisions.

PPI SyEN readers are encouraged to carefully study the article, *Complexity Thinking: Should Systems Engineers Take Up Systems Gardening?*, in PPI SyEN Edition #134 (March 2024) to gain further insight on how ST and SE methods apply to various solution development challenges.

References

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[3] Suh, N.P., 2001. Axiomatic Design: Advances and Applications, Oxford University Press, 2001, ISBN 0-19-513466-4.
[4] Mendonza, P. and Fitch, J.A. 2013. "Integrating System Models around Decisions". Paper presented at 23rd Annual International Symposium of the International Council on Systems Engineering, Philadelphia, PA (US), 24-26 June.
[5] Mendonza, P. and Fitch, J.A. 2012. "Decision Management (DM) as the engine for scalable, crossdomain Systems Engineering". Paper presented at 22nd Annual International Symposium of the International Council on Systems Engineering, Rome, Italy, 9-12 July.

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.

SYSTEMS ENGINEERING RESOURCES

Useful artifacts to improve your SE effectiveness

PDMA Resource Recommendations

kHUB PDMA Knowledge Hub

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

Book recommendations
kHUB periodically offers a review of books on the PDMA Recommended Reading Book List. Recent reviews include:

- Learn & Adapt: ExPD an Adaptive Product Development Process for Rapid Innovation and Risk Reduction
- Transform with Design: Creating New Innovation Capabilities with Design Thinking

General Recommendations
Recent PDMA resource recommendations include the following articles, webinars, podcast, blogs, newsletters, etc.:

Aligning Product Portfolios with Strategic Plans (article)
It is generally recognized that one key to maximizing the return on investment (ROI) from product innovation is to ensure that portfolio decisions are driven by business and product strategy. However, many companies struggle to keep product portfolios aligned with their strategic plans. In some instances, that's because the strategies are ambiguous or inconsistent. In others, the underlying reason is that strategic planning and portfolio management are treated as independent processes, and the two are never truly tied together.

Artificial Intelligence (AI) Use in Product Management (chapter webinar)
AI is becoming more central to all product managers both in differentiating their product, accelerating their product development process, and making them more efficient. Dave Mathias and Rolf Biernath are going to bring two perspectives in leveraging AI in product management and do's and don'ts.

The Business Leader (LinkedIn newsletter by Steven Haines)
Ideas and trend that shape business acumen, strategic thinking, and leadership excellence.

Creativity – TED Talks with Practitioner Insights (Viewpoint blog)
In this Viewpoint blog post, Carlos M. Rodriguez summarizes practitioner insights drawn from three TED Talks that address different aspects of creativity as related to product innovation and design:

- The First Secret of Design is … Noticing (Tony Fadell)
- Imagination: It's Not What You Think. It's How You Think (Charles Faulkner)

- A Powerful Way to Unleash Your Natural Creativity (Tim Harford)

Cultivating Creativity: How to Nurture Innovative Skills in Product Teams (chapter webinar)
As technological advancements and market demands evolve at an unprecedented pace, the ability of product teams to harness creativity and innovation is more critical than ever. This talk is designed to equip corporate innovators, team leaders, and product development professionals with the tools and insights needed to foster a culture of creativity within their teams. We will delve into the core principles of nurturing innovative thinking and problem-solving skills in diverse teams. We'll talk about how to create an environment that encourages empirical risk-taking, open communication, and collaborative brainstorming.

Ideation Techniques: Conceptualizing New Products and Services (Viewpoint blog)
The kHUB Curator Team members have each been assigned a BoK section to own. This includes seeking, editing, and sharing content related to that section. The curators are also sharing their perspective of various sub-sections of their chapter and contributing personal examples, experience, or related articles corresponding to the subject matter.

Delivery of Complex Product Through Strategy (webcast)
The post pandemic and Artificial Intelligence era have seen an exponential growth in product development activities. This growth has created a competitive landscape, which has made STRATEGY the differentiator! View the webcast.

Lessons Learned from PDMA Corporate Innovator Award Winners (webcast)
Choosing the right innovation management platform is critical for companies that want to stay ahead of the curve and achieve their innovation goals. In this webinar, we will discuss the key features to consider when selecting an innovation management platform that suits your organization's needs. View the webcast here.

Monitoring Competitive Threats: A Holistic Approach (webcast)
This session is designed for product managers, researchers, and business professionals who need to have their fingers on the pulse of their market landscapes and competition, beyond simply monitoring the feature lists of competitors' products. This workshop uses MIDIOR's Competition Cube as a practical approach and framework for identifying and tracking competitive threats. Access the webcast.

Sharing Your Customers' Dreams (article)
How well do you understand your customers? Are you driven by ideas or solving problems? Do you know your customer well enough to identify a need, then find a way to meet it in their way, not yours? Do you blindly pursue "innovations" hoping they will magically match someone's need and then try to convince them they need something they really don't?

TED Talks on Motivating Teams (article)
Keeping team members motivated is challenging for leaders. Looking at the science of teams, Dan Pick offers some ways to motivate people. Dan Pink's 2009 TED talk uses humor and personal experience to explain how the business model of carrot and stick stifles motivation rather than driving it. Pink explains that for more complicated problems needing cognitive skills, giving the team leader flexibility, and adapting your motivational model to more intrinsic motivation is the best way to keep your team driven. Watch the video here.

The Back End of Innovation: The Neglected Stepchild of NPD (webcast)
For more than two decades, most of our time, attention, and research about New Product Development has been focused on the so-called Fuzzy Front End – discovery, Voice of the Customer, ideation, concept development, etc. Important? Absolutely! But what about the later stages of NPD, the activities found in what our Body of Knowledge labels as the Commercialization phase? Unfortunately, this has become the new stepchild of NPD. In this highly informative webinar, product development guru Gerry Katz will attempt to define and expound upon The Back End of Innovation. In Katz's view, these activities are just as critical as those in the Front End and may present just as many opportunities for innovation. Access the webcast through the PDMA store.

Together We Create: The Power of Integrating Customers in Your Product Development (chapter webinar)
Exceptional products and services are born from valuable insights. The most profound insights aren't based solely on formal research. They come from Community Voice, a relational engagement with community members and customers. Community Voice is a powerful combination of customer insights and emotional engagement with the customers and community members who have personal investment in both the products you build and the communities they are used in. This speech explores the concept of Community Driven Product Development (CDPD), a methodology that goes beyond traditional design and development by embracing the wisdom and input of the user community. View slides here.

Untold Stories of Innovation (podcast)
How do leading innovators get people to believe, fund, and support their big ideas? Can the power of storytelling fuel a culture of idea-generation? Can storytelling ignite innovation? Join us as we sit down with the nation's top innovators to tell the stories of their innovations. After all, what good is an innovation left untold?

Using the Working Backward Framework to Create High Confidence Product Features (chapter webinar)
Working Backwards is a product framework developed at Amazon to de-risk customer focused products. Learn how to write a working backwards document to build rigor in customer obsession, critical product thinking, risk understanding and cross functional management.

Journal Papers
kHUB includes links to a mix of open access and subscription-only papers published in the Journal of Product Innovation Management (JPIM). Recommendations among these papers include:

A tale of two distractions: How institutional forces influence R&D-based problemistic search in transition economies
The behavioral theory of the firm (BTOF) suggests that firms are motivated to increase R&D search in response to profitability shortfalls - that is, R&D-based problemistic search. Although prior studies have provided considerable evidence for this influential explanation of R&D search, recent research shows that it is not the case in transition economies. Our study sheds light on this critical question of Why not for transition economy firms (TEFs), by identifying institutionally derived mechanisms that distract TEF decision makers' attention from R&D-based problemistic search.

Read the full open access article on Wiley.

Biocultural innovation: Innovating at the intersection of the biosphere and ethnosphere
Scientists, economists, and politicians increasingly recognize that Indigenous peoples possess invaluable knowledge and practices that have the potential to drive innovation to solve critical global challenges. Indeed, thousands of important drugs - including lifesaving cancer treatments - have their origins in centuries old Indigenous knowledge and practices. Similarly, Indigenous practices have fueled the fast-growing regenerative agriculture industry that is able to yield windfall profits while sequestering carbon and enhancing biodiversity. Referred to in policy circles as biocultural innovation a form of innovation that occurs at the intersection of the biosphere and ethnosphere - hundreds of diverse examples from a wide array of industries have been documented outside of the innovation literature.

Read the full open access article on Wiley.

Employee acceptance of digital transformation strategies: A paradox perspective
Digital transformation (DT) strategies often aim at innovating an organization's business models (BMs) and developing digital innovations. However, most of the DT strategies fail or result only in incremental innovation. Research predominantly identified critical management capabilities for DT success, neglecting the role of employees, although employee support is vital for the successful implementation of DT strategies. We conceptualize employee acceptance of DT strategies and draw on paradox theory and organizational change literature to shed light on the antecedents of employee acceptance.

Read the full open access article on Wiley.

Technology strategies in converging technology systems: Evidence from printed electronics
Novel technology systems, such as “fiber optics” and “printed electronics,” increasingly emerge at the interface of hitherto unrelated technology areas. As such, new technology systems often arise through technology convergence, characterized by integrating technology components and knowledge from different technology systems, resulting in a novel system architecture. This phenomenon is of utmost societal relevancy but simultaneously poses tremendous challenges for firms' technology strategies. Firms must not only cope with unrelated knowledge rooted in hitherto different technologies but also have to decide deliberately how systemic (i.e., complete technology system) versus focused (i.e., single component of the technology system) their engagement in technology development in the converging technology system ought to be. In addition, firms need to decide strategically to what extent to develop specialized or design knowledge. Extant concepts of technology strategy fall short of capturing this complexity inherent in converging technology systems. Therefore, to address how technology strategies co-evolve along with the emergence of new technology systems, this study adds a systems perspective to technology strategy by developing the concept of technology system coverage.

The professionalization of innovation management: Evolution and implications
Just over two decades ago, in a Perspective article in the Journal of Product Innovation Management (JPIM), Tomkovick and Miller, called for the professionalization of new product development (NPD). Professionalization of innovation management (as the broader function in which NPD is embedded) was posited to require a combination of scientific knowledge coupled with specific expertise. We revisit that call to (1) assess whether innovation management has established itself as a formal, professional function similar to human resources or marketing, and (2) critically discuss whether (and

if so, how) the professionalization of innovation management impacts both academic research and professional practice in the field. We suggest four tests as hallmarks of a profession and apply them to the emerging field of innovation management. Based on our findings, we propose a set of actions for innovation management academics and practitioners. We also recommend directions for future research to promote discussion on this topic within the JPIM community.

Read the full open access article on Wiley.

Access to kHUB is free and open to the public.
Create a guest account or join PDMA here.

OMG Journal of Innovation: Generative AI

The Object Management Group (OMG) published the 24th edition of its Journal of Innovation in March 2024. The theme of this 135-page edition is "*Bringing Creativity, Agility, and Efficiency with Generative AI in Industries*".

Articles to consider include:

- Industrial Use of Generative AI: Opportunities and Risks. Insights from the OMG's Thought Leadership Task Group from their exploration of the opportunities and risks that come with the industrial use of Generative AI.
- Responsible Generative AI: An Examination of Ongoing Efforts to Tame This Powerful Technology. The responsible use of Generative AI and the measures needed to harness its power for the greater good.
- Unlock the Potential of OpenAI in Smart Manufacturing. A guide through the journey of unlocking innovation in smart manufacturing using the transformative capabilities of Generative AI.
- Adaptive Systems Using Generative AI. Insights into how Generative AI is driving self-adaptation in industrial products, enhancing efficiency and adaptability.
- Driving Healthcare Transformation Through Generative AI. How Generative AI is steering the transformation in healthcare, paving the way for innovative solutions.
- Advancements in Synthetic Video Generation for Autonomous Driving. Advancements in synthetic data generation for autonomous driving, leveraging Generative AI, deep learning, and image processing.

Prior editions of the Journal have tackled diverse leading-edge topics such as:

- The Role of IoT in Shaping the Future of Supply Chain
- Toward a Greener Planet Through IoT
- Business Outcomes of Utilizing Innovative Technologies
- Trustworthiness
- Role of AI in Industry
- Rapid Advancements in Digital Transformation
- Applying Solutions at the Digital Edge

Join the OMG mailing list.

Digital Twin Consortium: Applying Reality Capture to Site Civil Projects

The Digital Twin Consortium (DTC) has published a guide for the use of reality capture technology to accurately and efficiently create digital duplicates of physical things, such as objects, rooms, buildings or planetary landscapes. The guide, "*Applying Reality Capture to Site Civil Projects*", is a follow-on to an original DTC whitepaper, Reality Capture: A Digital Twin Foundation which introduced reality capture as a critical component underpinning the lifecycle of a digital twin.

The user guide breaks down site civil reality capture for digital twins into areas including:

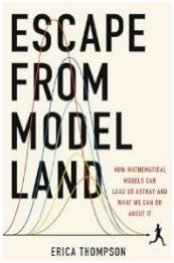
- Reality capture devices used for site civil projects
- Standards, compliance, and specifications
- Future use cases, trends, and technologies supporting digital twins.

Download the guide.

View other DTC publications here.

Learn more about the Digital Twin Consortium and its Architecture, Engineering, Construction & Operations (AECO) Working Group.

Escape from Model Land – How Mathematical Models Can Lead Us Astray and What We Can Do About it



The System Dynamics Society (SDS), in partnership with the University of Bergen's student-led MINDS CAST series, has made available a webcast presented by Dr. Erica Thompson, Associate Professor of Modelling for Decision Making at UCL's Department of Science, Technology, Engineering, and Public Policy. In the webcast, Dr. Thompson, the author of Escape from Model Land, elaborates on the book's themes concerning the intricacies of using mathematical models in decision-making, highlighting both the potential benefits and the pitfalls of relying heavily on these models. Topics addressed include:

- The essence of models in decision-making
- Challenges in mathematical and social contexts
- Best practices for responsible modeling
- Navigating Model Land

Key takeaways from the webcast include:

- The importance of model diversity and assumption transparency
- The role of experts in modeling
- Models as conviction narratives
- The future of modeling

Read the SDS summary of the webcast. Watch the recording on YouTube.

SYSTEMS ENGINEERING RESOURCES

Business Analysis Resources in Multiple Languages

The International Institute of Business Analysis (IIBA) is a non-profit professional association formed in 2003 with the purpose of supporting and promoting the discipline of business analysis. IIBA has expanded multi-language support for many of its leading business analysis resources. These resources include:

- *A Guide to the Business Analysis Body of Knowledge (BABOK® Guide)* – Available in English, Chinese, French Standard, Canadian French, German, Japanese, Russian, and Brazilian Portuguese.
- *BABOK Guide Glossary* - Available English, Arabic, French, Japanese, Brazilian Portuguese, Russian, Spanish, and Ukrainian.
- *The Business Analysis Standard* – Accessible in English, Brazilian Portuguese, Canadian French, Japanese, Chinese, and Arabic.
- *Being Nimble: The Scalable Capability for Organizations to Sense and Respond to Change* – Available in English, Brazilian Portuguese, and Canadian French.
- *Guide to Business Data Analytics* – Available in English and Japanese.
- *Agile Extension to the BABOK Guide* – Available in English and Japanese.
- *Entry Certificate in Business Analysis (ECBA™) Handbook* – Available in English, Chinese, French Standard, Canadian French, Japanese, and Brazilian Portuguese.

Join IIBA to access these resources in the IIBA Store at reduced or no cost.

Course: Engineering Ethics Essentials

The Institute of Industrial and Systems Engineers (IISE) Training Center is offering an online course, *Engineering Ethics Essentials*. This concise and informative short course is designed to introduce engineering professionals and students to the fundamental principles of ethical decision-making within the engineering field. It explores the ethical dilemmas and challenges that engineers often encounter in their careers, providing practical guidance and tools to navigate them responsibly. The course includes 75 minutes of video lecture and discussion, plus 3 downloadable documents on ethical frameworks.

Learning objectives include the ability to:

- Define what ethics means in the context of engineering.
- Articulate why ethics are violated.
- Identify and describe several ethical frameworks useful to engineers.

Learn more and register here.
View other IISE Training Center online on-demand course offerings.

Join IISE and get a discounted rate on these courses.

FINAL THOUGHTS FROM SYENNA

Trusted AI?

Syenna, staring at the screen, muses:

"Self, you're a thoroughly modern Millie! Why are you hesitant to discuss your shipping problem with an Artificial Intelligence?"

A bit of background. I had ordered a pack of five "things" through a global e-commerce giant – one that has the letter "z" somewhere in its name. The type of things ordered doesn't really matter. It was nearly a week beyond the promised arrival date, so I went online to plead my case. After identifying the product and order in question (through a cool graphical user interface that showed the last 10 or so "things" ordered through this channel), I found myself at an uncomfortable fork in the process road. I could proceed down the Chat path and most likely face interactions with a bot; I wasn't particularly thrilled at spending time "explaining" my problem to and arguing for relief with a faux human.

I "took the road less traveled" (to rip off the American poet, Robert Frost) and opted for a call back. In less than a second after the click, my smartphone chimed and I picked up, excited to communicate with a flesh and blood human being, full of empathy for my plight and wise through thousands of experiences, with total mastery of the hidden process magic that makes the company-with-the-z-in-its-name such a global juggernaut.

The voice tone of this empathetic caller was the first clue that perhaps my assumptions were invalid. Indeed, I quickly discerned that I was ear-to-Natural-Language-Processor with an AI. But hope springs eternal, so rather than quickly hang up I engaged in a robust interchange with this personality. My hope was that whatever Mr. or Ms. AI lacked in their ability to feel my pain and frustration would be overcome by its (his/her?) big brain and total access to all the relevant information related to my lost purchase.

Completing the back-and-forth, I left the site reasonably confident that the fix was in. Issue sorted! After a few days passed, I received notification that the delivery truck for the company-with-the-z-in-its-name was approaching my domicile. 9 stops away, then 7, then … you get the picture. Blood pressure rising in anticipation, I detected the sound of the truck pulling up my driveway, spitting loose gravel in its wake. Standing in my hidden spot, well-worn from spying on the hundreds of other end-of-the-supply-chain staffers who approach my home each year, I saw the package being carried and thought:

"I was expecting something larger."

Frozen in a moment of hesitation and thinking that this might be another order (there are so, so many), I let the trim twenty-something drop the package at my door and stride quickly back to their not-yet-EV form of conveyance.

As the departing vehicle reached the roadway, I quickly retrieved my solution. It did seem smaller and

lighter than expected, so ripping away the package seal I investigated further.

"Oh, a miniature version of the product I expected – about half-sized. Oh, one of said product, not the required five. Oh ……"

Commence e-commerce fun, round two!

Heading back to the global knowledge grid, I returned to the "Oops" page of the company-with-the-z-in-its-name. Not finding a "You screwed up again" option, I returned to the Call Back vs Chat branch point, found the colorful image of the original order, and clicked the Chat option.

A few seconds passed before the interrogation began, but at least Not-A-Given-Name-of-Any-of-My-Relatives seemed to be the genuine article. There was sufficient time delay and her? responses to my answers suggested that a brain filled with language skills and knowledge over a few decades was typing at a physical keyboard. Cryptic text confirmed: *Wrong product, wrong quantity*. The offer of a full immediate refund was truly the human thing to do. I was decidedly uninterested in giving the company-with-the-z-in-its-name a third bite at this apple, so I took the cut-your-losses alternative. Reflecting on my learning experience, I wondered:

- How could an AI with full access to a unique 20-digit order number and its details ever send out the wrong product and quantity?
- Is it paranoid to think that the AI had chosen to send the wrong stuff (smaller and fewer), knowing broader statistics on how many customers give up at this point and accept their losses, to the profit of the company-with-the-z-in-its-name?
- Was Not-A-Given-Name-of-Any-of-My-Relatives really a product of DNA-enabled life, or just Version 43.7 of more realistic AI?
- How can AI doing the obviously wrong thing be prevented or at least be detected during process/system design, development, deployment, and operations?
- What will it take before we trust AI with routine processes enough that we prefer such interactions to human engagement? How much higher is the bar for trusting AI with safety-critical activities that involve our loved ones?
- Should all interactions with AI be clearly labelled as such, so that a human actor can factor that into their decision-making where process options are available?

One final thought:

To whom in the family should I gift this half-sized thing?

Regards,
Syenna