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SYSTEMS ENGINEERING NEWSLETTER

PPI SyEN 75 – 26 March 2019

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Systems engineering can be thought of as the problem-independent, solution technology-independent, life-cycle-oriented principles and methods, based on systems thinking, for defining, performing, and controlling the engineering effort within a technical project. The approach aims to maximize the benefit delivered to the enterprise, as influenced by the needs and values of the other applicable stakeholders.

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1. QUOTATIONS TO OPEN ON

“The only significance of the word “spiral” in the “spiral model” is that a spiral is a way of fitting a long timeline onto a computer screen. But it is a great approach where there is significant risk and/or opportunity.”

Robert John Halligan

“There is no exercise better for the heart than reaching down and lifting people up.”

John Andrew Holmes

“Character is formed, not by laws, commands, and decrees, but by quiet influence, unconscious suggestion, and personal guidance.”

Marion L. Burton

2. FEATURE ARTICLE

2.1 An MBSE Solution for Critical Characteristics Monitoring

by

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Abstract

When architecting and designing a system, it is important to track critical system characteristics. We chose civil engineering as a sample domain to demonstrate this. We will see how Model-Based Systems Engineering (MBSE) can facilitate monitoring safe margins for critical characteristics of the system, such as the footing area, over the design of the building. We will also see how modern systems engineering, modeling tools, and integrated ecosystems enable this efficiently.

Case Studies

1. **Sinking Library Story**

There is a well-known story about an architect who designed the perfect library. However, every year the entire building would sink a few inches into the ground. Eventually, the building was condemned. The architect forgot to account for the weight of the books! This story repeats itself for many libraries. One of the most famous is The Geisel library (see Figure 1), designed by William Pereira in the late 1960s as part of the University of California, San Diego (Architecture Blog Post).

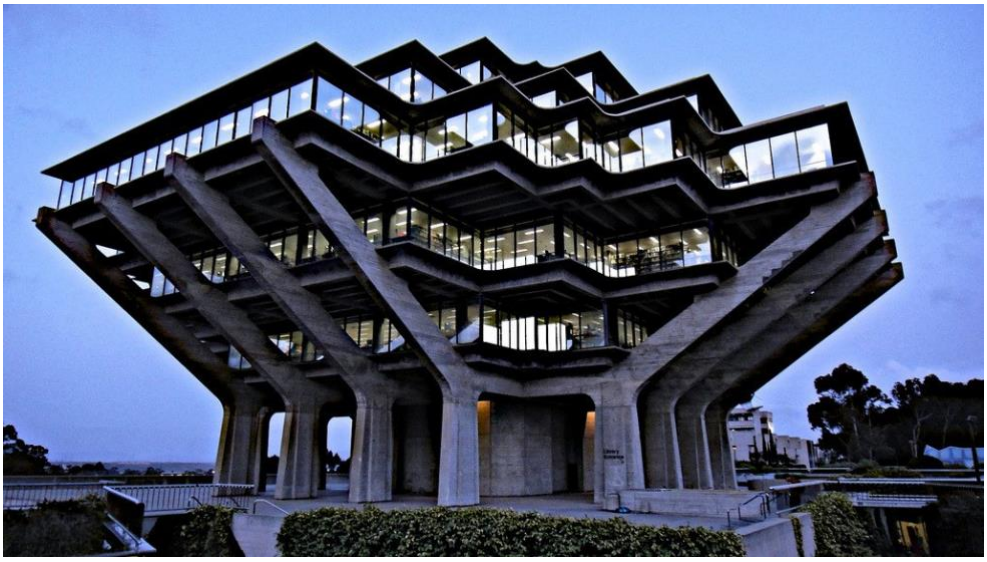


Figure 1: 'Sinking' Geisel Library

Thus far, the "weight of the books" explanation has failed to hold up to scrutiny. It is still beloved of students, however, and is still widely believed. This case cannot be true because there is a standard for regalements that considers all possible loads in a building design and architects are required to provide evidence of having met the standard (ASCE 7 & SEI Standards). Complex systems require much effort to track and update each change over the design process. An example of failure is described in the next section when a critical engineering mistake of 75 tons difference in a newly designed **S-80 Plus class Spanish submarine** was discovered just before production.

2. **The Sinking Submarine - "well-colored but did not float."**

The Spanish Navy commissioned a new submarine at a cost of 2.2 billion euros. The S-80 submarine (see Figure 2), with an original delivery date of 2015, was hailed by some as one of the most modern non-nuclear submarines in the world (Fieras de la ingenieria). However, it contained a serious design flaw: it was 75-100 tons overweight, an excess that could compromise its ability to surface after submerging. The 233-foot vessel would now have to be lengthened to compensate for the excess weight, which could take up to two years to correct the problem at a cost of $9.7 million per meter. The problem could have been solved by reducing the weight; however, the Spanish Navy did not want to compromise features such as combat systems or the air-independent propulsion system. It has been said that a comma was in the incorrect place in the original calculations, and the calculations were not sufficiently reviewed prior to production (Daily Mail).

Engineering mistakes can occur in any system. For example, in document-based systems engineering, two problems that are often encountered include: a disconnect between design and analytical models

and, in general, between different design artifacts. In the next section, we will show how to ensure that critical characteristics are met in systems engineering, how to consider characteristics of the system over the design process and how to recalculate them based on changes, preferably without additional effort. We will use a building as a sample system.

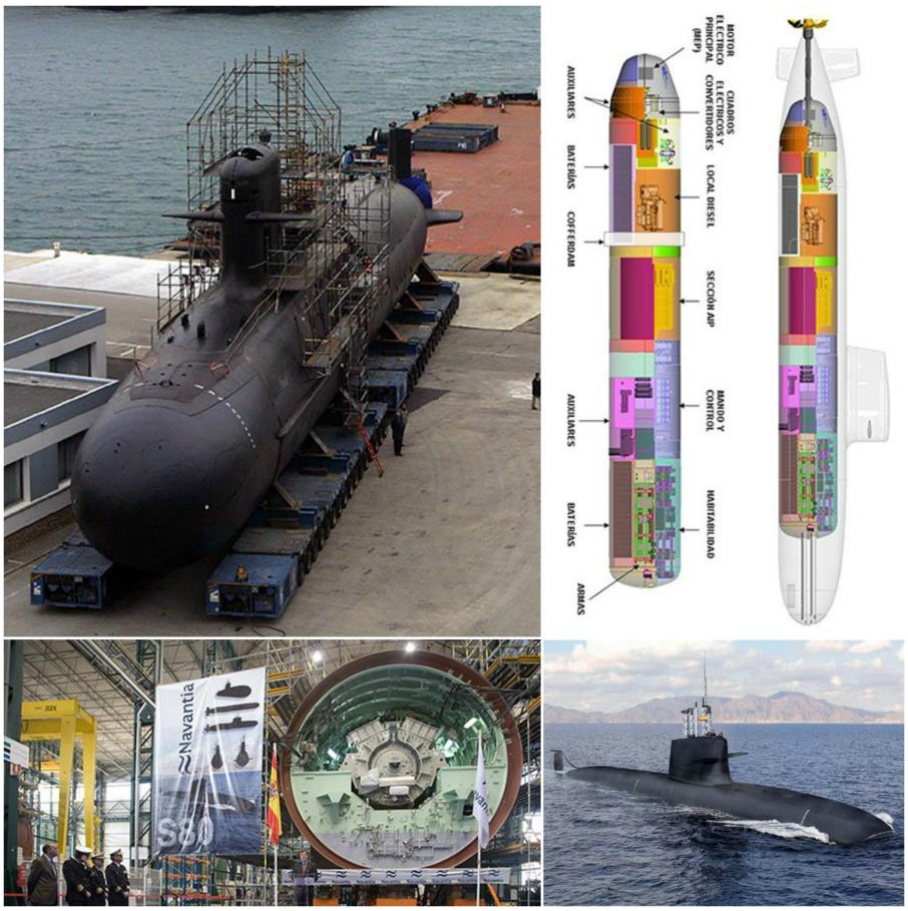


Figure 2: New S-80 submarine by Navantia

Problem Specification

We must ensure that the system design is on target to meet the requirement: “Total load per unit area of the footing shall not exceed the bearing capacity of the soil with a 10% margin.”

i. Core Knowledge

In systems engineering, critical system parameters (Measures of Effectiveness (MoEs)) define validation criteria for stakeholder requirements. Technical Performance Measures (TPMs), which trace to MoEs, are monitored over the system design process to ensure that each MoE is met. During design, TPMs are updated due to supplier changes, availability of more precise data, changes in architecture etc. (Handbook, INCOSE). **The building foundation footing area** is our MoE. It depends on both building load and soil capacity.

The total load of the building consists of dead and live loads (see Figure 3). The dead load is the weight of the building itself and is constant over the life of the building. Live loads change over the life of a building and come from people, wind, etc.

The total load is transmitted to the building foundation, then to the earth. The total load per unit area of the footing cannot exceed the **bearing capacity of the soil** (Frederick, M., & Kuprenas, J.).

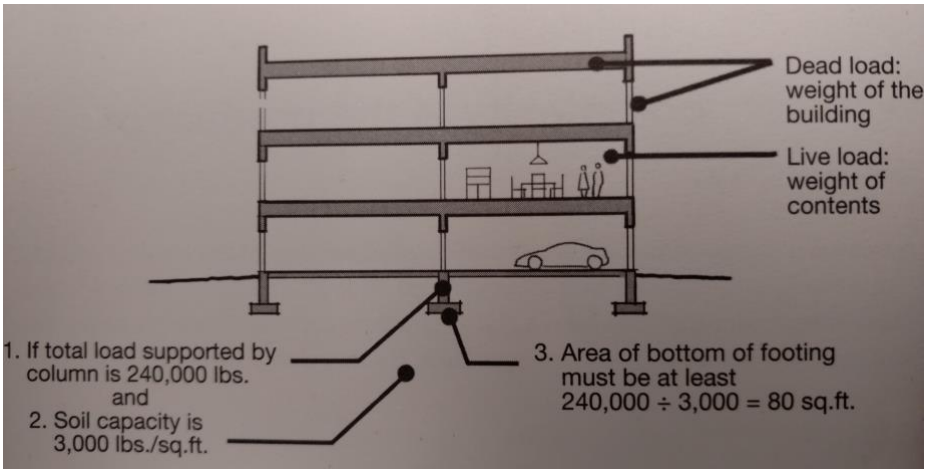


Figure 3: Building load and footing area (Frederick, M., & Kuprenas, J.)

We will create a model to track how each MoE is met over the time of design. For this purpose, we will use MBSE and SysML as the language - OMG and ISO standard. We will skip explanation of the advantages of MBSE and SysML, as they are readily available. We will briefly mention that MBSE and SysML transform systems engineering significantly in a more formal way, enabling reuse, traceability, and data integration. In general, modeling gives transparency, and due to abstraction enables head-around complex systems.

ii. System Structure

We will use the SysML Block Definition Diagram (BDD) to create a system structure, in this case, a library building.

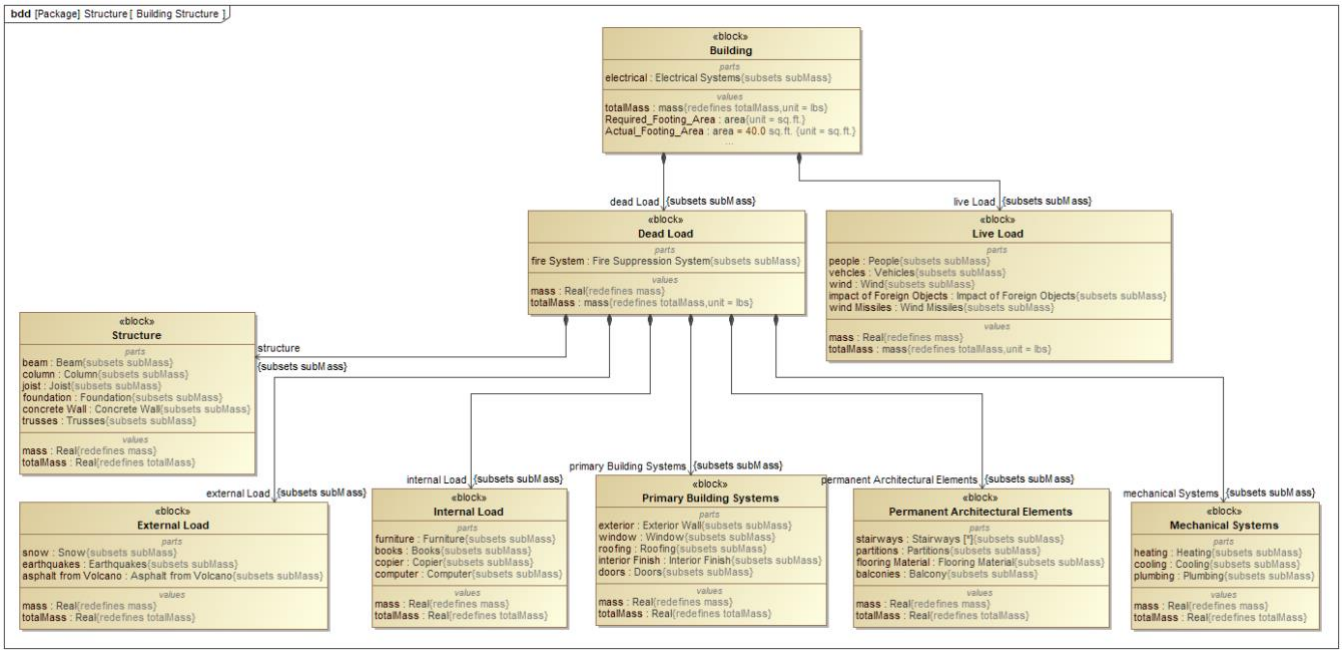


Figure 4: SysML block definition diagram representing building structure to specify dead and live load

The full diagram is quite large, so we will create a Structure Map (Figure 5). This diagram type is vendor defined (as opposed to the SysML defined diagram types) and is a feature of Cameo Systems Modeler

(No Magic, Inc.). Once the subject element is selected, the diagram is automatically generated by the tool. The diagram also dynamically updates whenever there are changes to the underlying model.

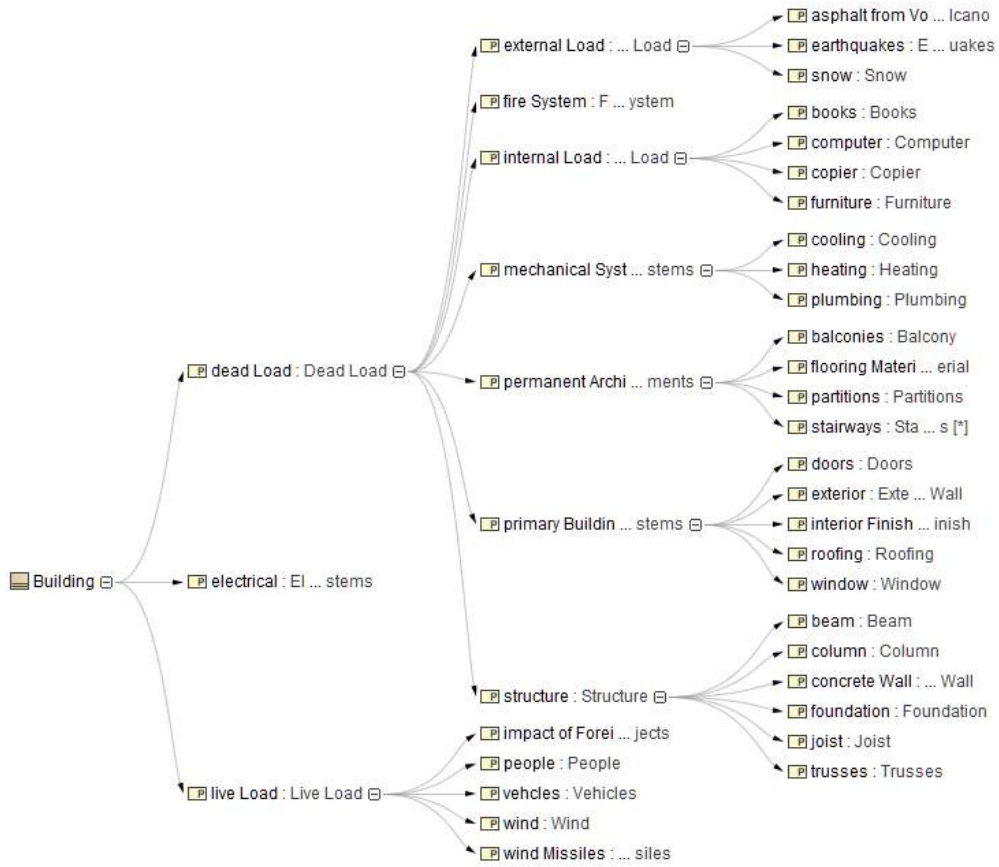


Figure 5: Compact representation of building structure

Blocks (shown in Figure 6) allow us to specify characteristics (SysML value properties) of the system, such as mass, required footing area, actual footing area, etc.

Figure 6: SysML block with characteristics

Notice that value properties have units. One can create one or use one of the many available from the ISO 80000-unit library.

iii. System Characteristic Relationship to Requirements which shall be Satisfied

We will create a satisfy relation from the Building block property Actual Footing Area to the requirement it will satisfy. With the aid of later analysis, we will check if the value of this property (and design) satisfy the requirement or not.

But what is a success criteria? How do we formalize a text-based requirement to a constraint block value property? In order to formalize a text-based requirement to a constraint block value property, we must create a constraint block which refines the requirement. Thus, a property that satisfies a requirement is constrained by a constraint block that refines the requirement (see Figure 7).

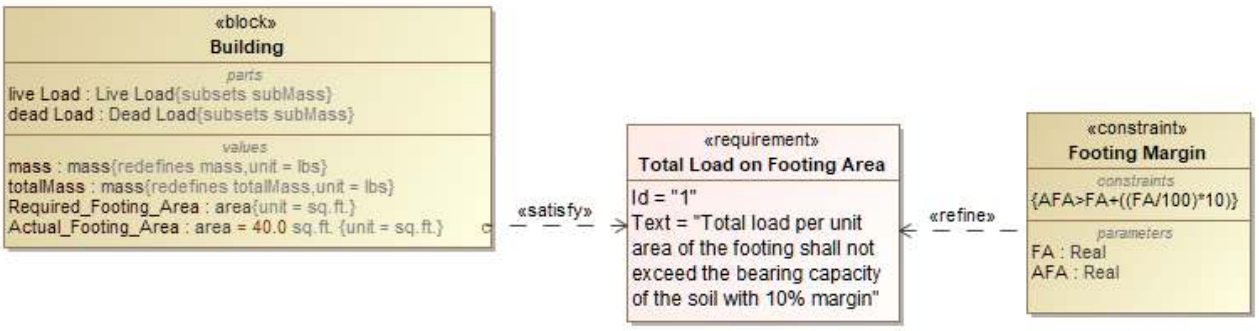


Figure 7: System Characteristics and Requirements Relationship

Note that in simple cases manual requirement refinement with a constraint block is not required. The natural language analysis capability (available in modern modeling tools) recognizes text-pattern-based, predefined, and customizable languages, and automatically creates constraints.

iv. Setup of Analysis

Calculating Total Mass

We will apply a mass rollup pattern to calculate the total mass of the system based on its part masses (Karban, R., Jankevičius, N., & Elaasar, M.), which will add the system part masses to the total mass. Notice that mass and total Mass properties are automatically created in blocks as a result of an applied pattern. You can choose whether or not to create physical value properties in blocks, have them available only in runtime analysis, and saved in the model instance.

Calculate Required Footing

We will not set up an analysis to calculate the required footing, based on the total mass and soil capacity. First, we will create a block for the analysis context to hold additional required characteristics for analysis, constraints, and the system under analysis (Figure 9). Normally, you would create one analysis context for each type of analysis or each MoE.

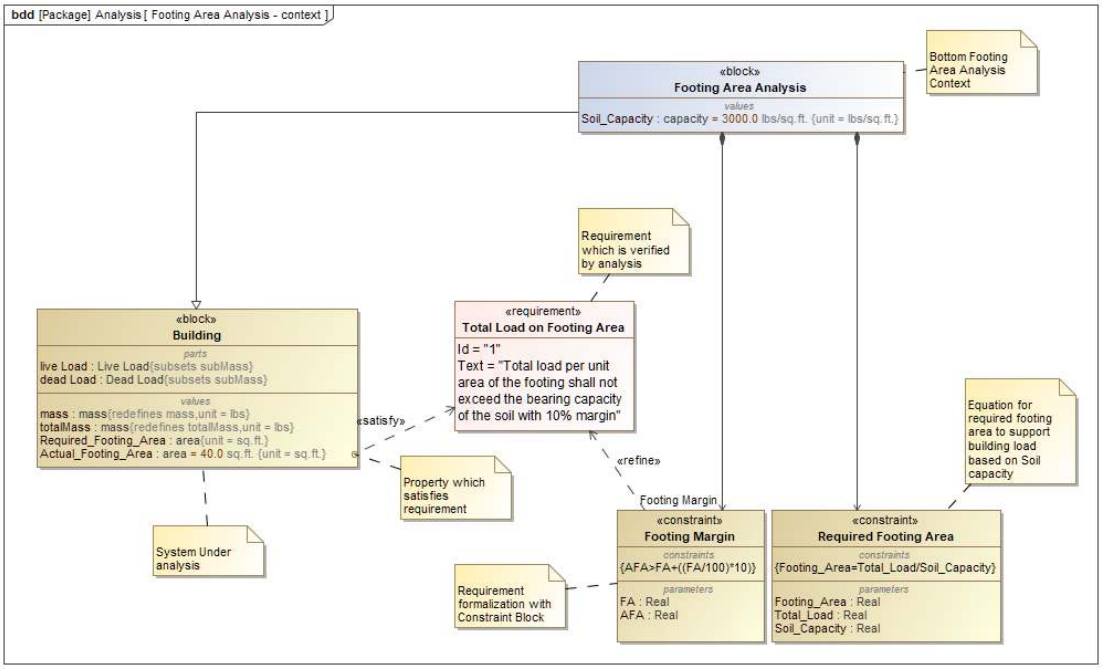


Figure 8: Footing Area Analysis Context

In the analysis context block “Footing Area Analysis,” we will create a parametric diagram (Figure 9), which will bind formulas represented in constraint blocks to system characteristics (value properties).

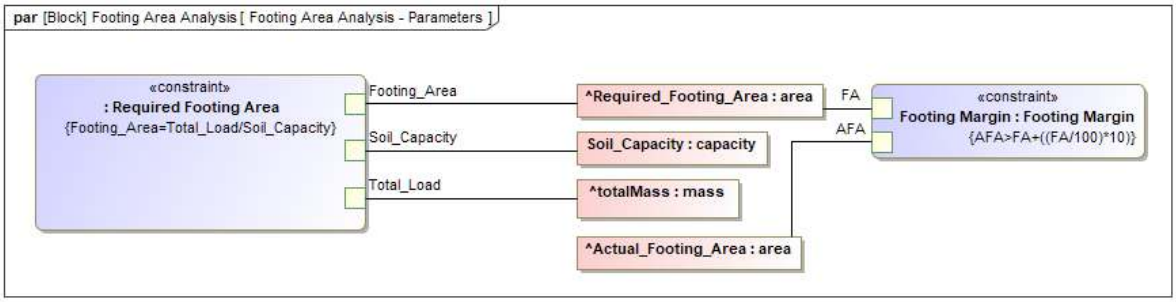


Figure 9: Parametric Diagram Binding Formulas Represented in Constraint Blocks to System Characteristics

We will then execute Analysis Context and specify parts mass values in the Simulation dialog Variables tab (Figure 10 - left slide). Note that Actual Footing is not only calculated, but marked in red because the satisfied requirement is actually not satisfied. Additionally, inputs can be modified and results calculated directly in the instance table, the same as the new instance/snapshot of the model.

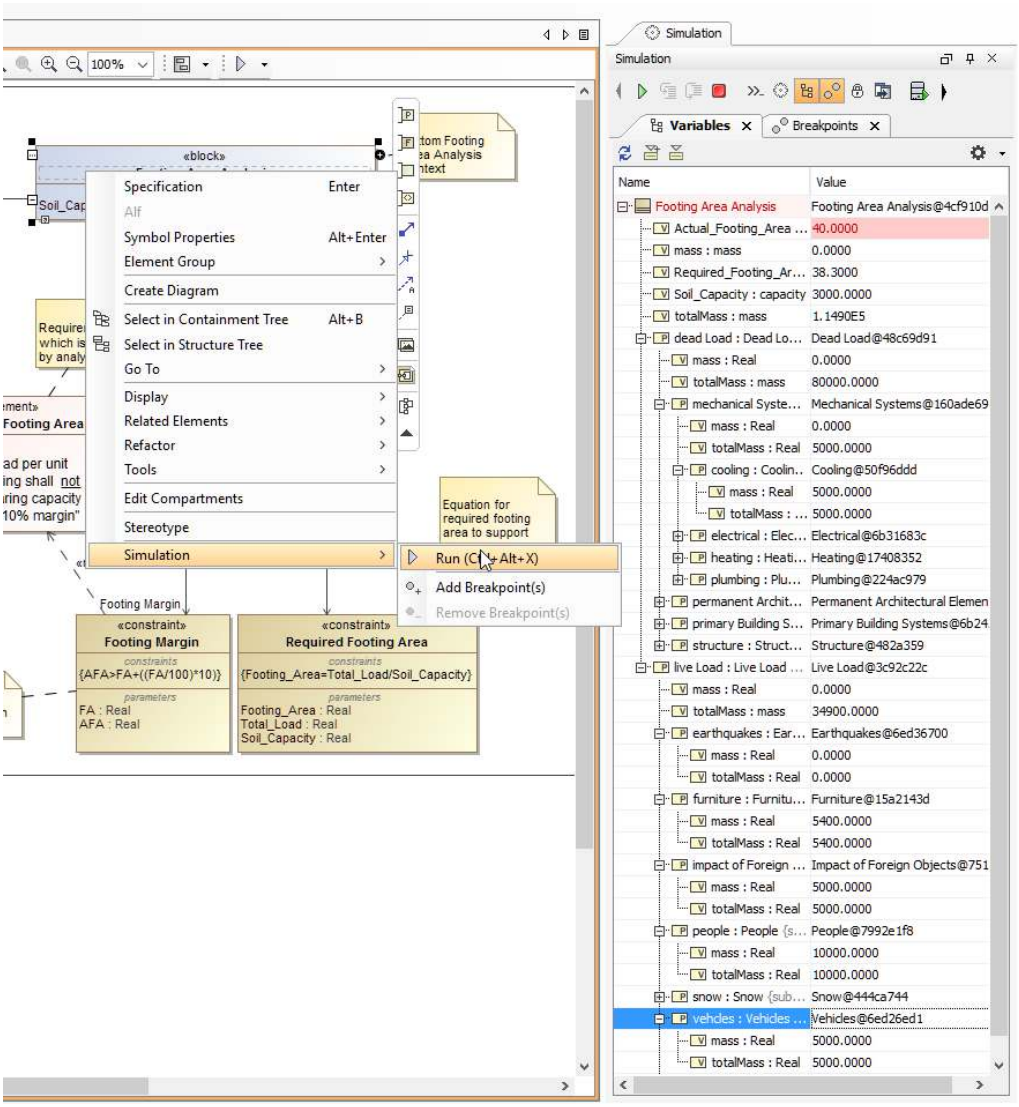


Figure 10: Running Analysis – Executing Analysis Context and Reviewing Results in the Simulation Variables Panel

v. Using Libraries

SysML contains the means to build and use libraries, and includes a model library element (a kind of package), dedicated to keeping and sharing library items (signals, value types, blocks, etc.). In this case, we will build a library of blocks to represent each type of load.

Building a Library

We can build a Library using a hierarchy of blocks (see Figure 11). The Library package Components Library (1) groups typical Balcony types. Specific types of balconies are inherited from an abstract Balcony (2) block. Each subtype also inherits all properties as class, area, concentrate and distributed loads. If properties are updated, they are refined in the context of subtype (3). A custom Balcony block can be created based on any library block by inheriting from it (4) in order to specify custom values as a balcony area. Note that a parametric diagram in a rollup pattern can be updated (by introducing a custom rollup pattern) to consider area, other custom properties, and custom pattern calculation logic.

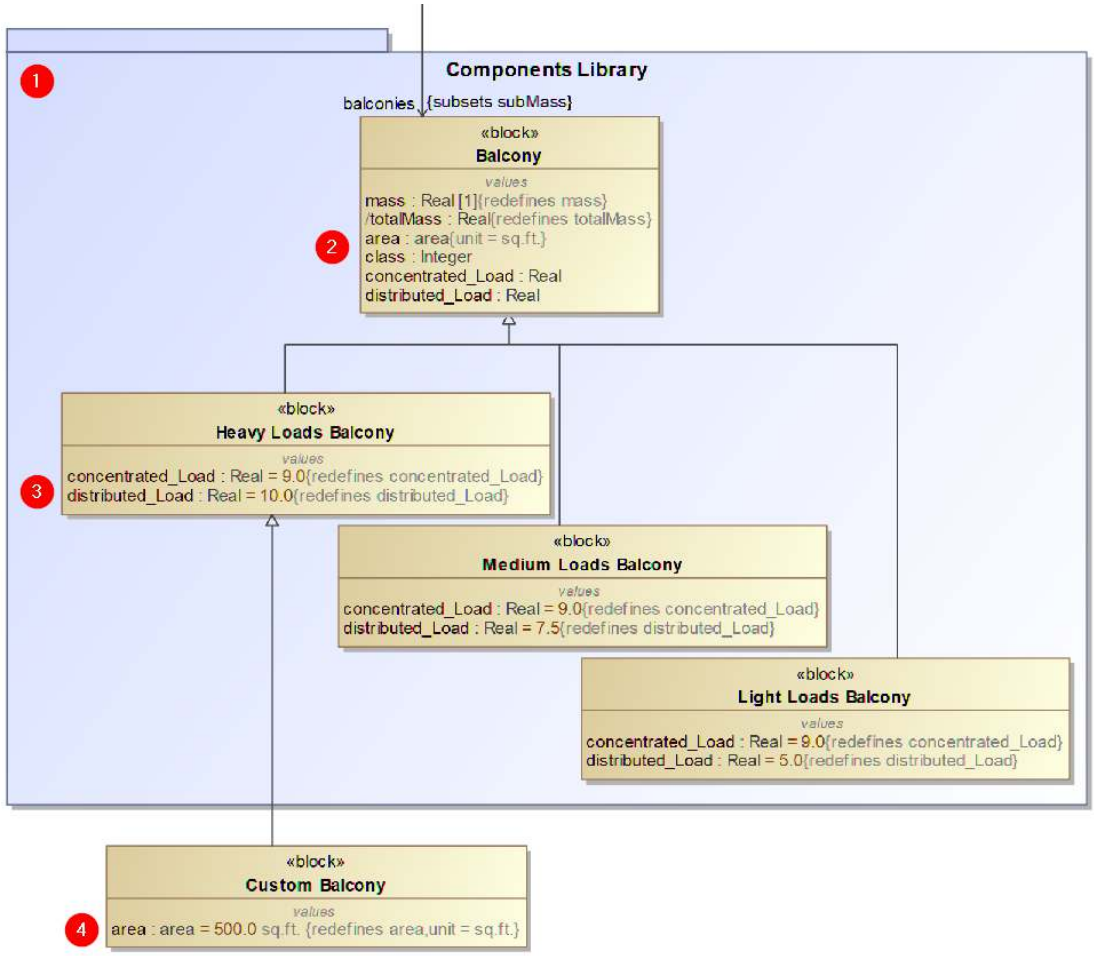


Figure 11: Typical Blocks Library

We can reuse a Library between many tools and domains (e.g. electrical, mechanical, software, etc.). For example, this can be achieved with integration between Project Lifecycle Management (PLM) tools (Pavalkis, S.), which can serve as data backbones integrating many authoring environments, as well as supporting cross-domain reusability (Digital Engineering).

Using the Library

We can reuse Library elements in multiple projects as-is, as read-only, or by inheriting from them and customizing (read-write (Figure 12. (4)). Figure 13 shows how we can select a typical or custom balcony for analysis.

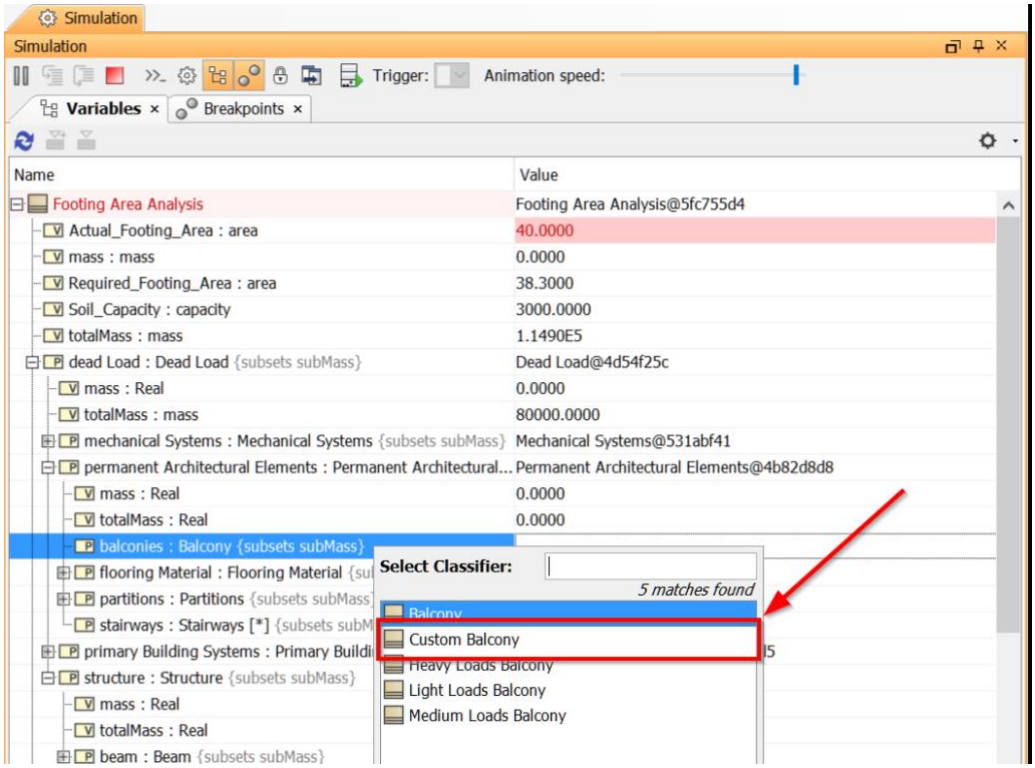


Figure 12: Selecting Required Library Block for Specific System Analysis

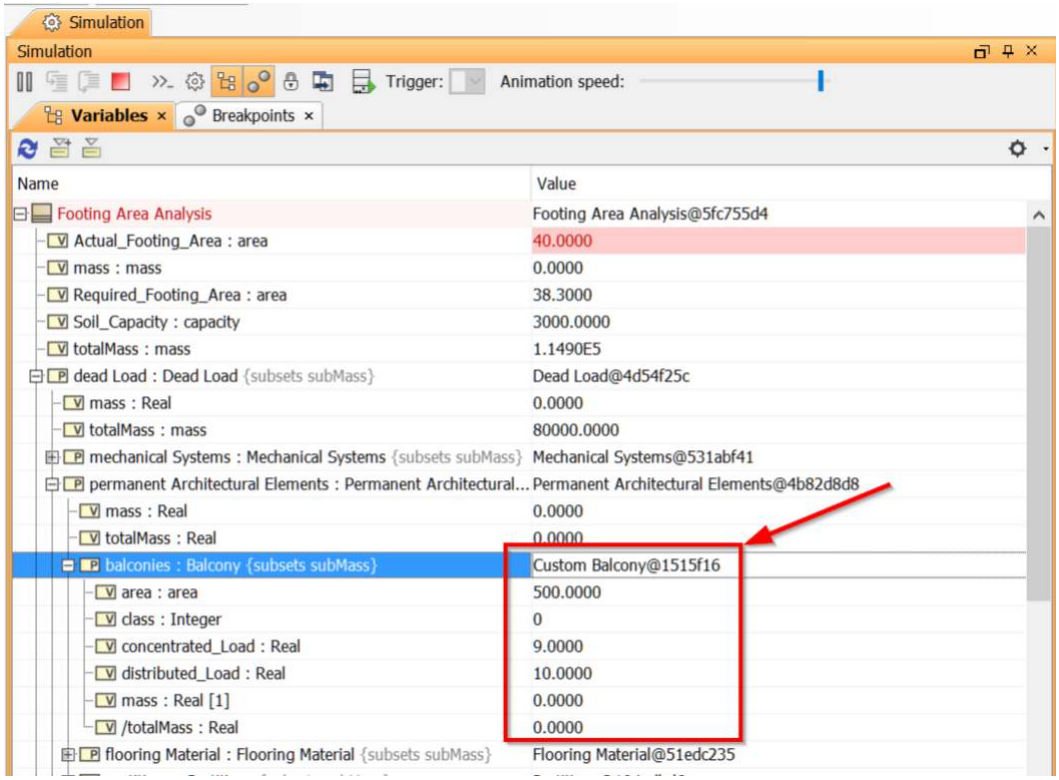


Figure 13: Selected Block Characteristics are Automatically Used in Analysis with the Ability to Modify Them

Tracking Results

We can save a Snapshot of parameters over time as an instance and represent it in an Instance Table. Each Instance Table line in Figure 14 represents a separate instance of the model containing all the parameters, calculated values, results, and automatically generated time stamp. The user selects which properties of an instance model to show in an instance table as columns.

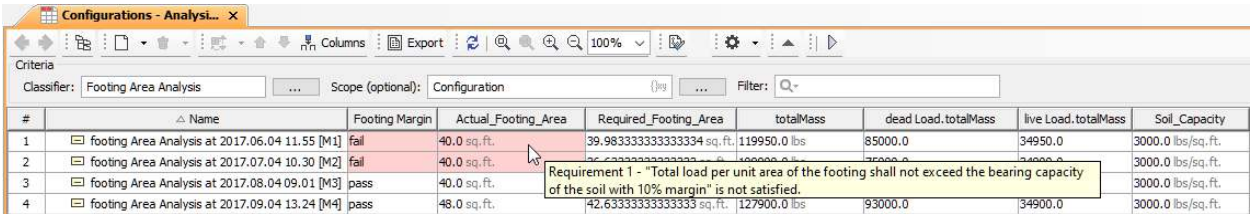
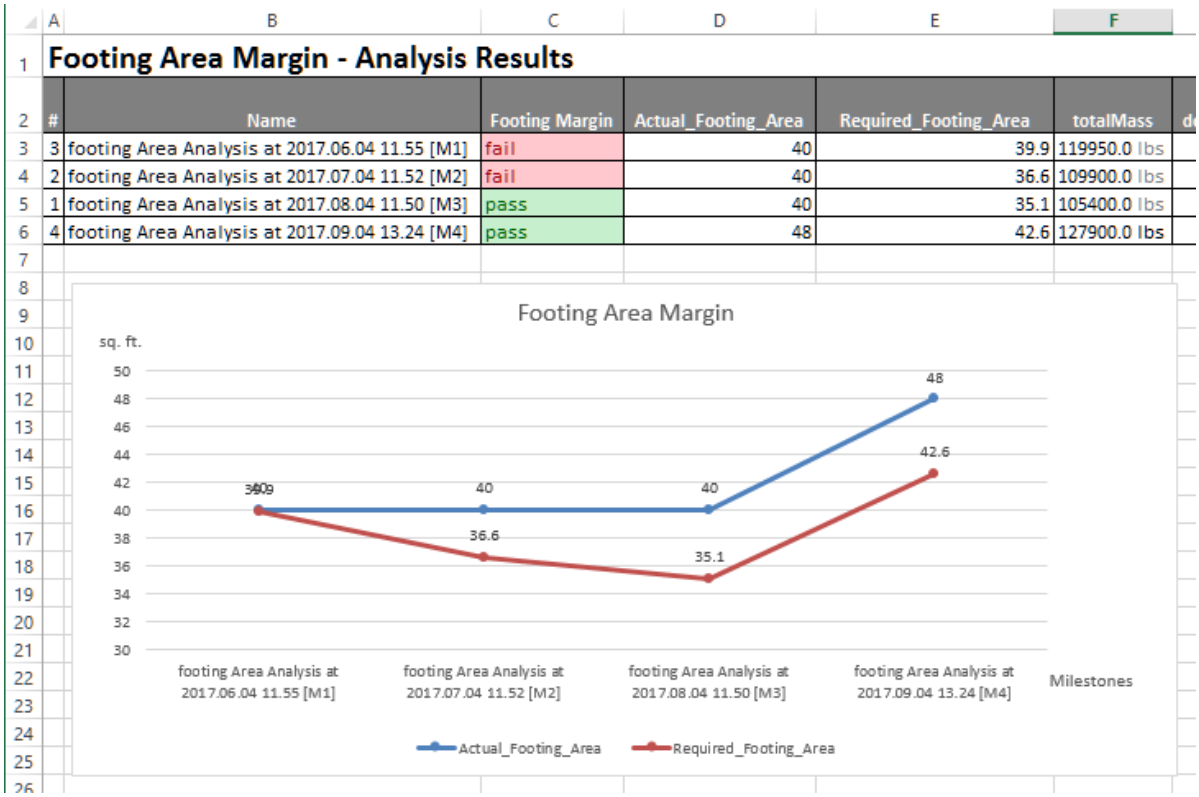


Figure 14: Snapshots of Results in Instance Table

The results from the Instance Table can be exported or synchronized to MS Excel (Figure 15). Additionally, they could be published online with the aid of web-based reporting.



Footing Area Margin - Analysis Results

#	Name	Footing Margin	Actual_Footing_Area	Required_Footing_Area	totalMass
3	footing Area Analysis at 2017.06.04 11.55 [M1]	fail	40	39.9	119950.0 lbs
2	footing Area Analysis at 2017.07.04 11.52 [M2]	fail	40	36.6	109900.0 lbs
1	footing Area Analysis at 2017.08.04 11.50 [M3]	pass	40	35.1	105400.0 lbs
4	footing Area Analysis at 2017.09.04 13.24 [M4]	pass	48	42.6	127900.0 lbs

Figure 15: Exported or Synchronized Results Exported or Synchronized to MS Excel

Existing web-based technologies, such as OpenMBEE, allow data input and retrieval through limited interfaces. This eliminates solution complexity.

Conclusions

SysML describes systems from different perspectives. It can also connect analytical models which can verify requirements at different milestones, or with different configurations. Modern tools have acquired the means to make these tasks more efficient, allowing system engineers to concentrate on system modeling and analysis. Existing web-based technologies allow automated data input and retrieval through limited interfaces, eliminating complexity of the solution. The actual solution does require expertise and adaptation as part of adopting MBSE in the context of the organization.

As we saw, MBSE and SysML transform systems engineering significantly in more formal ways, enabling reuse, traceability, and data integration. In general, modeling gives transparency, and due to abstraction, enables head-around complex systems.

Modern systems projects are very complex and challenging. Similar systems, created 60 years ago by the entire nation (e.g. the U.S. moon rocket) can now be accomplished with very limited budgets. It also allows modern systems engineers to more easily track changes, synchronize results, and collaborate on projects.

Referring to the S-80 case, the Spanish Defense Ministry said technical problems are normal for projects of this scale: “The technology challenges that these programs face during development are much more than simple calculations… All the major military programs, especially submarines, have experienced delays and often have required the support of a technology partner.”

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Dr. Saulius Pavalkis is a Chief MBSE Solutions Architect and PLM Product Integrations Manager with 15 years of experience working on modeling solutions. He works with major client companies around the globe leading successful and efficient MBSE adoption. He has 10 years' experience as former analyst in R&D department, core MagicDraw team. His major expertise areas are requirements engineering, MBSE, SysML, UML, traceability, modeling solutions, simulations, PLM integrations. Saulius has multiple certificates (OMG-Certified Systems Modeling Professional, OMG-Certified UML Professional, etc.) and is the author of numerous scientific and industrial papers accepted by the top systems engineering conferences, such as INCOSE IS, NDIA, and GLRC. No Magic, Inc. has nominated him as the representative at INCOSE CAB and a member of the CAB leadership team. Saulius is the founder and chief editor of No Magic's modeling community blog (blog.nomagic.com) dedicated for sharing practical knowledge in model-based engineering. He holds PhD in Software Engineering, MSc and BSc from Electronics and Telecommunication from Kaunas University of Technology.

3. ADDITIONAL ARTICLE

3.1 Integrating Program Management and Systems Engineering

March 2019 Update on the INCOSE – PMI Alliance

by

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Hi,

February was a quiet month for INCOSE – PMI Alliance activity. Given the intense activity in January associated with the INCOSE IW event, the relative calm was a welcome change!

The updated alliance agreement is currently working its way through PMI review, once comments are received we'll coordinate resolution with INCOSE and then route the final document for signatures. The alliance continues to operate under the old agreement until such time as the new one is fully executed and replaces it.

PM and SE are clearly interdependent, which makes conducting them independently seem like a rather poor idea. Given that reality, how did we end up with two diverging professions?

Definition and execution responsibility interact in complex ways throughout the development program life cycle. Development programs don't come with build to print drawings, instead they make progress by oscillating between *definition* that enables execution and *execution* that enables further definition.

The need to do two complex things at once – define a solution and make progress towards it – quickly overwhelms any individual as task scale increases. It is hard to become an expert in two increasingly sophisticated bodies of knowledge at the same time. It is also hard to serve "two masters" when technical and non-technical stakeholders disagree on program direction. Even when all of the skills are present, the hours any individual can devote to work in a day are limited.

When faced with tasks beyond our individual ability to imagine and execute, our only recourse is to divide what a single mind does and spread that effort across multiple minds engaged in coordinated activity. In development the price for dividing any system is the new requirement to define and manage an interface that ties all the pieces together. As the number of pieces goes up the quality of the interface quickly becomes the dominant factor limiting overall system performance. It also becomes very tempting to optimize pieces at the expense of the whole.

This is no less true when speaking of the functional roles of PM and SE, which evolved out of the need to address each dimension more formally. Once tightly integrated, each profession has matured along largely independent paths over the past fifty years. The result is the emergence of two communities that have very different definitions of success, independent method and practices, confusing terms for the same thing, and even different views of their own roles.

These differences begin at the individual level, then are further reinforced by position titles, organizational boundaries and promotion paths, tools, educational programs, and many other forces. These environmental pressures drive the roles further apart, and that pressure in many organizations far exceeds the available energy working to connect them more effectively.

It is also important to note that some degree of execution management is *always* required, whereas *definition* only occurs on development projects. As a result, nearly all practicing SE have some familiarity with the PM world, but many in the PM world have never needed or even encountered SE before.

All the best,

Randall Iliff

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4. SYSTEMS ENGINEERING NEWS

4.1 Update on Systems Engineering in Germany - Study Results

At TdSE2017, the company Prozesswerk, as a corporate GfSE member, started a second survey after 2013, on the subject of systems engineering in Germany. With the support of the participants and members a new survey had been initiated. In addition, interviews were conducted in 2018. The result and a summary were published at EMEASEC / TdSE2018. At the conference, there was also an interesting panel discussion on "Systems Engineering in Germany - Strategies for Introducing to Industrial Practice" with representatives from Audi, Claas, and Dassault.

Currently, the study can be ordered through the Prozesswerk Academy. Information and can be found here.

4.2 INCOSE Social Media Job Opportunity

Are you a social media guru? You might be the right person for this role!

INCOSE is seeking volunteers to assist with building out a consistent presence on Facebook. Volunteers would report to the Assistant Director of Social Media. As part of the role, you would work to help set the direction for the growing global social media presence for INCOSE.

For more information and further inquiries please contact marcom@incose.org

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4.3 Upcoming INCOSE Certification Exams

Not yet certified? The exam will also be offered at regional conferences in 2019, as well as at universities around the world. Registration for the exam is generally part of standard conference registration.

Upcoming INCOSE Certifications Exams are listed below.

March 23: Central Arizona Chapter (Phoenix, AZ, USA)

https://incose.ps.membersuite.com/events/ViewEvent.aspx?contextID=9725473f-0078-c3a3-107e-0b3f578ea3da

April 4: Socorro Summit (Socorro, NM, USA)

https://incose.ps.membersuite.com/events/ViewEvent.aspx?contextID=9725473f-0078-c408-f93c-0b3f54b788bf

April 8: IEEE SysCon (Orlando, FL)

https://incose.ps.membersuite.com/events/ViewEvent.aspx?contextID=9725473f-0078-c949-221e-0b3f47c4cac1

If you already have an INCOSE account, please login before using link

Already certified? You may be eligible to become a Certification Application Reviewer (CAR). All ESEPs are eligible, and CSEPs with at least twenty years of experience may qualify. Email certification@incose.org if you'd like to become a CAR. There is mandatory in-person training, which will be offered at both the IW and IS, as well as at some regional conferences.

4.4 Systems Engineering Webcasts are Available from GfSE

Gesellschaft für Systems Engineering e.V.

German Chapter of INCOSE

Currently, at least one webinar a month is organized by Martin Geisreiter. These began in December 2018 and enjoy a large increase in participants. In order to participate in the webinar, each participant must register in advance by sending an e-mail to webinar@gfse.de. The access data will be sent by e-mail.

More Information

4.5 INCOSE Call for Nominations for Outstanding Service Awards – Extended Deadline

INCOSE members, did you miss your opportunity to nominate a colleague? The deadline for nominating a colleague for an Outstanding Service Award has been extended until 29 March. Award criteria, nomination instructions and guidelines can be found at:

INCOSE Awards

4.6 IISE President-Elect Poirier heads IISE Election Winners

New leaders for 2019 have been chosen in the Institute of Industrial and Systems Engineering (IISE) annual elections, announced by CEO Don Greene. Chosen to the 14-person board of trustees were David Poirier, President-elect; Carl Kirpes, senior vice president, industry; and Gül Kremer, senior vice president, international operations. The new officers were elected by IISE professional members and will serve for three years. Terms begin April 1.

More information can be found here.

4.7 IISE Lean Division rechristened as Operational Excellence

The IISE's Lean Division will be answering to a new name after members voted to change the division's moniker to Operational Excellence. In the vote, 37 percent of division members casting ballots voted for the new name, 29 percent for keeping the old name; 22 percent for Lean Six Sigma; and 12 percent for Continuous Process Improvement. The idea behind the change was to make the division more inclusive and welcoming to members who specialize in other areas of performance improvement. 'The Lean Division has evolved over several years to encompass more than Lean and Six Sigma,' division president Valentine Boving told ISE.

For more information, visit the following page

4.8 Most Loved and Loathed Programming Languages as Rated by Engineers

Online recruitment firm Hired released a report designed to paint a picture of software engineering job seekers in 2018. The Hired report combined data from its job sites around the world with responses to a survey of 700-plus developers around the world. Hired dug into the love/hate relationships between software engineers and programming languages, and teased out mismatches between the software skills engineers have and the skills employers seek.

To figure out which programming skills sparked the most corporate interest in 2018, Hired looked at the number of interview requests received by a job seeker listing experience with a given programming language during the two to six weeks the job seeker was available through Hired.

The winner, globally, was Google's Go—probably because developers are in such short supply. That programming language is used by only 7 percent of the job-seekers on the site. It's also a good time to be working with Scala; that's number two in terms of employer desire, and only 3 percent of developers surveyed listed it as their primary language.

More details from the research can be found here.

4.9 SWE & NSC Joint Networking Meeting

25 March 2019, Minneapolis (United States)

The Society of Women Engineers (SWE) and the North Star Chapter (NSC) of the International Council on Systems Engineering (INCOSE) are hosting a joint networking meeting which will entail several short presentations on various experiences as a Systems Engineer and how they relate to the engineering society, INCOSE. The NSC will also present information about the INCOSE initiative, Empowering Women as Leaders in Systems Engineering (EWLSE) which has the vision, "... to live in a world where men and women are equally represented as leaders in systems engineering."

The agenda is as follows:

6:00pm - 6:20pm	Networking
6:20pm - 6:40pm	Presentations
6:40pm - 7:00pm	Q&A, Adjourn

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5. FEATURED ORGANIZATIONS

5.1 International Requirements Engineering Group Promotes Partner Nederlandse Spoorwegen's Requirements Competence Center

Editor's Note: For quite some time, the International Requirements Engineering Board (IREB) has promoted a partner program for companies worldwide that value sound requirements engineering and align the qualifications of their employees to IREB's best practices. One of the largest of these partners is the Requirements Competence Center of Nederlandse Spoorwegen (NS - Dutch Railways), based in Utrecht, the Netherlands. With almost half of its 180 employees CPRE certified, the IREB has awarded them Gold Partner status.

Nederlandse Spoorwegen's (NS) Requirements Competence Center has been contributing to mobility and progress in the Netherlands for over 175 years. The company plays a very significant role in its domestic market. Over the past years, NS has been accumulating an increasing share of rail transport in other European countries through its subsidiary Abellio.

NS operates in the public transport sector. It provides reliable passenger transport, comfortable trains and buses, lively stations and station areas and a range of services for a pleasant journey from door-to-door. The 28,500 NS employees put their combined efforts into a single mission: making passengers feel connected by NS.

The top priorities for NS are 'passengers, passengers and passengers' and NS continues to work as hard as ever with other carriers and stakeholders to improve mobility by making the door-to-door journey and public transport as a whole simpler and more attractive. Investing in IT is an important part of that.

In order to get the right results with IT, it is key to pay attention to requirements. Within NS this is being acknowledged and implemented in various ways. One way is by investing in the requirements engineering expertise of its employees. IREB is the standard in this competence area.

Visit the NS Partner Page at the IREB.

5.2 The Ergonomics Center

The Ergonomics Center of North Carolina (Center) is a membership-based organization housed in the Edward P. Fitts Department of Industrial and Systems Engineering at North Carolina State University. Founded in 1994, the Center was created to make workplaces safer, more productive, and more competitive by providing practical, cost-effective ways to reduce or eliminate America's fastest-growing occupational injury and illness problem: painful, crippling cumulative trauma disorders (CTDs).

The Center's staff provides occupational ergonomics consulting, training programs, and research for corporations, facilities, and individuals to support and enhance a company's ergonomics efforts. Each service is tailored to meet an organization's specific ergonomic needs and corporate goals. With extensive experience in ergonomics research, consulting, and training they understand the challenges of managing ergonomics and minimizing ergonomic risk factors in today's work environments. Industries served by the Ergonomics center include aircraft engine manufacturing, electrical systems, power equipment manufacturing, shipping and others.

More Information

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6. NEWS ON SOFTWARE TOOLS SUPPORTING SYSTEMS ENGINEERING

6.1 New MapleMBSE Release

by

Alwyn Smit

Principal Consultant & Course Presenter, Project Performance International (PPI)

Email: asmit@ppi-int.com

MapleMBSE 2019.0 recently released by Maplesoft, is an Excel-based tool that enables companies to employ a model-based systems engineering (MBSE) approach to their design projects without requiring every engineer on the project to be an expert in complex MBSE tools.

MapleMBSE provides:

- An intuitive, Excel®-based interface
- Automatic population of information into your MBSE tool
- Integration with standard SysML-based MBSE platforms such as IBM® Rational® Rhapsody® and Teamwork Cloud from No Magic
- Rapid impact analysis of design changes to test for conflicting requirements
- Optimized tool views for common MBSE tasks
- Designed to reduce many common errors that occur when using MBSE tools directly
- Customized implementations provided by Maplesoft Engineering Solutions experts to ensure that MapleMBSE is tailored to your exact MBSE process

The Full-Featured Spreadsheet User Interface enables:

- Flexible cut & paste with all style and value conversions
- Full range of formatting options
- Data validation and duplicate detection
- Excel-based formula capabilities

MapleMBSE Spreadsheets further provides:

- Editing almost all of your SysML model, not just dependencies
- Using bidirectional Query Path Expression (QPE) language to flexibly query model elements
- Easily filter model elements
- Simply add new rows or columns to create new model elements

Watch the tool video on the Maplesoft website, or contact them for a demo.

7. SYSTEMS ENGINEERING PUBLICATIONS

7.1 People Skills for Engineers

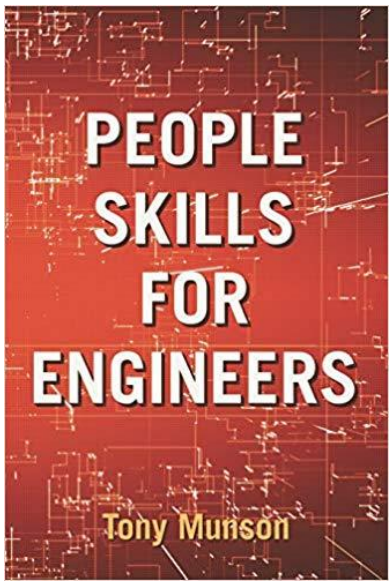

Image Source

by

Tony Munson

Drawing on more than sixteen years of experience working alongside other engineers, Tony Munson provides a foundational set of people skills every engineer should possess in order to avoid and resolve relational problems before they have a chance to impact your personal effectiveness.

These problems include but are not limited to:

- Feeling isolated and disconnected from others.
- Problems with management or co-workers.
- Poor performance at interviews or meetings.
- Interaction regret or wishing you would have behaved differently in personal interactions.
- Inability to properly lead and motivate others.

Don't learn the hard way, through repeated failures, when your career is on the line! *People Skills for Engineers* can help fill in the gaps in this crucial and often underdeveloped engineering skill set.

Publisher: Independently published (September 29, 2018)

ISBN:

ISBN-10: 1723996785

ISBN-13: 978-1723996788

More Information

7.2 Challenges in the Elicitation and Determination of Precise Requirements from Animal Stakeholders

How to use requirements gathering techniques to determine product

by

Jason Hansen

Article from Requirements Engineering Magazine (18 January 2019)

Requirements elicitation is the process of seeking, uncovering, acquiring, and elaborating requirements for a system (we will be using the terms system and product interchangeably). The process of requirements elicitation is generally accepted as one of the critical activities in the requirements engineering process, and the selection of appropriate elicitation techniques is a critical factor for the success of the requirements elicitation. Elicitation of precise requirements can be a long and hard process when dealing with human stakeholders. Imagine having to go through the same process with stakeholders who cannot verbally state what they want, really do not have any idea of what they want, or may not really want anything at all.

The fact that requirement elicitation methodologies are human-oriented is strongly reflected in the assumption made in the requirements engineering literature that assumes that all stakeholders are human. Whether dealing with an animal computer interaction, or with an animal interacting with a physical object, taking a user-centric approach in the design of animal technologies can have many benefits for both animals and humans. It could support dogs with occupations on their missions, such as search and rescue and seizure alert. It could lead to further insights into animal cognition, for example, by informing the design of interactive technology for behavioral studies that affords optimal usability and creative appropriation for the animals.

Elicitation of precise requirements from an animal stakeholder (animal) presents unique challenges. These challenges are similar to eliciting requirements from infant stakeholders. Like an infant stakeholder, an animal cannot verbalize what it is they require, nor can they tell you exactly what is wrong with the current design. They can only express, in very basic terms, if they like, dislike, or can tolerate your current iteration. Based upon their reaction, we only know if we need to change or not change the current iteration, not how or why it should be changed. We must change our point of view to that of the dog, which can be a hard thing to do since how a dog thinks is foreign to us. It is much easier to put ourselves in the position of what another person is thinking as we have a common frame of reference and the person can provide verbal feedback to adjust our thinking to more closely match his or her way of thinking.

Read the Article

7.3 101 Things I Learned® in Engineering School

by

John Kuprenas

and

Matthew Frederick

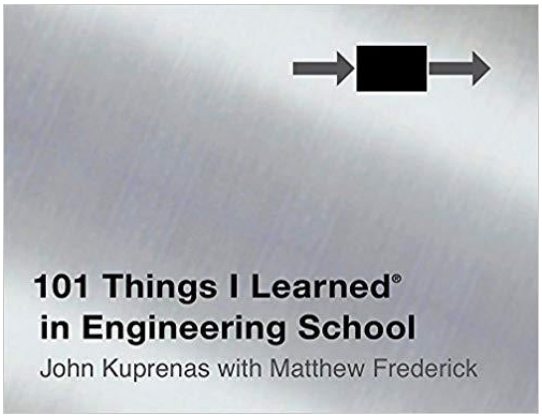

Image Source

From the Amazon.com Website:

An experienced civil engineer presents the physics and fundamentals underlying the many fields of engineering. Far from a dry, nuts-and-bolts exposition, 101 Things I Learned® in Engineering School uses real-world examples to show how the engineer's way of thinking can illuminate questions from the simple to the profound: Why shouldn't soldiers march across a bridge? Why do buildings want to float and cars want to fly? What is the difference between thinking systemically and thinking systematically? This informative resource will appeal to students, general readers, and even experienced engineers, who will discover within many provocative insights into familiar principles.

Formats: Kindle, Hardcover

Publisher: Three Rivers Press (April 3, 2018)

ISBN:

ISBN-10: 1524761966

ISBN-13: 978-1524761967

More Information

8. EDUCATION AND ACADEMIA

8.1 Systems Engineering at Worcester Polytechnic Institute

Through a combination of courses in Engineering, Science, and Management, WPI's rigorous graduate programs prepare professionals for challenging careers in Systems Engineering. WPI's approach stresses a hands-on, practical, applied, project-based curriculum taught by instructors who have actually practiced real-world Systems Engineering for decades.

WPI's Systems Engineering programs are offered 100% online, affording working professionals access to this education wherever they live, and the flexibility to expand their knowledge base and skills while working full-time. Areas of study include a certificate, Master's and PhD in Systems Engineering and a certificate in Systems Thinking.

More Information

8.2 Systems Engineering Apprenticeship Master's Program

Defence Growth Partnership (DGP)

UK's Defence Sector

The Systems Engineering Masters Apprenticeship Program is a 1-5 year program of blended vocational and academic learning at Master's level, which will develop rounded systems engineer at the INCOSE (International Council on Systems Engineering) practitioner level and who should also be likely to be able to apply for a CEng.

The Systems Engineering Masters Apprenticeship Programme is a part of the Department for Business, Innovation and Skills Apprenticeship Trailblazer programme, which aims to make apprenticeships employer-led, simpler and more standard. It has been developed under the sponsorship of the Defence Growth Partnership, through an Employer Group led by Atkins.

More Information

9. SOME SYSTEMS ENGINEERING-RELEVANT WEBSITES

25 Q & A Sites for Engineers

A list of 25 question and answer websites for anyone looking for answers from professional engineers, professors, 'weekend engineers' and more. Sites include MIT Engineering, American Institute of Aeronautics and Astronautics and Engineering Ethics.

https://www.onlineengineeringdegree.org/25-qa-sites-for-engineers

Research to Recycle Systems Engineering

This is the website of Terry Bahill – a Professor of Systems and Industrial and Engineering at the University of Arizona. The site is a directory created for Bahill's students and contains abstracts from his seminars and short courses, access to posters describing various aspects of the systems engineering process and a list of definitions related to systems engineering.
http://sysengr.engr.arizona.edu/index.html

The Value of Systems Engineering

A page on the Carnegie Mellon Software Engineering Institute website containing a detailed breakdown of the value of engineering. The page describes the link between systems engineering and project and organizational performance and introduces The Business Case for Systems Engineering Study: Results of the Systems Engineering Effectiveness Study.
https://insights.sei.cmu.edu/sei_blog/2013/05/the-value-of-systems-engineering.html

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10. STANDARDS AND GUIDES

10.1 ISO 15704:2000 Industrial Automation Systems – Requirements for Enterprise-Reference Architectures and Methodologies

This International Standard defines the requirements for enterprise-reference architectures and methodologies, as well as the requirements that such architectures and methodologies must satisfy to be considered a complete enterprise-reference architecture and methodologies. The scope of these enterprise-reference architectures and methodologies covers those constituents deemed necessary to carry out all types of enterprise creation projects as well as any incremental change projects required by the enterprise throughout the whole life of the enterprise, including:

a) enterprise creation,

b) major enterprise restructuring efforts, and

c) incremental changes affecting only parts of the enterprise-life cycle.

More Information

10.2 Guide for the Application of Systems Engineering in Large Infrastructure Projects

Developed by the INCOSE Infrastructure Working Group

This Guide covers the application of Systems Engineering (SE) practices to Large Infrastructure Projects (LIPs). Such projects include the construction of infrastructure (e.g., highways, railways, electricity generation and distribution, water collection, storage, and distribution, and waste water collection and transfer), and the construction of major industrial plants, such as oil & gas platforms, refineries, mines,

smelters, water and wastewater treatment and steel works. These projects may include a design stage, if this has not been completed prior to going to construction, but the emphasis of this Guide is on how to use SE practices to better perform the construction stage of a project. The focus is on the realization of the designed (or engineered) solution during construction and the transition into service of the resulting built product, and as a consequence, the application of SE practices is concentrated more on the construction process than on the design of the product or on the continuing operation and maintenance stage.

Download the manual here.

11. SOME DEFINITIONS TO CLOSE ON

11.1 Product

1. (noun) “Something produced.”

   Source: Merriam-Webster Dictionary

2. (noun) “A thing or person that is the result of an action or process.”

   Source: Oxford Dictionary

3. **Recommended definition of product in the context of engineering:**

   (noun) “A thing that is purposefully produced”, Robert John Halligan, PPI

Origin of the word: Latin, *productum*: "something produced"

11.2 Service

1. (noun) Useful labor that does not produce a tangible commodity.

   Source: Merriam-Webster Dictionary

2. (noun) The action of helping or doing work for someone.

   Source: Oxford Dictionary

3. **Recommended definition of product in the context of engineering:**

   (noun) “A purposeful activity that changes some aspect of the state of the world external to the service provider to the benefit of another stakeholder”, Robert John Halligan, PPI

Origin of the word: Old French *servise*, or Latin *servitium* ‘slavery’, from *servus* ‘slave’.

12. CONFERENCES AND MEETINGS

For more information on systems engineering related conferences and meetings, please go to our website.

The featured event for this edition is:

CSER – Conference on Systems Engineering Research

3 – 4 April 2019, Washington D.C.

The 17th Annual Conference on Systems Engineering Research will be held at The National Press Club in Washington, D.C. from 3-4 April 2019. CSER focuses on theoretical work in systems engineering and its translation to practical application. The conference will include research papers, plenary speakers, panels, and interactive sessions where attendees can engage in discussions and idea generation. Since its inception, CSER has become the primary conference for disseminating systems engineering research and germinating new research ideas.

Registration fees after March 1st:

- $675 for Standard Registration
- $600 for INCOSE Members/SERC Member University Faculty/Stevens Institute & Virginia Tech Alumni
- $150 for Students/Active Military/Seniors.

Register here

13. PPI AND CTI NEWS

13.1 Robert Halligan to Present at SESA National Speaker Program

We are proud to announce that PPI Managing Director Robert Halligan will be presenting at the Systems Engineering Society of Australia (SESA) National Speaker Program on 28 May 2019. In his presentation, Robert will provide an overview of the existing systems engineering competency frameworks, including the new and very significant INCOSE Competency Framework. After questions, he will then present a recommended framework, drawing on other frameworks where applicable, explain the reasons for his recommendations, and invite further questions.

More about SESA

The Systems Engineering Society of Australia (SESA) is a Technical Society of Engineers Australia and the Australian affiliated chapter of the International Council on Systems Engineering (INCOSE). Technical Societies provides a forum for mutual technical development, networking, expanding and

sharing knowledge with like-minded professionals. Members of Technical Societies provide expert opinion on a broad range of issues and have a capacity to exert considerable influence about professional practice in a changing world market.

13.2 PPI Welcomes a New Marketing Assistant

PPI welcomes new team member Rebeca Carneiro who will assist within the PPI team in the role of Marketing Assistant. Rebeca originally hails from Brazil, is fluent in Portuguese, has a Marketing Degree and experience in working with Fundação Abrinq (Save The Children) in Brazil. We feel that Rebeca's diverse background will contribute greatly to the marketing and communication functions at PPI.

13.3 PPI Adds New Delhi to Its Worldwide Footprint

PPI is honoured to be able to add New Delhi to our world map. Being able to contribute to India's growth and development has been a satisfying and exciting experience and we are looking forward to providing more training and consulting in the region. PPI's recent Systems Engineering 5-Day course was a great success and received overwhelming positive feedback. The map shown in Figure 1 below highlights all locations where PPI courses have been delivered.

Figure 1: World Map illustrating PPI course locations to date

14. PPI AND CTI EVENTS

On-site systems engineering training is being delivered worldwide throughout the year. Below is an overview of public courses. For a full public training course schedule, please visit https://www.ppi-int.com/course-schedule/

Systems Engineering 5-Day Courses

Upcoming locations include:

- Stellenbosch, South Africa (P006-771)

  01 Apr - 05 Apr 2019

Requirements Analysis and Specification Writing 5-Day Courses

Upcoming locations include:

- Sydney, New South Wales, Australia (P007-478)

  20 May – 24 May 2019

Systems Engineering Management 5-Day Courses

Upcoming locations include:

- Melbourne, Victoria, Australia (P1135-169)

  29 Apr – 3 May 2019

Systems Engineering Overview 3-Day Courses

Upcoming locations include:

- Las Vegas, Nevada, United States of America (P884-14)

  04 Sep – 06 Sep 2019

Requirements, OCD and CONOPS in Military Capability Development 5-Day Courses

Upcoming locations include:

- Washington, D.C., United States of America (P958-59)

  13 May - 17 May 2019

Engineering Successful Infrastructure Systems (ESIS5D)

Upcoming locations include:

- Amsterdam, the Netherlands (P2005-2)

  17 Jun – 21 Jun 2019

Architectural Design 5-Day Course

Upcoming locations include:

- Pretoria, South Africa (P1768-19)

  15 July – 19 July 2019

CSEP Preparation 5-Day Courses (Presented by Certification Training International, a PPI company)

Upcoming locations include:

- Laurel, MD, United States of America (C002-92)

  06 May – 10 May 2019

Medical Device Risk Management 3-Day Course

Upcoming locations include:

- Sydney, New South Wales, Australia (P1848-6)

  27 May – 29 May 2019

Other training courses available **on-site** only include:

- Project Risk and Opportunity Management 3-Day
- Managing Technical Projects 2-Day
- Integrated Product Teams 2-Day
- Software Engineering 5-Day

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15. UPCOMING PPI PARTICIPATION IN PROFESSIONAL CONFERENCES

PPI will be participating in the following upcoming events. We support the events that we are sponsoring and look forward to meeting old friends and making new friends at the events at which we will be exhibiting.

The 10th Israeli International Conference on Systems Engineering (Participating)

(Participating)

Date: 26 – 28 March, 2019

Location: Herzliya, Israel

Systems Engineering Test and Evaluation (SETE) Conference (SETE19)

(Exhibiting)

Date: 29 April – 1 May, 2019

Location: Canberra, Australia

The INCOSE International Symposium 2019

(Exhibiting)

Date: 20 – 25 July, 2019

Location: Orlando, Florida, USA

EnergyTech Conference 2019

(Exhibiting)

Date: 21 – 25 October, 2019

Location: Cleveland, Ohio, USA

The INCOSE International Symposium 2020

(Exhibiting)

Date: 18 – 23 July, 2020

Location: Cape Town, South Africa

Kind regards from the PPI SyEN team:

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Ralph Young, Editor, email: ryoung@ppi-int.com

René King, Managing Editor, email: rking@ppi-int.com

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