

# PPI SyEN

SYSTEMS ENGINEERING NEWSJOURNAL

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## *Bridging Horizons with Systems Engineering*

**HOLISTIC HABITS AT WORK  
A Rapid Immersion into Systems Thinking: Part 1**



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**WELCOME**

Dear Readers,

Welcome to the December edition of our Newsjournal, the final issue of the year, where we explore the theme 'Bridging Horizons with Systems Engineering'. As we wrap up the year, this edition showcases the power of SE in connecting diverse domains and perspectives.

Dive into the latest from the Modelica Association, and stay abreast with SERC's insightful updates. Discover forward-looking developments from the OMG Systems Modeling Community (SMC) and delve into the INCOSE Model Portfolio Management Guide, a landmark in the SE field. NAFEMS' launch of the EMAS Journal and the INCOSE-Loyola Marymount University academic equivalency agreement are pivotal developments in bridging academic and professional realms.

The SE event calendar featuring the PDMA January Webinars, ETSI AI Conference, and GfSE February Workshop and calls for participation and submissions for MBSE-CON-2024 and ISDC 2024 invite a diverse range of perspectives.

PPI's René King and John Fitch are the authors of this month's Feature Article, 'A Rapid Immersion in Systems Thinking - Part 1'. This article highlights Systems Thinking (ST) Habits from the Waters Center for Systems Thinking and how these habits may be leveraged for better SE and vice versa.

Our resources, from the highly anticipated "Don't Panic! The Absolute Beginner's Guide to Integration and Test" to the Digital Twins Consortium's 'Digital Reflections Blog', offer knowledge that bridges the gap between novices and experts.

The ISO Sustainable Development Standards and the essay 'Multisolving: Making Systems Whole, Healthy, and Sustainable' highlight SE's role in societal progress. 'System Thinking for Kids' introduces young minds to SE, bridging generational learning.

Sticking to her usual tongue-in-cheek reflections, Syenna juxtaposes humor and professional insight in her version of Scrooge's Guide to SE.

As we conclude 2023 and step into the festive break, let's reflect on the bridges we've built through Systems Engineering. This edition, marking the end of a year filled with learning and growth, celebrates SE's role in connecting disciplines, industries, and communities.

We hope it inspires you to continue bridging horizons in your professional and personal endeavors.

On behalf of the editorial team of PPI SyEN, I wish you a wonderful festive season and a joyful conclusion to the year.

Warm regards,

*René*

Managing Editor (on behalf of the Editorial Team)

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

## START A NEW CHAPTER IN YOUR CAREER?

*Already an outstanding SE professional?*

*Ready for a career and lifestyle change?*

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

*There are opportunities to join our team through one of three engagement models:*

- *full-time employment*
- *part-time employment*
- *independent contractor, perhaps with your own trading entity, with exclusivity to PPI for SE-related training, otherwise free to consult independently.*

*Interested? [managingdirector@ppi-int.com](mailto:managingdirector@ppi-int.com)*

### 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*

## 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 (November 2023) newsletter.



### Conferences

The International Modelica Conference 2023 took place on 9-11 October in Aachen, Germany. The scientific papers presented at the conference are available from the [conference tool](#).

Modeling practitioners are encouraged to save the date for 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.

### FMI News

The Modelica Conference 2023 included a beginner's tutorial for the Functional Mock-up Interface (FMI). Watch the video [here](#). Download presentation materials [here](#).

An eFMI® Tutorial presented at the conference is also available as a video on [YouTube](#) and at the [eFMI website](#) (slides and videos). The tutorial covers the current state-of-the-art of available eFMI tooling, including a high-level introduction to the eFMI Standard and a hands-on experience of eFMI technology for selected Modelica example models. It shows how to configure a tooling workflow from acausal physics models in Modelica down to embedded target code and investigates the generated eFMUs and their various intermediate model representations. Video segments include:

- [Part 1](#): eFMI® motivation and overview
- [Part 2](#): Running use-case introduction
- [Part 3](#): Hands-on demonstration in Dymola and CATIA ESP
- [Part 4](#): Live demonstration in TargetLink
- [Part 5](#): Short presentation of further tooling

See more [FMI-related news](#).

### Modelica Vendor News

Modelica vendors highlighted numerous new capabilities:

- [orchideo easySSP v1.2.8](#) is now available with a new documentation area, new integration options and extended support for Simulation Resource Metadata (SRMD).
- XRG offers two Modelica libraries, [HumanComfort](#) and [FluidDynamics](#), along with a complementary [XRG Score application](#) for pre-processing simulation inputs and post-processing simulation results. Additional XRG solutions include an [HVAC Library](#) and the [ClaRaPlus Modelica library](#) for thermal dynamics and controls simulation of energy systems.

- [Siemens Digital Industries Software](#) has released Simcenter Amesim 2310 which simplifies deployability of system simulation models and improves interoperability of models with AI frameworks.
- [Version 1.22.0](#) of OpenModelica was released, including significant improvements to the OMEdit GUI.
- Demonstration examples are available for the application of Modelon Impact to the [design of residential heat pump systems](#).
- [Dymola 2024x](#) is available with new features that include connection with the 3DEXPERIENCE platform, improved simulation performance, and support for thermal separation processes.

### 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](#).

Learn more about the [Modelica Association](#).

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### SERC Updates



[Recent updates](#) from the Systems Engineering Research Center (SERC) include reports from two workshops that address the leading-edge topics of AI and model-based test and evaluation.

#### AI4SE & SE4AI

The SERC and INCOSE co-organized an AI-focused workshop in October to enable an international assembly of experts to exchange ideas and insights on these topics. Over fifty presentations at the event indicate the depth of interest in understanding the intersection between AI and systems engineering.

From the perspective of Artificial Intelligence for Systems Engineering (AI4SE), speakers believe that AI shows potential to streamline processes, boost efficiency, and guide decision-making in system engineering. From the perspective of Systems Engineering for Artificial Intelligence (SE4AI), speakers recognize that applying systems engineering principles to AI systems remains a significant challenge.

Read the [SERC summary](#) of this event.

Download presentation slides [here](#).

#### Model-Based TEMP Strategy & Integrated Decision Support Key

In August 2023, a diverse team of U.S. Department of Defense (DoD) Test & Evaluation (T&E) subject matter experts convened in a hybrid setting to explore and advance the practices of model-based T&E. Approximately 115 colleagues participated in the workshop, with more than 40 participating in-person. The workshop focused on two key elements of the T&E process:

- Test and Evaluation Master Plan (TEMP): Documentation of the T&E strategy that spans major defense program milestones.
- Integrated Decision Support Key (IDSK) and Evaluation Matrix family of related tables (e.g., requirements, evaluation measures and metrics, key program decisions, test events, etc.). The IDSK derives acquisition decisions from the developmental and operations test-based evaluations; the Evaluation Matrix links high level systems performance metrics to their supporting test data.

Download the 18-page [workshop summary](#).

Access the latest SERC news [here](#).

Follow [SERC on LinkedIn](#).

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### OMG Systems Modeling Community (SMC)



On 30 November 2023, the [Object Management Group \(OMG\)](#) announced the launch of its new [Managed Communities Program](#). The program will provide a competitive advantage to OMG Managed Community members by enabling them to obtain valuable knowledge about best practices and future technologies through networking and participation in the development of community products.

Bill Hoffman, OMG Chairman & CEO, says, "By joining an OMG Community, companies can become involved in industry projects that will advance their expertise and set them apart from their peers."

The OMG [Systems Modeling Community \(SMC\)](#) is the first of many planned communities. The SMC will provide a forum for systems modeling end users, tool vendors, and academia to share best practices that promote the adoption and advancement of Model Based Systems Engineering (MBSE) using various OMG standards such as SysML v2 and UAF.

Other SMC functions include:

- Acting as a bridge to the OMG Standard Development Organization (SDO) process, providing validated inputs to the SDO to update relevant specifications based on evolving user needs, including KerML, SysML and Systems Modeling API & Services
- Providing support for building other modeling languages and domain-specific extensions based on KerML and/or SysML

Read the OMG [press release](#).

Investigate [Managed Communities membership](#).

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### New INCOSE Academic Equivalency Agreement with Loyola Marymount University



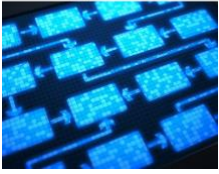
INCOSE has announced that an Academic Equivalency Agreement has been approved for courses at Loyola Marymount University. Students who do sufficiently well in university courses which have been assessed to have Academic Equivalence (AcEq) are allowed to bypass the certification knowledge exam when applying for ASEP and CSEP Certification. The assessments they complete through their coursework have been recognized by the INCOSE Certification Program's volunteer reviewers as an equivalent alternative to the standardized test developed by INCOSE.

Learn more about the Academic Equivalency process [here](#) and in the [Certification Blog](#).

Learn more about [Loyola Marymount's Systems Engineering program](#).

### INCOSE Model Portfolio Management Guide is Published

Model Portfolio  
Management Guide



INCOSE's [Tool Integration and Model Lifecycle Management Working Group](#) provides a forum for discussion of best practices, methods and processes that promote the development, validation and deployment of standards to advance data exchange capability of digital data created during a product development lifecycle. The Working Group has announced the publication of the *Model Portfolio Management Guide*. The Guide defines the roles, tasks, and products to assist organizations in ensuring that their collection of models:

- Aligns with organizational needs
- Has a planned evolution
- Meets integration targets
- Identifies known risks
- Fulfills quality assurance requirements
- Can be used to establish and implement modeling best practices and standards throughout their organization.

Contents of the 80-page Guide include:

- Model Portfolio Management (MPM) Initiation: Define portfolio strategy, governance and roadmap
- MPM Planning: Portfolio scope, plan and resources.
- MPM Execution: Frameworks and quality and maturity assessments.
- MPM Monitoring and Control: Portfolio metrics, risks, optimization and maintenance.
- Supporting resources: MPM glossary, examples and MPM Plan template.

Learn more about the MPM Guide [here](#).

Download the Guide (free to INCOSE members) from the [INCOSE Online Store](#).

For more details, read the INCOSE [press release](#).

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### NAFEMS Launches Engineering Modeling, Analysis & Simulation (EMAS) Journal



[NAFEMS](#) is an international society that aims to provide knowledge, collaboration and educational opportunities for the use and validation of engineering simulation. NAFEMS has announced the launch of [Engineering Modelling, Analysis & Simulation \(EMAS\)](#), a new open-access journal to showcase the latest advancements, research, and novel applications of engineering simulation and related technologies.

The first edition, Volume 1 (2024), of EMAS is available. This issue contains selected articles, expanded from presentations from the NAFEMS World Congress 2023. A sample of the diverse articles in this inaugural issue include:

- Microscopic and macroscopic modeling of linear viscoelastic vibration behavior of short fiber reinforced plastics
- Hybrid NVH modeling approach: How numerical and experimental methods complement each-other
- Model-based Design Optimization - Taking into Account Design Viability via Classification

The editors of EMAS welcome submissions of original, previously unpublished research papers, review papers and case studies demonstrating clear contributions to engineering simulation. Submissions

should emphasize the practical applications of engineering simulation techniques. See submission guidelines [here](#).

Join NAFEMS [here](#).

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### SE Tools Database (SETDB) Updates



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.

Tools entries are searchable across over 80 categories of capabilities – the largest categories include:

Modeling & Simulation/MBSE (excluding CAD, Math & Value modeling)	195 entries
Testing (and V&V)	133 entries
Requirements Engineering	131 entries
Domain Specific - Software	119 entries
Engineering Management - Other	111 entries
Application Lifecycle Management (ALM)	105 entries
Data Visualization	93 entries
Visualization – Other	80 entries
SE Tool Integration Software	72 entries
Mathematical Analysis & Modeling	71 entries
Lifecycle Management – Other	64 entries
Decision Support – Other	60 entries
Risk Management	59 entries
Documentation Management	57 entries
Graph Visualization	54 entries
Product Lifecycle Management (PLM)	51 entries

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

Vendor: [Aha!](#)

- Aha! Suite: Covers every step of the product development lifecycle so teams can create real value - for customers and the business.
- Aha! Ideas: A collaboration tool for use by team leaders to capture, review, organize and prioritize ideas.
- Aha! Develop: Get an unprecedented level of visibility into your product roadmap. Aha! Develop seamlessly connects with Aha! Roadmaps, empowering engineering to partner closely with product management on the bigger plan. Visualizes how each feature contributes to your strategic goals so engineers see their value.
- Aha! Roadmaps: A roadmapping tool intended for use by project and program planners or managers to capture the development plan for a product.

Vendor: [BCPG PLC](#)

- beCPG PLM: Manages the lifecycle of finished and semi-finished products, raw materials, packaging and documents. The product repository provides Product data management (PDM) for specifications, technical sheets, bill of material and regulatory data and Product Information Management (PIM).
- New Product Development (NPD): New product development (NPD) software covers the



complete process of bringing a new product to market, renewing an existing product or introducing a product in a new market. With beCPG, manage projects, assign tasks to people with workflows, track planning and budget!

- **Product Specifications & KPI:** Product Specification Management software allows you to generate automatically technical data sheets and documents for Clients, Factory, R&D and Regulatory! You can also visualize your KPIs and build your queries by drag-n-drop.
- **R&D Formulation:** Formulation software facilitates the design of new products from the recipe, packaging and processes, it automatically calculates regulatory data, labeling data and product costs to develop food and cosmetics formulations in order to be compliant with food and cosmetics regulations.
- **QMS:** beCPG accelerates the development of new products while improving the products' quality. As a Quality Management System (QMS) software, beCPG manages quality documents, customer complaints, non-conformities, CAPA, control plans and quality controls.

Vendor: [Inflectra Corporation](#)

- **SpiraTeam:** Application Lifecycle Management (ALM) tool intended for teams to manage the entire project lifecycle from requirements and test cases to tasks and code.
- **SpiraTest:** Test management, requirements management, and defect management software tool intended for teams to manage requirements, features, and use cases; create, edit and execute test cases; track bugs, enhancements, risks and issues and generate personalized reporting.

Vendor: [OpCloud Ltd.](#)

- **OPCloud:** A cloud-based collaborative MBSE software-as-a-service featuring an innovative cloud-based framework to enable you to architect, design, develop, test, and deliver their products faster resulting in significant cost reduction and time-to-market shortening.

Vendor: [Professional Systems Associates Inc.](#)

- **CMPRO:** Web-based, Commercial-off-the-Shelf (COTS) Product Lifecycle Management (PLM) solution designed to orchestrate all of your organizations PLM data in one secure database.

Vendor: [SigmaZone](#)

- **Quantum XL:** Includes Statistical Tools, Design of Experiments (DoE), and Monte Carlo Simulation in one easy-to-use Excel Add-In. Support for Full/Fractional Factorial, Central Composite, Box-Behnken, Plackett-Burman, Custom, and D-Optimal Designs is included.
- **SPC XL:** Integrates into Excel, streamlining your workflow and saving you time. Control Charts XbarR, XbarS, Individuals, n, p, u, and np Charts. Update charts after they've been created. Identify outliers and have them displayed without affecting the control limits.

Vendor: [Sodius Willert](#)

- **OSLC Connect for Confluence:** Allows engineering teams to embed IBM Engineering Lifecycle Management (Jazz), Siemens Polarion ALM, and CATIA Teamwork Cloud artifacts into Confluence pages. Enable stakeholders to have access to critical and up-to-date engineering artifacts in one single place.
- **OSLC Connect for Jira:** Allows engineering teams to connect Jira to IBM Engineering Lifecycle Management (Jazz), Siemens Polarion ALM, and CATIA Teamwork Cloud to maximize the visibility and traceability of engineering artifacts across product and software development projects.

- Publisher for Rational Software Architect: Publishes complete RSA UML or UPIA models to MagicDraw/Cameo, including diagrams in the push of a button.
- Publisher for System Architect: Automated exporter for Unicom System Architect DoDAF Version 2.0 models to MagicDraw™ UPDM™ Version 2.1 models.
- Publisher for Rhapsody: Systems model transformation tool that converts IBM Engineering Systems Design Rhapsody models into CATIA Cameo or MagicDraw file format.
- Publisher for Rhapsody - Cameo Importer: Converts and exports complete UML, SysML, or UPDM Cameo Systems Modeler models into a compatible IBM Rhapsody file format.

Vendor: [Trace.Space](#)

- Trace.Space: AI-Enhanced Requirements Management.

Vendor: [TraceLynx](#)

- TraceLynx: A traceability management solution which helps engineers create traceability links from within their familiar applications, without requiring the use of a 3rd party solution (e.g. MBSE/ALM/PLM).

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

Access the [SETDB website](#).

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*Simulation is not the real thing; it is a model or approximation or experiment of the behavior of the real thing for the purpose of drawing inferences about the real thing.*

**Robert Halligan**

# CONFERENCES, MEETINGS & WEBINARS

## PDMA January Webinars



The [Product Development Management Association \(PDMA\)](#) will host three webinars in January 2024 aimed at improving the business results associated with innovation and new product development.

A PDMA webcast on 11 January will feature Susan Penta of MIDIOR Consulting presenting on *"Monitoring Competitive Threads – A Holistic Approach"*. 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. Attendees will be guided through the various elements of robust competitive analysis, common approaches and frameworks and where and when to apply them for timely and accurate monitoring of competitive threats. This workshop uses MIDIOR's Competition Cube as a practical approach and framework for identifying and tracking competitive threats.

### Learning Objectives:

- Demonstrate an approach to rapidly assessing competitive threats from multiple angles.
- Use the Competition Cube in real time to assess a product or service of their choice. Walk through case example as well as one or two live examples based on products or services selected at random from session attendees.
- Walk away with a template and process that they can use at their own firms.

Learn more and register [here](#).

Also on 11 January, the PDMA St. Louis (Missouri, USA) chapter will host *Using the Working Backward Framework to Create High Confidence Product Features*. Jenn Bordner will share the Working Backwards product framework that was developed at Amazon to de-risk customer-focused products. Participants will learn how to write a working backwards document to build rigor in customer obsession, critical product thinking, risk understanding and cross functional management.

### Specific learning objectives include:

- General understanding of the Working Backwards philosophy and why it works.
- High Level Do's and Don'ts in developing your document.
- How to gain company buy in for your vision.

This is a free event for both PDMA members and non-members alike. Learn more and register [here](#).

On 17 January, the PDMA Minnesota (USA) chapter will host a webinar titled *"Artificial Intelligence (AI) Use in Product Management"*. David Mathias and Rolf Biernath will discuss their understanding of how and why AI is becoming more central to all product managers in differentiating their product, accelerating their product development process, and making them more efficient. Dave and Rolf will bring two perspectives in leveraging AI in product management and do's and don'ts.

Learn more and register [here](#).

[Join PDMA.](#)

### ETSI Artificial Intelligence (AI) Conference



ETSI is an international standards organization that publishes globally applicable standards for systems enabled by Information and Communications Technology (ICT). ICT-enabled systems, applications and services are deployed across all sectors of industry. ETSI is hosting the [Artificial Intelligence \(AI\) Conference](#) in Sophia Antipolis, France on 5-7 February 2024. The theme of this in-person conference is *Status, Implementation and Way Forward of AI Standardization*.

Artificial Intelligence / Machine Learning (ML) are already part of the networks and services, and are present across multiple sectors such as finance, manufacturing, medical, telecommunications and transportation. AI/ML will fundamentally shift the ICT industry, as technologies such as Natural Language Processing, Deep Learning, and others will enhance the performance of communications, applications, content, and digital commerce.

The event will present the regulations in the different regions of the world and will provide the opportunity to get involved in standardization that will play an important role in the context of European and global regulation.

Keynote addresses include:

- Generative AI – Is It Even Possible To Do That Responsibly?
- Generative AI, from Vision to Language
- Standardization Work in Support of the AI Act

The conference consists of nine technical sessions:

- Opening Address, Setting the Scene
- AI Regulation on a Global Level/Across regions
- Standardization in Support of the Upcoming AI Act and the Legal Frameworks Outside EU
- Cyber Security in the Context of AI
- Applications of AI in Cellular and Communications Networks
- Applications of AI in Various Sectors
- Novel AI Features, and Related Conformity Assessment
- Deep Dive on Selected Topics
- Panel Discussion: New ETSI Initiatives in the Field of AI

See the [full agenda](#).

Register [here](#).

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### Topic Call: GfSE February Workshop

[GfSE](#), the German chapter of INCOSE, has issued a Topic Call for a GfSE Workshop to take place in Hanover on 20-21 February 2024. The organizers are looking for problems from the daily life of a systems engineering practitioner that can be solved in about two half-days in a group of around 10 people. The solution may take the form of a position paper, a white paper, a well-annotated collection of sources, a detailed mission statement for a working group, a well-annotated model, or any other form that is appropriate alone” to be made available to the members of the GfSE.

#### Concept implementation

The project sponsor defines the problem, helps solve the problem during the workshop and, if possible, is also the “facilitator” of the workshop sessions on his topic. The project sponsor does not



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have to be an expert in the topic area; if necessary, the GfSE will look for a sponsor for the topic who will provide the necessary basics.

The projects must be formulated in such a way that they are:

- appealing to the general public in the area of SE.
- free of restrictions (Non-Disclosure Agreement/NDA) on the use of the data or results.
- solvable within the workshop.
- manageable under the environmental conditions (infrastructure).
- made available to the participants and the GfSE in documentation at the end of the event and ideally be included as content in the German SE manual.

Project sponsors may submit their proposal via email to [workshop@gfse.de](mailto:workshop@gfse.de).

For more information, email: [office@gfse.de](mailto:office@gfse.de).

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### Call for Presentation: MBSE-CON-2024



The [Lifecycle Modeling Organization \(LMO\)](#) develops and maintains an open-source modeling language that models both structure and behavior, the [Lifecycle Modeling Language \(LML\)](#). LML provides a simple way to understand and communicate cost, schedule, and performance design information to all stakeholders in a standard manner. The LMO is hosting the Model-Based Systems Engineering Conference (MBSE-CON-2024) in Orlando, Florida, USA from 1-2 May 2024. The theme of this hybrid conference is *"Modernizing MBSE through Digital Engineering, Mission Engineering, and Modeling and Simulation"*.

A [Call for Presentation](#) has been issued seeking 30-minute presentations that support the conference theme. Important dates for authors are as follows:

- 19 January 2024: Abstracts Due
- 9 February 2024: Author Notification
- 17 April: Final Presentations and Copyright Release

Abstracts should be submitted to [mbsecon@lifecyclemodeling.org](mailto:mbsecon@lifecyclemodeling.org)

The keynote speaker for the conference is [Eugene Fleeman](#), author of the textbook, [Missile Design and Systems Engineering](#). Mr. Fleeman has 50+ years of government, industry, academia, and consulting experience in the design, development, and system engineering of missile systems.

Learn more about [MBSE-CON-2024](#).

Learn more about LML [here](#).

Discounted early registration is open for MBSE-CON-2024. Register [here](#).

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### Call for Submissions: International System Dynamics Conference (ISDC 2024)



The System Dynamics Society (SDS) will host its annual International System Dynamics Conference (ISDC 2024) on 4-8 August 2024. The in-person portion of this hybrid event will take place in Bergen, Norway. ISDC 2024 invites work related to System Dynamics and Systems Thinking from all people active in the field.

The theme of ISDC 2024 is *"Bridging Perspectives for New Insights"* which highlights the need for building

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bridges across different fields and approaches to benefit everyone. In support of this theme, ISDC 2024 seeks experts from different fields with an interest in connecting with the System Dynamics community to better understand and address dynamic problems.

Types of submissions include:

- Conference Presentation (Research Paper, Practitioner Application, or Work in Progress)
- Workshop Proposal
- Student-Organized Colloquium
- Other submissions (e.g., Roundtable)

Important dates for submissions include:

- 16 January – 19 March: Submissions Window
- 9 May: Author Notification
- 28 May: Author Registration Deadline

[Investigate](#) the International System Dynamics Conference (ISDC 2024)

Review the [Call for Papers](#).

See [submission instructions](#) for details.

Learn more about [SDS](#).

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### IIBA Building Business Capability Conference



The International Institute of Business Analysis™ (IIBA®) is a professional association with over 30,000 members that is leading the global business analysis community to achieve better outcomes through better analysis. IIBA® is hosting the Building Business Capability (bbc 2024) conference in Orlando, Florida, USA from 15-19 April 2024. The theme of this in-person conference is *"Igniting Your Potential"*. The goal of the bbc 2024 conference is to enhance participants' ability to advance *People, Product, Data, and Knowledge* to build core leadership skills, to create a customer centric organization, and to deliver digital transformation.

The five-day conference will feature 7 content tracks, 20 tutorials, 108 sessions and 86 speakers to serve the anticipated 1000+ delegates.

Keynote and spotlight talks include:

- Igniting Your Potential (Keynote)
- Knowledge as Part of Every Business Solution
- Business Architecture and Processes Design in the Knowledge Age
- The Indistractibles: Holding Stakeholder Attention

Presentations and panels will be organized into [capability focused tracks](#):

- Building People Capability
- Building Product Capability
- Building Data Capability
- Building Knowledge Capability
- Foundational
- High-Impact Techniques
- Practitioner's Chat

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These capabilities will cut across various elements of the business analysis process model aka “trails”, including Business Analysis, Business Architecture, Business Design, Business Leadership and Everyday AI.

A small sampling of the twenty tutorials, to be delivered on 15-16 April includes:

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### 2024 INCOSE Systems Engineering in Healthcare Conference

The [INCOSE Healthcare Working Group \(HWG\)](#) is sponsoring the Ninth Annual Systems Engineering in Healthcare Conference on 23-25 April 2024 in Bloomington, Minnesota, USA. The theme of this in-person conference is *How SE Can Reduce Cost & Improve Quality*. The target audience is systems engineering practitioners, product developers and testers, certifiers, and leaders of organizations developing complex healthcare products and services, from large Healthcare IT systems to medical devices to healthcare delivery organizations.

The keynote address, *The Double-Edge Sword of Technology in Healthcare*, will be delivered by Michelle Jump, CEO of MedSec.

Learn more [here](#). Watch the [HWG video](#) for information on prior events.

Register [here](#).

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# FEATURE ARTICLE

## A Rapid Immersion in Systems Thinking - Part 1

*by René King and John Fitch*

*Project Performance International*

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Authored for PPI SyEN

### Introduction

In Resources section of [PPI SyEN Edition #129 \(October, 2023\)](#), we provided a quick overview of the [Waters Center for Systems Thinking](#) and described the range of Systems Thinking (ST) courses offered by this non-profit foundation. The courses fell into three categories:

- Habits Courses (15 – includes an intro course plus coverage of the 14 habits listed below)
- Tools Courses (9)
- Archetypes Courses (9)

ST skills are certainly among the enablers of most successful systems engineering practitioners. However, as noted in the INCOSE Systems Engineering Handbook, Fourth Edition, there is no universally accepted definition of systems thinking; nor how this discipline interacts with the discipline of systems science, nor with the systems engineering principles and practices to lead to successful outcomes. [1]

The goal of this article is to provide a rapid immersion into the key concepts associated with systems thinking, as experienced by the authors when taking an initial set of the Habits courses mentioned above. We hope to absorb the systems thinking content as packaged and presented by the Waters Center and compare its precepts and practices with our understanding of systems engineering done well. In addition to highlighting how the Waters Center materials align with our mental models, we hope to draw clear distinctions that are of particular relevance to those who engineer systems that address a diverse range of problems and stakeholder concerns.

### Systems Thinking Habits

The Waters Center identifies 14 habits of a (presumably successful and effective) Systems Thinker. According to the defined habits, a Systems Thinker:

1. Makes meaningful connections within and between systems
2. Seeks to understand the big picture
3. Changes perspectives to increase understanding
4. Considers how mental models affect current reality and the future
5. Observes how elements within a system change over time, generating patterns and trends



6. Surfaces and tests assumptions
7. Recognizes that a system's structure generates its behavior
8. Identifies the circular nature of complex cause and effect relationships
9. Recognizes the impact of time delays when exploring cause and effect relationships
10. Considers short-term, long-term and unintended consequences of actions
11. Considers an issue fully and resists the urge to come to a quick conclusion
12. Pays attention to accumulations and their rates of change
13. Uses understanding of system structure to identify possible leverage actions
14. Checks results and changes actions if needed: "successive approximation"

Readers should note that these Waters Center ST habits have been directly incorporated into the INCOSE Systems Engineering Handbook, Fourth Edition [Reference 1]

In this article we will address the first four habits covered by the first five courses; look for follow-on articles to dive deeper into the remaining habits and the relationships between the habits and associated ST tools. The authors appreciate the sentiment carried by the Waters Center throughout these courses which states that systems thinking habits do not function in isolation but are interlinked with other systems thinking habits.

### **Habits Course #1: Beginning Your Systems Thinking Journey [Precursor]**

The ST Habits series commences with an introductory course that offers practical approaches for guiding actions and self-reflection. This course establishes a framework for identifying personal strengths and areas for improvement, encompassing 14 essential habits. These habits cover a variety of skills including connecting different systems, striving for a comprehensive view, shifting perspectives for enhanced understanding, and acknowledging the impact of mental models. These habits involve scrutinizing system elements and patterns, questioning assumptions, grasping the link between structure and behavior, understanding cyclical cause-and-effect dynamics, and considering the time-related impacts and consequences of actions.

The course emphasizes the importance of thorough issue analysis when deconstructing a context via the vehicle of systems thinking, recognizing accumulations of elements in the scenario, and using an understanding of systems to inform actions through a process termed "successive approximation." Successive approximation is a strategy of improving incrementally from one iteration to the next. A set of specific tools is introduced to support successive approximation in applying these habits, such as behavior-over-time graphs, stock-flow maps, causal loops, ladders of inference, connection circles, and icebergs, which are integrated into practice exercises.

The course delves into the application of these habits in various aspects of life, including personal well-being, workplace dynamics, community involvement, family interactions, and educational environments. Through use of examples and relatable illustrations, ST is portrayed as a collaborative and adaptable learning strategy, suitable for a variety of settings. ST provides a comprehensive toolkit consisting of visual, verbal, and kinesthetic tools for analysis and a shared language for problem definition and resolution.

In this first Habits Course, ST is distinguished from standard curricula, lesson plans, or teaching strategies. Instead, ST offers a deeper insight into understanding life experiences and conditions and working with natural system forces.

### **Course 1 Reflections**

The following quote from Course 1 provides insight into the scope and focus of systems thinking:

*"Developing a deep understanding of complex systems is the practice of a systems thinker."*

The ST habits are aimed at providing a deeper understanding of existing systems, especially those characterized by complex interactions among the system elements. The belief is that a deeper understanding of a system will yield better decisions as to how to improve its performance over time. This deeper understanding is achieved by perceiving connections across time and space with tangible and intangible elements. System Thinkers appreciate that a cross-sectional view of a system, scenario or otherwise will allow for a certain breadth and depth of elucidation. They also recognize that the status of the cross-section changes over time (hence all the associated connections are subject to change). This adds another dimension to taking a holistic view. Achieving a clearer view of connections in this manner is not a black and white methodology and requires repeated application of principles, processes, and techniques in order to gain efficiency and effectiveness in this skill.

*“Systems thinking can help you design thoughtful, enduring solutions to challenges.”*

The ST habits provide a variety of methods to model and explain the behavior of a system, plus softer skills that help system designers appreciate the inputs of stakeholders with differing perspectives. As such, the ST habits align well with trends in Model-Based Systems Engineering (MBSE). MBSE provides a diverse set of modeling constructs with which to capture and explore the definition of the problem, the description of the current solution and the thinking by which potential improvements may be identified, designed, deployed, and evaluated.

The ST habits, as taught in the Habits courses, don’t represent a comprehensive methodology or defined process flow for system development or enhancement. Rather, they equate to broad principles or heuristics that provide the foundation for successfully addressing complex challenges. They are not presented as an executable sequence of steps, but as building blocks of a flexible strategy for managing change.

The definition provided in Course 1 for a “system” would be recognized as valid by most systems engineering practitioners.

*“A system is a group of interacting, interrelated, and interdependent parts or components that form a complex and unified whole.”*

However, the course asserts:

*“Most systems thinkers focus their attention on living systems, especially human social systems. However, many systems thinkers are also interested in how human social systems affect the larger ecological systems in our planet.”*

This assertion was reinforced by the “five sample systems” that were suggested as the basis for practice exercises (Well-being, Workplace, School, Community, and Family examples).

Many systems engineering practitioners work in development of products that improve the lives of other human beings. They understand that their products will be used in the context of broader human social systems, but limit their consideration of this broader context to the definition of system users, use cases, environmental conditions, and the full lifecycle interactions between the product and external actors. However, it is an observation that for many systems engineering practitioners, the emphasis in development seems to be on the technical aspects of the system. This may be conscious or unconscious to engineers, but one suggested reason for this tendency is that human interactions in socio-technical systems bring about the highest degree of complexity therefore choosing the system boundary conveniently to avoid consideration of these highly complex factors is preferable from a design perspective. ST with its heightened focus on seeing connections across time and space, can help to further understand some of human-centric aspects in socio-technical complex system development.

SE practitioners accept the risk of narrowing the effort invested to understand the full system context, to deliver a system that meets the need amidst genuine cost and schedule constraints. Requirements modeling and analysis techniques, e.g., Context Analysis and Functional Analysis (or simpler use cases and user stories) are mature practices that have been developed to strike the right balance between deep and deep-enough understanding of the problem domain.

Another question raised was whether the 14 habits apply equally well to all types of systems. It appears that they are “tuned” to fit best with natural systems and socio-technical systems that have human actors/agents whose behavior is predictable, but not fully controllable. Many ST habits appear less relevant and valuable (and a potentially incomplete set) for the designers of a typical product with a well-defined and constrained mission, such as the Energy Absorbing Deceleration Barriers (highway sand barrels) that were used as a design example in the feature article in [PPI SyEN Edition #130 \(November, 2023\)](#). It would have been helpful if a suggested example was included for a simple electromechanical product, e.g., “a better method of collecting household detritus from surfaces”.

### **Habits Course #2: Makes Meaningful Connections Within and Between Systems [Habit 1]**

If Habits Course #1 is about recognizing the existence of and beginning to see the multiple connections present in a systems view, Habit Course #2 is about understanding the mechanics of the relationships between elements connected.

Systems thinking is a methodology that centers on forming meaningful connections and integrating them to foster clearer thinking and generate innovative ideas. Tools such as [Kumu.io](#) and [Plectica.com](#) can be useful in this process, offering capabilities for data visualization and information mapping. Nature itself is a prime example of the interconnectedness that systems thinking aims to encapsulate, with numerous instances that illustrate this concept.

A key technique in systems thinking is the causal connection circle, which is utilized for mapping relationships within systems. The course places emphasis on exercises that involve defining systems, comprehending their elements, objectives, and their evolution over time. Central to this learning process is the skill of making connections, a sophisticated ability that requires assimilating vast amounts of information to understand the System of Interest (Sol).

The course highlights the significance of forming connections in diverse contexts. For instance, it encourages participants to attend conferences and integrate the knowledge gained at conferences into their work environments, then adapting the knowledge culture of their organization to improve team performance (SE practitioners will recognize this as tailoring). Various techniques are covered in this second course, such as mapping causal connections, defining systems and their interrelated parts, making transfer connections, and identifying patterns and trends across different systems.

Regardless of the system being studied, the ability to connect and transfer information is pivotal for enhancing understanding, learning capacity, and operational effectiveness within any system. Furthermore, the course recognizes the innate human need for connection, suggesting that acknowledging and acting on this need for human connection can lead to greater personal fulfillment. The course also acknowledges the complexity of relationship causal loops, which can have reinforcing or undermining effects.

### Course 2 Reflections

The causal connection circle was introduced using a simple example at the intersection between nature and human activity (agriculture). The elements on the diagram, connected by various relationship arrows were:

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Plant	Farmer's success
Predators	
Fruit	
Seed	

*Which of these things is not like the others?*

As named, the items in the first column are all tangible “things”. *Farmer's success* is an intangible property, a measure of performance. Systems engineering intuition and experience suggests that all such items should be of the same class (performance parameters), i.e. such that they can be related mathematically or at least in terms of positive or negative correlation. Likely the things in column one are just proxies for performance parameters (number of plants, predators, or seeds, volume of fruit, etc.).

In this sense, does the value that SE can bring to ST come to light, offering consistency and rigor to the application of habits, thus enabling quicker recognition of trends and patterns between relationships.

The authors propose, however, that this example may be a brilliant use of abstraction or information-hiding when teaching a new concept to young students (perhaps deferring the concept of complexity until it is needed). It may also be used as an indication that the ST habits and tools, when applied in absence of scientific or engineering principles, can lead to expressions of relationships that lack the precision required to support design decision-making.

*“A systems thinker continually makes meaningful connections and consciously weaves them together to produce clearer thinking and new ideas.”*

However, meaningful connections, if they are to be efficiently shared with other human beings, imply a common language. Such languages are based on an information model that has a constrained set of information classes (e.g. distinguishes system performance parameters vs. system elements) and valid relationships between and attributes on the instances of each class.

On the topic of Making Transfer Connections, the course states:

*“Systems thinkers develop the ability to transfer understanding of one system by making connections to other very different systems that behave in similar ways.”*

*“Systems thinkers further their learning by applying their understanding of systems to multiple contexts”*

These statements indicate that systems thinkers recognize and leverage patterns. This habit certainly rings true in the case of the discovery and use of decision patterns, as highlighted in [PPI SyEN Edition #107 \(December, 2021\)](#). The product design decision pattern was the basis for patterns for process capability design, service design, courseware design and life design. Systematic thinking (aka rational) processes, learned decades earlier, were the foundation for recognizing that decisions were the integrative mechanism within any design process. [2]

### **Habits Course #3: A Systems Thinker Seeks to Understand the Big Picture [Habit 2]**

In this part of the course, the focus is finding the crucial balance between zooming out to see the macro, or big-picture, view and knowing when to pay meticulous attention to detail. Understanding this balance is essential for gaining a comprehensive perspective and understanding of systems in their entirety, encompassing their objectives, actions, and the impact of system boundaries. The importance of this skill is captured in Daniel Goleman's book titled *Focus* which states, *‘Directing attention toward where it needs to go is a primal task of leadership.’*



The first lesson in this course, titled "Big Picture Views," highlights the importance of avoiding premature conclusions by taking a zoomed-out perspective. In order to identify patterns and trends, it is essential for systems thinkers to understand the broader context.

The practice exercises in Habits Course #3 are designed to help participants develop their ability to see the big picture. The importance of adjusting one's perspective by mentally shifting boundaries, noting the limitations inherent in both an excessively broad or narrow viewpoints, is emphasized.

A message from this course in application to one's personal life, is to focus on areas of one's life where one has influence, thereby creating a more expansive system of influence. An example given is the balancing of personal needs with family, work, and health commitments, illustrating the value in maintaining a big-picture view of one's life in order to establish priorities. This course aims to equip learners with the skills to balance overarching views with detailed understanding, ensuring a well-rounded approach to systems thinking.

### Course 3 Reflections

The course summarizes big picture skills as follows:

*"Systems thinkers balance the big picture view with attention to detail. Much like the focus on the forest while appreciating each tree, systems thinkers hold both views. ... This balancing act is a practiced skill."*

However, the course (at this point) doesn't explain how to learn the big picture visualization skills that yields the ability to see "out of place" elements. These skills appear to be the assumed output of practice, but experience in many domains demonstrates that *not all practice makes perfect*.

From the authors' experience, big picture skills include the ability to:

- Shift context, i.e., zoom in, zoom out, pan around and flex the scope and boundaries of the system of interest.
- Retain the point of entry into the latest view, whether mentally or visualized graphically, to enable switching back and forth without loss of "place".
- Maintain alignment between the resulting views, e.g., detect inconsistencies between content of views that exist at different levels of depth in the system structure or when flexing the system boundary.

These skills are certainly dependent on a mix of nature and nurture, but nurturing is enhanced by learning proven systems engineering techniques such as the aforementioned Context Analysis and Functional Analysis.

Context Analysis creates a clear definition of the boundary of the system of interest by:

- Identifying all of the relevant external systems and actors (stakeholders) that the system will interact with across its full lifecycle. In this context "relevant" implies that the external actors are likely to be a source of meaningful requirements imposed on the system of interest.
- Naming and specifying the inputs that the system will receive from these external actors.
- Naming and specifying the outputs that the system will generate and pass to these external actors.
- Characterizing the interfaces over which each input and output will pass between the parties.

When visualized as a Context Diagram, the results of Context Analysis make it easy to flex the boundary of the system of interest by pulling an external actor into the system scope, e.g., making the maintenance personnel and their tasks and tools part of the system design.

While Context Analysis focuses on the physical boundary of a system, Functional Analysis enables engineering practitioners to bound what the system has *TO DO* and distinguishes system functionality

from functions performed by external systems and actors. Context Analysis and Functional Analysis are complementary techniques that often lead to iterative refinement of the system physical and logical boundaries. SE there comprises the conscious oscillation between seeking converging and diverging outcomes.

The ST course proposes a set of simple techniques to explore system boundaries.

*"It is important to pay attention to the boundaries that define your system of interest. Sometimes boundaries are drawn for you, as in a map, job description or organizational chart; other times, you can determine them based on your viewpoint, disposition and perspective."*

While the above techniques are effective for quick illustrations, readers are encouraged to investigate the article, *MECE+ Thinking: Engine for MBSE*, in [PPI SyEN Edition #116 \(September 2022\)](#) for details on a more rigorous approach to model a system such that its elements are:

- ME = Mutually Exclusive
- CE = Collectively Exhaustive [3]
- OD = Optimally Decomposed
- OI = Optimally Integrated
- AC = Across Classes (of knowledge)

Following this deconstructed approach will result in a much more valuable output from energy and time invested in modeling activities.

#### **Habits Course #4: A Systems Thinker Changes Perspectives to Increase Understanding [Habit 3]**

This course section delves into the significance of understanding various perspectives within the context of systems thinking. It fosters a mindset where systems thinkers strive to perceive situations, experiences, and viewpoints through the eyes of others, exploring the necessity of considering diverse viewpoints. The course encourages the practice of viewing situations from different perspectives and urges participants to examine their deeply-rooted beliefs to understand how these beliefs shape their views. An essential distinction is made between merely hearing and actively listening, with an emphasis on dialogue as a disciplined method of communication.

The first lesson Habits Course #4, "Perspective Taking," highlights the importance of empathy and the ability to comprehend things from another person's viewpoint. This lesson is based on the idea that success hinges on understanding and caring about others' perspectives. Author Ellen Gallinsky's shares in her book titled, "Mind in the Making", that the ability to change perspectives is one of seven essential life skills that facilitate learning and achievement from childhood through adulthood.

The course warns about the dangers of clinging to a single perspective, which can result in incomplete or inaccurate interpretations of systems and promote isolated thinking. The importance of dialogue is highlighted in this segment and David Bohm's collection of essays, "On Dialogue," is referenced as a foundational resource to understand the meaning and value of this type of communication. This lesson emphasizes the discipline of dialogue for effective communication, encouraging participants to move beyond their entrenched judgments and to refrain from valuing certain perspectives or contributions over others. It differentiates between simply hearing and genuinely listening to understand, thereby fostering divergent thinking that enables exploration, discovery, and insight. In contrast, skillful discussion is associated with convergent thinking, focusing on decision-making, agreement-reaching, and priority setting. In this way, ST focuses on intentionally converging and diverging in perspective, similarly to SE as unpacked in the previous habit.

#### Course 4 Reflections

From the perspective of assessing ST habits in the light of proven systems engineering principles and

practices, there is common understanding concerning the necessity of engaging the full range of system stakeholders in a dialogue that surfaces their requirements and values. Most experienced engineers would agree with the assertion:

*"This Habit ... asks us to actively change our own perspectives; to get into other people's shoes and see the system from a lens created from different experiences, backgrounds and cultures."*

While Context Analysis helps to identify missing or lightly-regarded stakeholders, numerous engagement and analysis techniques are part of the systems engineering toolkit to help stakeholders communicate their priorities to sufficient depth and detail to inform solution development.

Recent "flavors" of engineering methods such as Design Thinking have further elevated the importance of *empathy* with stakeholders. [4] See the article, *A Fresh Look at Design Thinking in the Light of Proven Systems Engineering Principles*, in [PPI SyEN Edition #104 \(September 2021\)](#) for details.

Agile development methods also emphasize *face-to-face communications* between end users and developers, plus putting *working solutions* (typically software code) in users' hands so that they may provide effective feedback. [5]

Although successful systems engineering practitioners may argue that the emphasis on stakeholder engagement promoted in Design Thinking and Agile isn't new, this mindset certainly does no harm when incorporated into the engineering effort for a developing a solution to any type of problem.

### **Habits Course #5: A Systems Thinker Considers How Mental Models Affect Current Reality and the Future [Habit 4]**

In this course section, the focus is on the origins of viewpoints and the factors that shape our perceptions and values towards different aspects of the world. Participants in the course are encouraged to contemplate the sources of their viewpoints and the reasons behind assigning different values to various things. The Iceberg Model is introduced as a means to uncover mental models and comprehend how these mental models influence our beliefs and actions. Mental models, defined as assumptions and beliefs shaped by personal experiences, culture, and life history, play a crucial role in how individuals interpret their surroundings.

The text underscores that each person possesses a unique set of mental models, largely molded by cultural and life experiences, which contribute to diverse worldviews. A quote from Donella H. Meadows shared in the course highlights the importance of recognizing that our knowledge and that of others is entirely model-based - every perspective we hold and everything that we know is just a model. Meadows encourages individuals to subject their mental models to scrutiny and challenge, describing these models as paradigms and points of leverage for change.

The section notes that while paradigm shifts may occur quickly for individuals, they often meet resistance at a societal level. It concludes with the assertion that no paradigm is intrinsically "true," as all are merely limited interpretations of the vast universe. This class advocates for approaching each situation with a beginner's mind, ready to absorb a broad spectrum of information, and to be conscious of how our limited mental models can impact decision-making and behavior.

### Course 5 Reflections

If you include human stakeholders as active agents within the system boundary, their individual mental models may have significant impact on system behavior and performance. Generally speaking, human actors will behave in accordance with their mental model of the system rather than strict conformity with written procedures. They may even disagree with some of the outcomes for which the system is designed and act in accordance with the own principles, leading to anomalous and unpredictable outcomes when they "freelance".

For social systems or socio-technical systems, the following assertions ring true:

*“Systems thinkers recognize the power and influence of mental models, and this important Habit of thinking reminds us that mental models are people’s current reality and greatly influence their view of the future.”*

Futhermore, the notes state:

*“One of the highest, most impactful places to intervene in a system is with the paradigms or mental models people hold of the system.”*

For a typical product with human users and maintainers, the intended human role to bring about desired system behavior is often captured in prescriptive form as Operating Instructions and Maintenance Instructions. If users and maintainers follow the procedures as written (and as trained to do so), the system should operate across its various use cases at designed-in levels of performance, reliability and availability. We learned in Habit Course #1 that humans tend to bring about increasing complexity when the boundary is extended to include human beings inside of the system, thus placing their behavior directly within our responsibility as system designers. We therefore must be able to predict undesirable and unintended interactions with the system in order to design safer systems for society.

Applying this ST habit through a vehicle such as the Iceberg model allows us to understand how the underlying mental models that lead to human behavior (individual human design) collectively produce patterns that lead to events (see Figure 1).

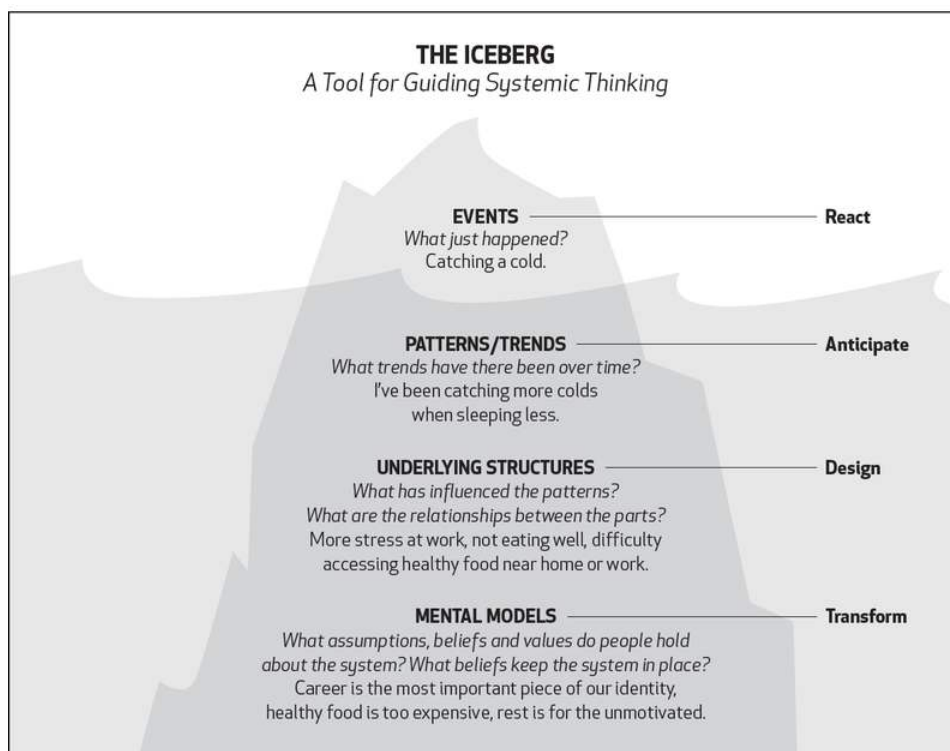


Figure 1: The Iceberg Model Commonly Used in Systems Thinking

Source: <https://ecochallenge.org/iceberg-model>

In such a development project, detecting inconsistencies between human mental models and written procedures depends on the process known as validation. Validation answers the question, “Does the system meet the need?”. Perhaps use of the Systems Thinking Iceberg proposed in this course could lead to earlier detection and resolution of such mental model vs. procedural design inconsistencies.

It is unlikely that a deep dive into mental models of drivers or highway crews would produce significant improvements to the design of the Energy Absorbing Deceleration Barriers system. The



system is designed to respond to the physics of an out-of-control vehicle in which the human agent has limited power to influence system outcomes. Nevertheless, the design itself may vary in different places where a different driving style is present, shaped by country laws and potentially cultural aspects.

The thrust of MBSE to enhance modeling languages is a partial answer to the variability of human mental models of a system. By agreeing on a common language with which to represent the problem domain, the solution space and the thinking that creates the solution, a significant source of communication “noise” between stakeholders is reduced. What remains should be valid differences between stakeholders based on their cultures, life experiences and values.

### Conclusions

The authors recognize that a partial walkthrough the ST Habits courses (5 of 15 modules) may expose questions that will be answered and issues that will be resolved in later courses. We ask that readers, particularly ST enthusiasts, treat this series as an exercise in Perspective Taking where we learn together by exploring the differences between diverse viewpoints.

Stay tuned for Part 2 – coming soon.

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### About the Authors



René King is a Senior Engineer and Business Development Manager at Project Performance International (PPI) who recently achieved her SE-ZERT® Level C certification. René acquired a BSc in Mechanical Engineering and a Master of Science (MSc) in Systems Engineering from the University of the Witwatersrand, Johannesburg. In her years as a junior engineer, René worked as part of the high pressure piping systems design team at Steinmüller Bilfinger and as a researcher for Transnet freight railway transportation systems in South Africa. Apart from her engineering and business development manager role in PPI, she is also Managing Director of PPI's daughter company, Certification Training International (CTI) where she works with a small, dynamic team to support engineers on their journey to SE certification.

René's professional interests revolve around the bridge between model-based systems engineering and digital engineering, exploring why highly intelligent engineers with good intentions still engineer systems without the use of proven successful practices, and lastly, leveraging diversity in organizations to improve systems engineering outcomes.



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

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

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P006-935	Las Vegas, USA PST 8:00 (UTC -8:00) In-Person	04 Mar - 08 Mar 2024
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P006-936-2	Oceania AEDT 8:00 (UTC +11:00) PPI Live-Online™	18 Mar - 22 Mar 2024
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# SYSTEMS ENGINEERING RESOURCES

*Useful artifacts to improve your SE effectiveness*

## **Don't Panic! The Absolute Beginner's Guide to System Integration and Test**

Or, "That difficult second book"

This is the seventh and latest volume in the INCOSE UK Chapter '*Don't Panic!*' series of guidance booklets, following on closely from Tim Weilkien's '*Don't Panic! The Absolute Beginner's Guide to SysML v2*'. Before we look at the book content, however, it is worth saying a few words about the UK Chapter itself, and its publication history

[INCOSE UK](#) was the first non-US Chapter, founded in 1994, and is one of the largest, at over 1000 members. The Chapter has always been very active; typically over 20% of the membership attend its events, and its volunteer effort has published many great products. The products started with the issue of the '*Z Guides*', responding to the challenge "What can we say, meaningfully, about aspects of systems engineering, constrained to a single double-sided sheet of A4 paper in trifold format?" and there are now over a dozen of these. Next, the member companies of the Chapter's UK Advisory Board produced the Competencies Framework on which the international INCOSE version is based.

Since 2016 however, under the leadership of the Chapter's Technical Director Jon Holt, the Chapter has augmented its offering with the *Don't Panic!* Guides. Each is an easy read, with an informal and illustration-rich style, and limited to 60 pages. Jon and his friend Simon Perry – now the series Editor for the books – wrote the first one themselves, the *Don't Panic! Absolute Beginner's Guide to MBSE*.

Subsequent volumes have covered Interface Management (my first one), Architectures and Architecting, Architectural Frameworks, Service Systems, SysML v2, and now System Integration and Test. More are planned... all are available via the [Chapter's Online Store](#). It is worth adding that they retail at only 20GBP for the softback version, and £15 (less than 20USD) for the E-book version.

So now for some author's notes about this latest volume:

'Integration, Verification and Validation is in principle a huge topic – I was already aware of [Avner Engel's great work](#) (687 pages) and an out-of-print 1997 volume from Jeffrey O. Grady (453 pages). They are very comprehensive, some might say prescriptive, and definitely not an easy read for an early- or mid-career SE practitioner. Since it is precisely these engineers that are the target audience for the *Don't Panic!* books, the challenge then becomes "How can I distil the essentials down below 60 pages, and add some insights and heuristics of my own?"

The first necessary sacrifice was to recognize that I could only cover Integration, Verification and Validation (IVV) of implemented system elements, aggregates and systems. Verification etc. of requirements, architectures and designs had to be left out. However, I felt it essential to cover requirements and traceability, and to move the topic into the current era by including MBSE patterns for traceability and progressive assurance stepping upwards through hierarchical layers of IVV towards acceptance. Along the way, all key concepts are introduced in the *Don't Panic!* icon editorial style. Plus, a playbook of pitfalls to avoid, and the business case for doing better, are included. I did manage to squeeze in some ideas about integration planning for non-sequential lifecycle models (including a short Annex on Agile), and some recommended progress metrics for when, in the occasional chaos of regression testing, conventional project management metrics start to fall apart. My initial target of 56 pages had already become slightly over 60, but I thought the remaining edits

could contain it. And then there was a deluge: in 2023, we saw updates to ISO 15288, the INCOSE SE Handbook, and four (!) relevant publications from the INCOSE Requirements Working Group (RWG). Since the intention for the *Don't Panic!* Guides has always been to remain consistent with the INCOSE mainstream publications, this required an awful lot of reading, and careful editing and decision-taking. However, I am happy with the final result – it says what I want it to say, and initial feedback from readers has been very positive.

In closing, some words from the back cover:

Principles and practices exist to cover progressive assurance of systems, backed by many years of cross-industry practical experience. Trying to follow every recommendation can be as financially ruinous as skimping on the integration and testing activities and suffering the resultant rework costs. This book sets out to summarize the best of the best practices in a short and easily digestible form; and to suggest ideas for how the practitioner may best tailor them to their project and enterprise needs.'

*By Paul Davies, December 2023*

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### Recap of INCOSE GfSE Webinar Series

[GfSE](#), the German chapter of INCOSE, has been hosting a series of webinars on a variety of leading-edge systems engineering topics since 2021. The webinars (conducted in English) have been made available in the INCOSE [Professional Development Portal \(PDP\)](#). INCOSE members and non-member visitors can [search the PDP Content Catalog](#) to access these resources using the following search criteria:

- Title: contains "GfSE"
- Type: Webinar

Each of these topics includes both a video and associated presentation (in PDF format). Videos are open access; but an INCOSE membership and login credentials are required to download the presentations. Join INCOSE [here](#).

PPI SyEN readers are encouraged to investigate the series content using the summaries and links provided below:

#### [SpesML - SysML Workbench for the SPES Methodology](#)

November 2021: Dr. Maximilian Junker, et al.

ABSTRACT: Scientific research results achieved together with partners from industry and academia by the Technical University of Munich show that the introduction of model-based system development of cyber-physical systems into the industrial development process offers a wide range of benefits, but requires a readjustment of the development. This concerns the development method, artifacts, tools and organization. So far, the industrial introduction of MBSE often uses the modeling language SysML as a quasi-standard, which is firmly established in practice by tool providers and standardization organizations. However, the analysis of the introduction projects shows that SysML is currently often used without a consistent development methodology, which (i) specifies which models are created and how these models are interrelated, and (ii) provides a precise understanding of the diagrams. Thus, crucial potential offered by MBSE remains unused, because ultimately the well-coordinated selection of methodology, modeling language and modeling tool is a crucial factor for a successful application of MBSE in industrial practice. The project "SysML Workbench for the SPES Methodology" (SpesML), funded by the German Federal Ministry of Education and Research (BMBF) and involving a total of 11 partners from industry and research as well as 2 active associated partners, aims to close

this gap and to show ways for a successful implementation of the MBSE methodology in industry. With the Software Platform for Embedded Systems (SPES), an end-to-end methodology for MBSE has been developed. On this basis, a SysML profile with a precise semantics that can be used for automation such as automated analysis and simulation, is defined in SpesML. This gives the widely used modeling language SysML a methodological foundation and thus opens the way to comprehensive MBSE.

View the [video](#). Download the [presentation](#).

### [Part I - Model-based Systems Engineering Demystified: The need for MBSE](#)

November 2021: Prof. Jon Holt

**ABSTRACT:** In this first of three webinar presentations, Jon will discuss the underlying reasons why MBSE is so important for any modern-day Systems Engineering project. He will provide an in-depth discussion on complexity and how it has not just increased but has evolved over the last few decades. Using a simple example, Jon will discuss four areas in which complexity has evolved, namely: system elements and their associated interfaces; system constraints; systems of systems; and how complexity has shifted. As the complexity of these Systems evolves over time, so must the approaches that we apply to realize our Systems successfully. Based on this, Jon will discuss how there is nothing inherently wrong with a document-based approach to Systems Engineering, but based on the evolution of complexity, how we must ensure that our Systems Engineering practice and techniques must be up to the job of coping with this complexity. Also, Jon will introduce the now-infamous Brontosaurus of Complexity that helps us to understand how complexity changes over the course of a project and he will conclude with an overview of his latest books that tackle this subject.

View the [video](#). Download the [presentation](#).

### [Part II - Model-based Systems Engineering Demystified](#)

February 2022: Prof. Jon Holt

**ABSTRACT:** Continuing the presentation series Professor Jon Holt will build on the concepts of complexity introduced in his 1st talk, in which Jon discussed how MBSE is a natural evolution of document-based systems engineering. In his 2nd talk Jon will present and introduce the main considerations that must be addressed for successful MBSE implementation and adoption. This is summarized and encapsulated in 'MBSE in a Slide.' This talk will not only introduce the main concepts, but will also dismiss many of the myths associated with MBSE, such as 'MBSE is all about SysML', 'MBSE adds a large overhead to system development' and that 'all models are wrong' amongst others. Topics covered will include: the system, models, notations, tools, frameworks, and compliance. Jon has 30 years' experience in using and deploying MBSE in industry and 'MBSE in a Slide' represents a summary of everything that he has learned in this period, which is either an indication of brilliant abstraction, or a shocking indictment on how little has been achieved in the last three decades!

View the [video](#). Download the [presentation](#).

### [Blueprint for requirements engineering in agile product development](#)

March 2022: Philip Stolz, et al

**ABSTRACT:** Every business context comes with its own unique needs and challenges. As requirements engineering consultants, we generally have an aversion to "ready-made solutions" and supposed "best practices". However, we have seen various organizations struggle with similar problems. Applying a few simple practices would have helped them. We have compiled them as a blueprint, and we're excited to share them publicly in this webinar.

December 2023

[\[Contents\]](#)



View the [video](#). Download the [presentation](#). Read the [paper](#).

### [Lessons Learned of the Introduction of Systems Engineering](#)

March 2022: Daria Wilke, et al

**ABSTRACT:** The product development of intelligent technical systems (ITS) is increasingly challenging due to rising complexity, interdisciplinarity and shorter development cycles. With Systems Engineering, companies can overcome these challenges. Many companies have recognized the potential for SE and are moving to embed it company-wide. One question that arises again and again in introduction projects is: What is the ideal way to start a Systems Engineering introduction? The research project SE4OWL, Systems Engineering for OWL, addresses this question. To find answers, the approach of qualitative research was chosen. In July and August 2021, an interview study took place. Fifteen Systems Engineering experts from all over Germany were interviewed. The experts come from the fields of research, consulting and industry and have many years of experience in Systems Engineering. In the interview, they reflected on the Systems Engineering projects they had carried out. In particular, the topics of processes, roles, methods, and tools were addressed, as well as the topic of qualification. In the webinar, we will present our approach and provide insights into the results of the qualitative interview study:

- Which Lessons Learned on Systems Engineering implementation were increasingly mentioned in the interviews?
- Is it possible to make a recommendation on what to start with? Or is a Systems Engineering implementation depending on certain factors?
- What were the learnings on already implemented implementation projects?
- This will be followed by a quantitative study.

Finding and propagating best practices for the introduction of Systems Engineering contributes to the INCOSE Systems Engineering Vision 2035 by enabling an increasing growth of the Systems Engineering application within all domains. Increasing numbers of experts will in turn improve the available good practices, increasing the added value of Systems Engineering even further.

View the [video](#). Download the [presentation](#).

### [Enterprise Architecture Guide for the Unified Architecture Framework \(UAF\)](#)

April 2022: Aerospace Corporation

**ABSTRACT:** This webinar describes a workflow for creating Enterprise Architecture (EA) views in accordance with the Unified Architecture Framework (UAF) standard published by the Object Management Group (OMG). This workflow will be the foundation for a new EA Guide now being published as part of the OMG standard. The nine steps of the workflow are laid out in alignment with the stakeholder domains in the UAF for producing the requisite UAF views in each of those domains. This architecture description method can be used in conjunction with processes for the conceptualization and evaluation of an architecture, and also used as the basis for an EA modeling methodology, architecture development planning, MBSE capability assessment, and modeling project organization. The Guide covers architecting of the enterprise as well as architecting (at a high level) of a major entity within the enterprise. The webinar will provide an understanding of what the Guide contains and how it could be used.

View the [video](#). Download the [presentation](#).

### [STAMP/STPA - A Systems Theory Approach to Analyze Security Concerns](#)

May 2022: D.Sc. Daniel Patrick Pereira

**ABSTRACT:** In this webinar, Daniel will discuss the importance of conducting a security risk assessment in early stages of system development. He will present different standards that cover the security risk assessment process. The demand for security increases tremendously for modern, complex software-intensive systems with increased communication and the application of new technologies. To cope with complexity, new methods have to be developed and integrated into the overall system engineering process to lead with the challenges of running a system as part of a system of systems. To address this issue, Daniel will introduce the STAMP/STPA methodology conceived by Prof. Nancy Levenson from MIT applied in the security domain. Using a simple example, he will demonstrate the application of STAMP/STPA for security and how this approach could be compliant with an aeronautical standard ED-202A/DO-326A.

View the [video](#). Download the [presentation](#).

### [Part III - Model-based Systems Engineering Demystified](#)

May 2022: Prof Jon Holt

**ABSTRACT:** In this third of a series of three presentations, Prof. Jon Holt will bring together what we have discussed in the previous two ones into the bigger picture of deploying Model-Based Systems Engineering (MBSE). Although the previous two ones will be referenced, this third presentation does not require attendance at the previous two to be understood or enjoyed. Successful deployment of Model-Based Systems Engineering is now, arguably, one of the hottest topics in engineering. It is no good having all the theory, practice, and mechanisms in place if they cannot be deployed effectively into a business. In this presentation Jon will discuss the importance of the three main concerns that must be considered to deploy MBSE, which are:

- The reason why MBSE is to be deployed. Without this, you are in danger buying solutions to a problem that you do not understand.
- The MBSE evolution of an organization in terms of its current and target position. This will reference what was discussed in the first presentation in this series.
- The MBSE capability of an organization in terms of its current and target position. This will reference what was discussed in the second presentation in this series.

These three considerations will be brought together to form the Trinity Approach to MBSE deployment.

View the [video](#). Download the [presentation](#).

### [Safety assurance under uncertainty](#)

June 2022: Prof. Simon Burton

**ABSTRACT:** Assuring the safety of modern, highly automated systems presents huge challenges to existing Systems Engineering processes. Such systems are becoming increasingly complex. That is, they exhibit emergent behavior, coupled feedback, non-linearity and semi-permeable system boundaries. These drivers of complexity are further exacerbated by the introduction of AI and machine learning techniques. The result of these developments is an increase in uncertainty in our ability to argue their safety. Using examples from the field of automated driving, this webinar introduces sources of uncertainty and emergent complexity in the safety assurance process of such systems and discusses why existing safety approaches are reaching their limits of effectiveness. Simon's talk will illustrate how defining sources of uncertainty and acknowledging the impact of these risk factors at the governance, management and technical levels of the system is key to developing effective safety assurance strategies. State-of-the-art and current research in this area is summarized. Simon's talk will conclude with the hypothetical question of whether such systems will ever be "safe enough" and how we could go about arguing such a claim.

View the [video](#). Download the [presentation](#).

### [How to Learn Systems Engineering \(or anything\)](#)

July 2022: Michael Gainford and René King

ABSTRACT: Many individuals and organizations seek to grow their Systems Engineering (SE) skills and capabilities in order to tap into the well-substantiated benefits of SE - see for example Elm and Goldenson (2012). During this webinar Michael Gainford and René King will explore how people can best learn Systems Engineering (or indeed any other topic). They will lay out a number of adult learning principles, illustrating them with examples as they go. Some of the principles are:

- Learners need to have a sense of progress towards their objectives;
- Learners need to participate actively;
- Learning should be related to the learner's experience and knowledge;
- Getting ideas wrong can be a valuable aid to developing understanding;
- Time must be allowed for reflection.

It is important that both the "learner" and the "learning facilitator" understand the principles, especially as people's learning preferences vary. There are many contexts in which learning takes place, so the facilitator might for example be described as a teacher/lecturer, coach, mentor, or colleague. In an effective learning environment, there is a bi-directional relationship between facilitator and learner; each influences the other, and in fact both become learners. If there are multiple learners, they take additional benefit from influencing each other. It is a very important principle that the learner takes responsibility for learning (rather than seeing it as a service provided by the facilitator), which is why it is important that learners learn about learning.

View the [video](#). Download the [presentation](#).

### [Linking RE and Design in Agile Projects: Where Teamwork Meets Fun in Day-to-Day Project Activities](#)

August 2022: Janika Pelz, et al

ABSTRACT: The goal of software development projects is to deliver a digital product to the client and end users that meets their expectations, needs, and goals. A symbiosis of Requirements Engineering and Design in agile front-end development helps to design a product that fulfills the business requirements, is technically and financially feasible and at the same time convinces the user with an outstanding user experience. But what exactly does an efficient dovetailing of Design activities with those of Requirements Engineering look like when these are handled by experts with different backgrounds and perspectives? How do we not just manage, but benefit from this diversity? Our experience shows that in many projects there is often either an imbalance between Requirements Engineering and Design or that the representatives of both disciplines are afraid of contact. In this webinar, we will pass on our experience in linking Requirements Engineering and Design in agile projects to the audience and underpin this approach with examples from everyday project work. You will see that the collaboration of requirements engineers and designers is not an obstacle to overcome, but the basis for successful and engaging projects.

View the [video](#). Download the [presentation](#).

### [Leveraging decision patterns to tame complexity and accelerate solution delivery](#)

September 2022: John Fitch

ABSTRACT: Decision-making is one of four fundamental human thinking (aka analysis) processes. Decisions comprise the essential thinking content, the integrative mechanism of any design process,

and as such effect the transformation of a problem definition into a solution description. The author's 35 years of experience in teaching and facilitating decision-making and systems engineering has led to the conclusion that there is a pattern of decisions behind every strategy, solution design or life. A wide variety of decision patterns have been created and refined through use in 150+ projects across 40+ organizations. This presentation summarizes the conceptual basis for decision patterns and how they were "discovered", defines a decision-centric information model of the engineering process, explains key principles behind how decision patterns create value, shares how a pattern-based decision model fits into a broader engineering process and identifies a range of use cases in which decision patterns have been employed. Using a decision-centric information model (metamodel) creates a much richer digital thread than is currently supported in formal systems engineering languages and MBSE tools. The presentation will demonstrate a simple but powerful technique by which a project decision baseline may be established by reverse engineering stakeholder decisions against a decision pattern. The resulting decision model (aka Decision Breakdown Structure) may be used validate system requirements and to focus project efforts on the decisions that are most critical to project success.

View the [video](#). Download the [presentation](#).

### [Method for Developing SoS Architectures Using SysML Model Federation](#)

March 2023: Chris Swickline

**ABSTRACT:** As system complexity increases, a greater number of organizations are being asked to contribute architecture / design content for systems development. An essential challenge to overcome is how to ensure digital continuity in connecting system models to form Systems of Systems (SoS) models. In this webinar, a method is presented for SysML model federation enabling multiple contributing organizations to provide peer models for inclusion within a federation SoS model. This method builds upon the previously published Systems Architecture Model (SAM) development method reinforced with automated model syntax validation, implemented style guide, and example model. Systems Engineers applying this method are capable of reusing constituent systems model content, from the problem and/or solution space, to describe the larger SoS behavior and structure while promoting reusability and commonality. The presented method is designed to permit style diversity across peer constituent models and ensure that every piece of data has an Authoritative Source of Truth (ASOT) within the federation. Multiple applicable examples within the defense industry are presented as well as real world example showing specific evidence of a measurable improvement. Systems Engineering practitioners engaged in and seeking to get the most benefit out of Model Based Systems Engineering (MBSE) will take away a multi-model management approach to construct SoS descriptive models in SysML in line with the DOD's Digital Engineering (DE) Strategy.

View the [video](#). Download the [presentation](#).

### [The Digital Systems Engineering Process Model - INCOSE's Coolest Interactive Technical Product](#)

May 2023: Alexander Efremov, Gerben C. Th. Wierda, and Phil Beauvoir

**ABSTRACT:** Join us for an exciting event exploring the world of Systems Engineering and its vital role in engineering successful systems. Systems Engineering relies on a set of 30 system life cycle processes, which act as a template for organizations to engineer systems. These processes are described in detail in two sources, the ISO 15288:2015 and the INCOSE handbook v4, both of which embody the expertise of professionals from diverse industries. These processes are some sort of a template for an enterprise which develops systems. And – as every template – it must be tailored to the reality before application. Tailoring these processes to meet organizational and product needs requires an in-depth understanding of their contents, including concepts, relations between them, and their meaning. However, with a 300-page book, it can be challenging to answer important questions such as how processes "architecture definition" and "design" are related or what processes use the artifact "life

cycle concepts". This webinar will introduce a new INCOSE Technical Product for enterprise systems engineering that addresses this need. Our product, called the Digital Systems Engineering Process Model, offers clear, interactive access to all aspects of the systems engineering life cycle processes, providing a template that you can use for model-based systems engineering of enterprises.

View the [video](#). Download the [presentation](#).

### [Very Advanced Systems Engineering with Functional Architectures for Systems \(Part I\)](#)

October 2023: Tim Weilkiens and Jesko Lamm

**ABSTRACT:** Whoever likes to keep developing systems with market success needs to be in control of system functions, for example, based on an explicit definition of the system's functional architecture. However, it is usually the system that is sold and not the artifact that defines its functional architecture. This calls for a lean and easy way to work with functional architectures. During this webinar, two practitioners of functional architecture work, Tim Weilkiens and Jesko Lamm, will present the approaches they have developed over the years to define and handle functional architectures in a system development context. These approaches are based on the FAS Method, which they published in the year 2010 and improved via several subsequent publications. In this 1<sup>st</sup> webinar talk an introduction to the FAS method itself and some supporting analysis methods will be in scope including:

- The motivation for working with functional architectures
- A quick introduction to the work with a well-defined system context and use cases as a precondition for the application of the FAS method
- An extensive description of how to apply the FAS method by refinement of use cases, functional grouping, and identification of the resulting functional blocks
- A brief deep-dive into the "FAS-as-a-formula" representation of the FAS method, which is one single matrix equation that captures the essence of the method and hence allows for easy automation of the corresponding steps
- A revisit of the preconditions to show a way to identify the needed use cases based on storyboards of the system's operational scenarios.

Tim and Jesko will provide an outlook into the application of the method in daily work and with available tools to teaser their 2nd webinar talk, scheduled for November 8th. This part, however, will stay out of detailed discussions about tools and modeling languages. It will use example representations of functional architecture in both informal representations as well as in SysML models to introduce already the different formats one may need for different stakeholder groups, or also for different kinds of systems engineering activities.

View the [video](#). Download the [presentation](#).

### [Very Advanced Systems Engineering with Functional Architectures for Systems \(Part II\)](#)

November 2023: Jesko Lamm and Tim Weilkiens

**ABSTRACT:** Whoever likes to keep developing systems with market success needs to be in control of system functions, for example, based on an explicit definition of the system's functional architecture. However, it is usually the system that is sold and not the artifact that defines its functional architecture. This calls for a lean and easy way to work with functional architectures. During this 2nd webinar talk, two practitioners of functional architecture work, Tim Weilkiens and Jesko Lamm, will continue the presentation of approaches they started in part I. After a short recap for those who could not attend the 1st webinar talk, they will elaborate on the practitioner's work with the so-called FAS Method for functional architecture. The application in daily work and the mapping of the method to modeling languages and modeling tools will be in focus, including:



- Informal techniques based on post-its or paper cards, to be used when running workshops face-to-face or with virtual post-it-boards in partially online meetings.
- Representations of the needed work items in the SysML modeling language.
- Traceability from functional architecture up to use cases and optionally further up to storyboards in the modeling tool.
- Demos of the corresponding modeling tool work, including automation of certain steps to carry out when applying the FAS Method and some tool support for creating functional diagrams from the model and later checking their consistency with the model.
- A demonstration of a pilot implementation for the upcoming new systems modeling standard SysML v2.

Note: No modeling language or modeling tool knowledge will be required; the demos will speak for themselves.

View the [video](#). Download the [presentation](#).

Systems engineering practitioners are encouraged to look for additional webinars in the on-going INCOSE-GfSE series, as these webinars are posted in the PDP.

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### Simulation Resources for Small and Medium-Sized Businesses



The mission of [NAFEMS](#) includes being globally recognized as an *"independent authority and trusted source for communicating engineering simulation knowledge, and for sharing best engineering modeling, analysis, and overall simulation practices in developing reliable products and innovative*

*solutions."* NAFEMS has identified the unique challenges that small and medium-sized businesses face in developing and deploying engineering analysis and simulation capabilities in a rapidly evolving technological landscape. In response to this need, NAFEMS has developed a set of recommended resources that include the following publications:

#### [What is Systems Modeling and Simulation?](#)

Overview: Business growth depends on developing new and improved products and technologies and getting these to the market ahead of competition. The digitalization of our lives today is driving an ever faster-paced environment. Developing products based on skills and capability in specific engineering domains is no longer sufficient. The demand for system-level solutions is driving a need to merge systems engineering and engineering simulation at a new level. Systems Modeling and Simulation relies on an integrated use of engineering models to fill this need.

#### [How to Build and Manage Simulation Engineer Competency](#)

Overview: With the advent of more powerful computers, the application of computational mechanics has gained widespread acceptance in engineering companies involved in the design and analysis of engineering components and structures. There are many commercially available computer codes which run on a wide range of computer hardware to analyze the behavior of a structure or a component under various loading conditions. It is not the computers that solve engineering problems though. A typical problem is formulated into a mathematical model which is run by computers and the solution must be subjected to an engineering appraisal; hence, the need to have a professional simulation engineer to perform such a design and analysis process. This publication highlights the issues related to the process of establishing competency in simulation engineering.

#### [How to Get Started with Simulation Process and Data Management](#)

Overview: Simulation Data Management (SDM) technology has been extremely successful in

supporting the day-to-day activities of Professional Simulation Engineers in dozens of leading companies, enhancing simulation quality, providing traceability, and increasing engineering throughput. After 20 years, most successful deployments are of SDM systems provided by expert, specialist SDM vendors or of systems built in-house. Usage of other generic information systems, such as Product Data Management (PDM) or Content Management (CM), to manage Professional Simulation Engineers' simulation data is essentially zero and most file data is still stored on shared drives.

The objective of this book is to provide prudent, actionable, vendor independent, information and best-practices on how to approach an SDM project and achieve a first successful SDM deployment as well as identifying pitfalls to avoid based on facts and data from 20 years of SDM project experiences.

### [What is Simulation Governance and Management?](#)

Overview: Developing a simulation governance strategy is necessary to build and nurture modeling and simulation capabilities and a company's confidence in those capabilities. It emphasizes the essential role of senior executive management to set the tone and send the message of how simulation will be used for product development and manufacturing, lifecycle support, and for decision-making. It addresses organizational capability, confidence, and understanding. As such, this is a classic business problem that involves people, processes, and technology; all three need to be addressed together and throughout the organization.

### [How To Manage Finite Element Analysis](#)

Overview: By now, most engineering companies have acknowledged that product simulation in one form or another provides benefits regarding correction of failure, robustness of design, cost of product or process, and product insight. Although many companies have realized some of these benefits, individual companies have experienced an uneven spectrum of them. This booklet seeks to explain issues that may arise from introducing FEA into the design process, how they might turn into bad - if not dangerous - "best practices," and how these issues might be resolved. This is a guide to managing FEA technology, not an introduction to the technology itself.

### [How To Get Started with CFD](#)

Overview: This booklet reviews how CFD simulations are run, and the requirements needed to do this in terms of software, hardware and suitably skilled people. It has been written to guide those who make commercial decisions about the use of CFD technology and so it is aimed mainly at the industrial user. However, it also has relevance for other users, such as academics seeking to start work in this field.

### [How To Get Started in Acoustics Analysis](#)

Overview: The purpose of this book is to present an overview of the current state of the art in predictive acoustics work. It is intended to form both an introduction to the subject, and to present a set of guidelines for good practice. This booklet may help practitioners be aware of some of the questions which need to be answered if results are to be trusted.

### [What is the Functional Mock-up Interface?](#)

Overview: Modeling and simulation have been an essential part of product development engineering across all industries and disciplines for decades. This work has been typically conducted by subject matter experts whose results have been largely inaccessible to other members of their enterprise who need these data to perform their tasks. Additionally, different CAE simulation vendors typically rely upon their own proprietary formats and interfaces for software tools that they have developed and maintain. This further complicates the ability for end users to share data among different engineering groups and across different engineering disciplines. To overcome these problems, the

Functional Mock-up Interface (FMI) was developed as an international standard for systems modeling. It addresses many of the issues associated with sharing of simulation information both inside and outside the enterprise.

Search the [NAFEMS Resource Center](#) for other topics of interest.

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### Digital Twins Consortium: Digital Reflections Blog



The Digital Twin Consortium (DTC) maintains a [Digital Reflections blog](#) with an ever-increasing range of content that addresses the fundamental concepts behind digital twins and guidance on the effective application of this technology across multiple domains.

Recent posts that may be of interest to systems engineering practitioners include:

- Understanding DTC's Digital Twin Platform Stack Architectural Framework (November 2023)
- A Case for World Models in Data-Driven Digital Twins (September 2023)
- Enterprise Transformation with Digital Twins (July 2023)
- When It Comes to Sustainable and Resilient Infrastructure, Digital Twins Are the Sharpest Tools in the Shed (February 2023)
- Overcoming the Obstacles to Implementing Reality Capture for Digital Twins (September 2022)
- Cognitive Digital Twins: Digital Twins That Learn By Themselves, Foresee the Future, and Act Accordingly (September 2022)
- Strategic Guidance to Reduce the Risk of Digital Twin Adoption (March 2022)

Learn more about the Digital Twin Consortium [here](#).

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### Book: The CM2 Approach to Change and Configuration Management

The book cover for "The CM2 Approach to Change and Configuration Management". It has a dark background with the title in white text. Below the title is a subtitle in smaller white text: "The DNA of the business ecosystem needed to drive evolution within organizations."

#### The CM2 Approach to Change and Configuration Management

The DNA of the business ecosystem needed to drive evolution within organizations.

The *CM2 Approach to Change and Configuration Management* explores the potential for the CM2 approach to serve as a catalyst for digital transformation, achieving engineering design robustness, manufacturing and operations excellence, and seamless logistics and service support. Authors Joseph S Anderson, Jorge D Camba, Travis J

Fuerst, and David L Ewing Jr. seek to help organizations go beyond adapting to change by learning to command it.

Topics addressed in this book include:

- Foundations of Operational Excellence
- Baselines and the Development Process
- Items and Datasets
- Change Management Foundations
- The Change Management Process
- The Complexities of Lifecycle Sustainment

Purchase the hardcover version [here](#).

Purchase and download the electronic version [here](#).

# SYSTEMS ENGINEERING IN SOCIETY

*Expanding applications of SE across the globe*

## ISO Sustainable Development Standards



The [International Standards Organization \(ISO\)](#) has published and maintains numerous standards related to the topic of sustainable development. Systems engineering practitioners working in the field of socio-technical systems or smart cities development may find these resources helpful.

### [ISO 37101:2016 Sustainable development in communities: Management system for sustainable development - Requirements with guidance for use](#)

ISO 37101:2016 establishes requirements for a management system for sustainable development in communities, including cities, using a holistic approach, with a view to ensuring consistency with the sustainable development policy of communities.

The intended outcomes of a management system for sustainable development in communities include:

- managing sustainability and fostering smartness and resilience in communities, while taking into account the territorial boundaries to which it applies;
- improving the contribution of communities to sustainable development outcomes;
- assessing the performance of communities in progressing towards sustainable development outcomes and the level of smartness and of resilience that they have achieved;
- fulfilling compliance obligations.

ISO 37101:2016 is intended to help communities become more resilient, smart and sustainable, through the implementation of strategies, programs, projects, plans and services, and demonstrate and communicate their achievements.

This standard was last reviewed and confirmed in 2022. Therefore the 2016 version remains current.

Download the [ISO 37101 overview guide](#).

### [ISO 37104:2019 Sustainable cities and communities: Transforming our cities - Guidance for practical local implementation of ISO 37101](#)

Guidance on how to implement and maintain a management system for sustainable development based on ISO 37101 principles, specifically in the context of cities, but applicable to other forms of settlement.

### [ISO 37106:2021 Sustainable cities and communities: Guidance on establishing smart city operating models for sustainable communities](#)

Guidance for leaders in smart cities and communities (from the public, private and voluntary sectors) on how to develop an open, collaborative, citizen-centric and digitally-enabled operating model for their city that puts its vision for a sustainable future into operation. This document does not describe a one-size-fits-all model for the future of cities. Rather, the focus is on the enabling processes by which innovative use of technology and data, coupled with organizational change, can help each city deliver its own specific vision for a sustainable future in more efficient, effective and agile ways.

### [ISO 37108:2022 Sustainable cities and communities: Business districts - Guidance for practical local implementation of ISO 37101](#)

Guidance on how to implement and maintain a management system for sustainable development in cities and communities according to ISO 37101 in the context of a business district.

### [ISO 37109:2023 Sustainable cities and communities: Recommendations and requirements for project developers - Meeting ISO 37101 framework principles](#)

Recommendations and requirements to project developers, decision-makers and managers responsible for authorizing, promoting, financing, planning, designing, procuring, managing, reviewing and implementing a project or program. The recommendations and requirements aim to ensure that a project or program adds value by aligning its development and implementation with a community's own or externally directed sustainability strategies and objectives and the requirements of ISO 37101.

### [ISO 37120:2018 Sustainable cities and communities: Indicators for city services and quality of life](#)

Defines and establishes methodologies for a set of indicators to steer and measure the performance of city services and quality of life. It follows the principles set out in ISO 37101 and can be used in conjunction with ISO 37101 and other strategic frameworks. This document is applicable to any city, municipality or local government that undertakes to measure its performance in a comparable and verifiable manner, irrespective of size and location.

### [ISO 37123:2019 Sustainable cities and communities: Indicators for resilient cities](#)

Defines and establishes definitions and methodologies for a set of indicators on resilience in cities. Applicable to any city, municipality or local government that undertakes to measure its performance in a comparable and verifiable manner, irrespective of size or location. Maintaining, enhancing and accelerating progress towards improved city services and quality of life is fundamental to the definition of a resilient city, so this document is intended to be implemented in conjunction with ISO 37120.

### [Standards in development](#)

In addition to ongoing refinement of these published standards, ISO is developing complementary standards in the *Sustainable cities and communities* area:

- [ISO/DIS 37111](#) Urban settlements - Guidance for a flexible approach to phased implementation of ISO 37101
- [ISO/CD 37114](#) Appraisal framework for datasets and data processing methods that create urban management information
- [ISO/DIS 37179](#) Smart community infrastructures: Disaster risk reduction - Basic framework for the implementation of disaster risk reduction

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## Essay: Multisolving - Making Systems Whole, Healthy, and Sustainable



Stanford SOCIAL  
INNOVATION Review  
Informing and inspiring leaders of social change

The team at the [Multisolving Institute](#) recently published an essay, titled [Multisolving: Making Systems Whole, Healthy, and Sustainable](#), in the [Stanford Social Innovation Review \(SSIR\)](#). This essay is part of SSIR's [Beyond Borders](#) series, a 12-part learning series sponsored by the Robert Wood Foundation, featuring ideas that inspire and inform efforts to create better health and well-being in communities around the globe.

Key points of this article include:

- Borders between issues get in the way of solutions.



- Multisolving starts by creating conditions that allow people to cross borders.
- New connections and new ways of thinking emerge with the crossing of borders.
- Visible results emerge from the new connections and capacities.
- Future dividends are expected as a changed system persists.

A 2018 SSIR article, [The Magic of Multisolving](#), by Multisolving Institute founder Elizabeth Sawin, highlighted six principles and practices that unlock cross-sector collaboration:

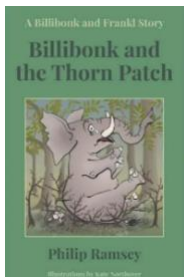
- PRINCIPLE 1: Everyone matters; everyone is needed.
- PRINCIPLE 2: We can succeed by addressing tough problems in an integrated fashion.
- PRINCIPLE 3: Large solutions start small; growth results from learning and connecting.
- PRACTICE 1: Welcoming – new partners to your team.
- PRACTICE 2: Learning and documenting – adjust direction based on measured results.
- PRACTICE 3: Storytelling – communicating achievements brings more partners and resources.

PPI SyEN readers should recognize proven systems thinking and systems engineering principles in this essay.

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### System Thinking for Kids: Billibonk and Frankl Series

The System Dynamics Society (SDS) is a non-profit, international organization dedicated to promoting the development and use of System Dynamics modeling, a powerful tool for understanding complex systems and solving real-world problems. Despite its focus on understanding complexity, the Society recognizes the value of teaching systems thinking, problem-solving and collaboration to the youngest among us.



To that end, the SDS has published the [Billibonk and Frankl book series](#) as a collection of captivating jungle-based fables that showcase principles of systems thinking through the experiences of various animal characters. The stories are engaging and relatable to both children and adults, as they demonstrate how different species in the jungle learn to collaborate and solve problems together. The Billibonk and Frankl stories aim to help children see systems and interdependencies in the world around them.

The book series emphasizes lessons such as:

- Understanding mutual interdependencies
- Focusing on the long-term view
- Getting to the root of the problem
- Recognizing our own role in difficult situations

The author, Dr. Phil Ramsey, is a Senior lecturer at Massey University in New Zealand and also a Director of Incite Learning, a consulting company that mainly works with schools, helping school leaders apply Organizational Learning concepts to solve tough problems.

Purchase books from the series from the SDS:

- [Billibonk and the Thorn Patch](#)
- [Billibonk and the Bugs](#)
- [Floods of Knith](#)

Additional resources are available for parents and teachers seeking to draw lessons and systems thinking concepts from the book:

- [Download posters](#) that explain key systems thinking concepts from the book.
- View Dr. Ramsey's [Summary of Key Concepts](#) video.
- View Dr. Ramsey's [Explanation of Main Systems Thinking Concepts](#) video.

For more resources about how to incorporate and discuss systems thinking concepts in the classroom or with children, visit the [System Dynamics Society's Pre-College Education Special Interest Group \(SIG\)](#) page.

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### ***PPI RESOURCES***

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

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

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

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

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

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

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

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

# FINAL THOUGHTS FROM SYENNA

## A Systems Engineering Christmas Carol

Dear reader,

Whilst this submission has its origins in the Christmas story, I wanted to start by saying that PPI welcomes people of all faiths and of no faith. Some of you may not be familiar with the 1843 work by the British author Charles Dickens entitled “A Christmas Carol”, so here is a synopsis. In the story, Ebenezer Scrooge starts out as a miserable person who despises Christmas. His catchphrase is “Bah! Humbug!”, expressing his distaste for Christmas traditions.

I have had some fun imagining Scrooge’s “Bah! Humbug!” message to the SE community as follows.

“Most worthy and esteemed Systems Engineer,

I humbly beg to commend to you the following set of principles for your miserable projects, and I look forward to celebrating their dismal failure with you.

- 1) Never name your system well or, preferably, give it two or three different names.
- 2) Make sure the boundary definition is fuzzy or non-existent.
- 3) Always believe that you have intelligent customers and that their specifications can absolutely be taken on faith.
- 4) Don’t talk to your customer whilst bidding for a piece of work; rather wait until the contract has been signed.
- 5) Don’t criticise the customer’s requirements – nobody likes a moaning supplier.
- 6) It’s far better to get something delivered on time, even if it’s the wrong thing. There’s never enough budget to get things right up-front, but the money always materialises to fix problems later. This is how organizational heroes are made, so go for it.
- 7) During the run-up to certification (or its equivalent), it’s only natural that you won’t have time to think about maintenance or retirement. Let somebody else worry about that later.
- 8) Proudly adopt a “Learn-Do-Learn” approach for transition into service. All your competitors will have problems with this as well, so you could still beat them.
- 9) In order to get out of boring things like documentation, think of a process name that gives your team permission to do anything they like – as long as they do it quickly.
- 10) To avoid pedantry in writing requirements, adopt a house style such as “The system should maybe do that and if possible the other, but only if safe to do so with a competent user”.
- 11) Don’t bog your engineers down with risk registers and time sheets. It’s far better to let them loose on pursuing new opportunities, so that they can find different ways of losing money.
- 12) If you are forced into the nauseating task of planning something, don’t go back to first principles and tailor from there. It’s much quicker to cut and paste from another plan. Any plan will do, as long as you get the credit for releasing it on time.
- 13) The academics will tell you to start certification planning early. Just ignore them and use the time to explore creative designs. There’s always a last-minute panic at certification time but everyone gets through it somehow.
- 14) Make sure your suppliers are contractually obliged to change their end of the interface (at no cost to you) when you change your mind on the interface requirements. And be sure to penalise them for the resultant disruption.

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## FINAL THOUGHTS FROM SYENNA

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- 15) Insist that you and all suppliers use Excel for requirements management. It's better to be consistent even when you're consistently awful.
- 16) Use things like the System Meddling Language as much as possible. Meddlers can then have fun together and nobody will understand how to challenge them.
- 17) Use the following picture as an exemplar for great HMI design:



I remain, as ever, your humble servant,  
Ebenezer"

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