SYSTEMS ENGINEERING NEWSLETTER

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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 applicable stakeholders.

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1. QUOTATIONS TO OPEN ON

"Of all the decisions to be made in managing a system development, choice of the style of development, design object by design object, between Waterfall, Incremental, Evolutionary, and Spiral is usually the most important."

Robert John Halligan

"Recall Peter Drucker's observation of the difference between doing things right and doing the right thing. This distinction is fundamental. The righter we do the wrong thing, the wronger we become. If we made an error doing the wrong thing and correct it, we become wronger. … It is much better to do the right thing wrong than the wrong thing right."

Russell L. Ackoff, and John Pourdehnad

[On misdirected systems. Systems Research and Behavioral Science, 18(3), 199-205.]

"Handle them carefully, for words have more power than atom bombs."

Pearl Strachan Hurd, Author

2. FEATURE ARTICLE

2.1 Vision and Leadership: Two Inseparable Pillars for the Future of Systems Engineering

by

Dr. Bernardo A. Delicado

Head of the Steering Committee

INCOSE Institute for Technical Leadership

Email: bernardo.delicado@incose.org

The global context for systems engineering is ever-more complex with differing challenges in traditional and newer domains. As a result, the Systems Engineering Vision 2025, published in 2014 by INCOSE, was not intended only to think about the future with imagination, but rather a panoramic view of the evolution of the systems engineering to address the imperatives of transforming systems engineering practices such as collaborative engineering, complex system understanding, systems of systems engineering, system architecting, composable design, design for resilience, design for security, decision support, virtual engineering, and model-based systems engineering.

It was clear from the outset that leadership would be our ability to translate the Vision 2025 into reality. For this reason, INCOSE established the Institute for Technical Leadership in 2015 and commenced an annual intake for a two-year technical leadership training program to accelerate the development of the required future leaders; in particular, those who will lead this transformation of systems engineering in our organizations. On the 2025 horizon, technical leadership has been recognized by INCOSE as one of the key systems engineering competencies and one of the key drivers for enabling the evolution and inevitable changes in the field of systems engineering.

It has been nearly three years since INCOSE launched the Institute initiative at IS 2015 in Seattle. Currently, the Institute is taking appropriate steps through communication events around the world to designate the need for an urgent transformation and a new kind of capable technical leaders for the common good of systems engineering to meet the challenges of our global VUCA environment. My presentation on “Recognizing the Future of Systems Engineering in a Changing World – Systems Engineering Leadership for the Common Good” recently made in Europe in one of the first international events of the Institute that can help you get a better understanding of the challenges ahead. It is available here.

3. ARTICLE

3.1 Decision Tables as a Useful Technique for Modeling Complex Systems

by

Robert Thomas

Email: bobthomas411@protonmail.com

Abstract

Analysts have many techniques at their disposal for modeling logic. Decision Tables, a technique for modeling logic, is largely forgotten. The technique removes verbiage and structures the logic into paths, delivering clarity that other methods do not provide. As system complexity increases, it becomes more difficult to describe logic in ways that are unambiguous, or understood by non-technical stakeholders, and that is where the Decision Tables technique excels. It is unfortunate that Decision Tables are seldom taught today. Increased use of decision tables would provide clarity and help simplify systems development.

Introduction

Many years ago, I was the Project Manager and Lead Business Systems Analyst on a project to develop a software system jointly with a Canadian company. We were a Waterfall shop in those days, and senior management was exploring ways to reduce the documentation. As an experiment, the team was instructed to document all of the requirements in use cases, rather than produce the structured requirement documents and specifications defined in our lifecycle.

The software system was complex. It had modules dealing with accounting, work scheduling and tracking, order processing, reporting, communications with business partners, and more.

As the project progressed, the analysts created hundreds of use cases, and all of them were reviewed and signed off by the team. Reviews became tedious because we were using a technique for a task for which it was not intended. The team became confused attempting to understand the interaction of requirements across multiple use cases and exhausted from the many reviews and meetings we held in an effort to eliminate the confusion.

As the team struggled to deliver, the relations between the two companies became strained. To the relief of all participants, the project was terminated early. The company I worked for decided not to pursue the market this software served, and I believe this project's failure was a factor in the decision.

A technique we could have used to clarify requirements and their interactions is decision tables.

Decision tables are a precise, yet compact way to model complex rule sets and their corresponding actions. Decision tables, like flowcharts and if-then-else and switch-case statements, associate conditions with actions to perform, but in many cases do so in a more elegant way.[1]

Working with analysts over several years, I learned that many of them struggle with techniques to model logic as system complexity increases. A common difficulty was explaining system logic to non-technical stakeholders who were responsible for approving the work. Everywhere I've worked, the first time I produce a Decision Table to describe a logical solution, the analysts and developers ask me to explain the technique. This article is based on a workshop I developed to teach the technique.

Benefits of Decision Tables

Decision tables have a number of benefits:

- They communicate logic concisely and unambiguously by significantly reducing verbiage.
- It is well-documented that requirements errors are the greatest source of software defects and quality issues (Dinkar, 2014; Firesmith, 2007; Easterbrook, 2001). The sooner defects are identified, the easier and cheaper they are to fix. It's much easier to spot a defect or missing requirement in a table than in paragraphs of text.
- Decision tables simplify the quality assurance process. In fact, QA loves decision tables! When creating their tests, they will create the entry and exit criteria, and then paste the decision table in the middle.
- It is usually a bad idea to share state transition diagrams with the average non-technical stakeholder. In my experience, this type of stakeholder can follow simple flowcharts, but once you add notations, individuals become confused. Decision tables allow the analyst to represent state transitions in a form that is much easier for a non-technical stakeholder to understand.
- Decision tables help the analyst and developer to think through each step of the system's logic. Logic can be broken into chunks that are more easily understood and managed.
- Anyone who's worked with poorly-defined requirements will understand the importance of clear and unambiguous requirements. In this article we will decompose some horrible requirements.
- Have you ever found yourself lost after reading several use cases, user stories, or scenarios? In the story provided above, our team became mired in the metadata and lost sight of how requirements interacted. It is easier to read and comprehend a table than paragraphs of text.

[1] See https://www.visual-paradigm.com/product/articles/decision-table-explained/ for an overview of the technique.

- Software systems are frequently revised or updated. It's much easier to modify a table than paragraphs of text.

Anatomy of a Decision Table

Decision tables are simple to construct. Always identify tables with a number and a description of the logic represented in the table. In the sample decision table provided below, the first column is used to capture revisions as the system develops or is modified. Anyone involved with systems development knows that changes from new development, market research, operating system updates, and countless other reasons create the need to update systems. Inserting the version number or a symbol representing the version in the first column facilitates tracking changes.

In the second column, we create headings for "User Action", "Condition", and "Result". We create concise statements describing the user action and the system's condition. In the Results section we describe the outcome of the combination of the user action and condition.

The last part of the table is the decision paths or logic paths. These are columns numbered 1, 2, 3, etc.

"User Action" and "Condition" are "If" statements, represented by "Y" for "Yes" or "N" for "No". "Result" are "Then" statements represented, by an "X".

Table 1: Example of a Decision Table

Rev.	User Action	1	2	3
	Condition			
	Result			

A Simple Decision Table

Decision tables are read across each row, down one logic path at a time. In the following example, we have five logic paths. Let's follow the logic paths to understand my Olympic venue strategy.

Table 2: Olympic Venue Strategy

Rev.	Condition	1	2	3	4	5

	Bobsleds are my favorite Olympic event	N	Y	Y	Y	Y
	The crowd is large		N	Y	N	Y
	It is very cold		N	N	Y	Y
	Result					
	Find events with small crowds	X		X		X
	Watch Bobsleds all day long		X		X	
	Wear another layer of clothes				X	X

1. Bobsleds are my favorite Olympic event: No. The result is: Find events with small crowds.
2. Bobsleds are my favorite Olympic event: Yes. The crowd is large: No. It is very cold: No. The result is: Watch Bobsleds all day long.
3. Bobsleds are my favorite Olympic event: Yes. The crowd is large: Yes. It is very cold: No. The result is: Find events with small crowds.
4. Bobsleds are my favorite Olympic event: Yes. The crowd is large: No. It is very cold: Yes. The result is: Watch Bobsleds all day long, and wear another layer of clothes.
5. Bobsleds are my favorite Olympic event: Yes. The crowd is large: Yes. It is very cold: Yes. The result is: Find events with small crowds, and wear another layer of clothes.

Conventions for Creating Decision Tables

There are a few conventions for creating decision tables. To obtain a “Result” you must have at least one “User Action” or “Condition”. In the preceding table, we simply had conditions and results. In more complicated tables, condition, user action, and result may repeat in the same table. If your table has more than two results sections, it may be too complicated. In these situations you should split the table. This technique allows you to take a complex system and break it into a series of related tables.

Revision marks should be used for changes that occur after the table was considered final for a release. It’s often helpful to know when logic changed, and the revision marks column provides a place to add a symbol or release number.

Always name and number tables. Naming them eliminates any potential confusion about the logic described in the table and it makes it easier for the team to discuss them. Instead of saying “Let’s discuss the second table on page 5…” they will say: “Let’s discuss Table #4: Installation Logic…”

Steps for Building Decision Tables

There are five steps for constructing tables:

1. Create the table and add lots of logic paths. It's easier to delete the unused paths later, than add them as you go.

2. Define the User Actions and Conditions and identify the possible combinations using Yes's and No's. For every "No" there should be a "Yes".

3. Step through the logic as if you were a user performing the action. If there are no user actions, step through the logic as if you were the system performing the actions. Place an "X" in the result. Every logic path must have at least one result.

4. Remove the logical flaws. There are four typical logical flaws:

   - Impossible combinations – an example of an impossible combination is selecting "typical" and "custom" software installation routines simultaneously.

   - Duplicate rows or columns – You may find that two logic paths are so similar that they can be combined, or you have created duplicate paths.

   - Contradictions – These are typically columns with conflicting logic paths. This may simply be an error, or an indication of a need for further analysis.

   - Indifferent conditions – An indifferent condition is when a "Y" or "N" **in the same cell** yields the same result. If I do not remove the column or row, I typically place a "–" in the cell to indicate that I've considered the condition.

5. Review and reorder the table for clarity. Building decision tables is as much an art as it is a science. Tables that display patterns are easier to comprehend, because our eyes look for patterns. Move entire rows in Microsoft Word with the Alt+Shift and up or down arrows.

Understanding Poorly-Written Requirements – Example 1

The IEEE provides several tests for quality requirements including: unambiguous, complete, verifiable, testable, and traceable. The following are actual requirements delivered to my development team. They fail many of the IEEE tests, but the development clock was ticking, so we had to proceed with what were given.

The Computer Security Monitor scans for and monitors the status of Antivirus and Firewall software installed on the computer. It utilizes a library of file and process listings to keep the user up to date and informed of the status of their computer's security.

We start by decomposing the first sentence, where we find the user action and conditions.

Table 3: Computer Security Monitor

Rev.	User Action	1	2	3	4
	User launches Computer Security Monitor				
	Condition				
	Antivirus enabled				
	Firewall enabled				

We find the results in the second sentence. We need further elaboration on the "library of file and process listings" and "up to date". "Up to date" and "informed" could mean the same thing. We put these aside until the author provides clarity. "…informed of the status…" indicates that we display messages. The messages are either a warning that the computer is at risk, or that it is protected.

Table 3: Computer Security Monitor

Rev.	User Action	1	2	3	4
	User launches Computer Security Monitor				
	Condition				
	Antivirus enabled				
	Firewall enabled				
	Result				
	Display Antivirus warning message				
	Display Antivirus protection message				
	Display Firewall warning message				
	Display Firewall protection message				

In this situation the user must launch the Computer Security Monitor. Therefore all user actions are a "Yes", or nothing else occurs.

Table 3: Computer Security Monitor

Rev.	User Action	1	2	3	4
	User launches Computer Security Monitor	Y	Y	Y	Y
	Condition				
	Antivirus enabled	N	Y	N	Y
	Firewall enabled	N	N	Y	Y
	Result				
	Display Antivirus warning message	X		X	
	Display Antivirus protection message		X		X
	Display Firewall warning message	X	X		
	Display Firewall protection message			X	X

Let us review the logic:

1. User launches the Computer Security Monitor: Yes. Antivirus is enabled: No. Firewall is enabled: No. Result: Display the Antivirus warning message. Display the Firewall warning message.
2. User launches the Computer Security Monitor: Yes. Antivirus is enabled: Yes. Firewall is enabled: No. Result: Display the Antivirus protection message. Display the Firewall warning message.
3. User launches the Computer Security Monitor: Yes. Antivirus is enabled: No. Firewall is enabled: Yes. Result: Display the Antivirus warning message. Display the Firewall protection message.
4. User launches the Computer Security Monitor: Yes. Antivirus is enabled: Yes. Firewall is enabled: Yes. Result: Display the Antivirus protection message. Display the Firewall protection message.

Understanding Poorly-written Requirements – Example 2

Here is another set of requirements delivered to my team to implement. They also fail several measures of quality. They are vague, compound, incomplete, and difficult to test. But we'll turn them into requirements that are unambiguous, testable, and traceable. If you are building mission-critical systems, you should practice requirements traceability[2] to ensure system performance. You can trace through requirements in tables significantly faster and with greater accuracy than through statements.

- Scanning progress should be displayed and should progress evenly.
- When scanning, the tool should query definition files for any start-up items it finds.
    1. If the start-up item is not listed as Dangerous or Unnecessary, then it should not be displayed in the Results screen.
    2. If the start-up item is Dangerous or Unnecessary, but is not currently enabled, it should be added to the Disabled group.
    3. If the start-up item is Dangerous or Unnecessary and was not previously disabled AND was not previously kept on then it should be displayed in the Results screen in its designated group.
    4. If the start-up item is Dangerous or Unnecessary and was previously kept on, then it should be displayed in its designated group and marked enabled.
- There should be a Cancel button.
- Pushing Cancel stops the scan and takes the user to the Results screen.

It's not clear what "progress evenly" means. We'll ask the requirement's author for clarification.

I've split the requirements into two tables. One table describes the scanning process. The second table describes the scanning logic. This is the beauty of decision tables – logic can be broken into multiple related tables that are easier to comprehend than a textual description.

Here are the requirements related to the scanning process:

- Scanning progress should be displayed and should progress evenly.
- When scanning, the tool should query definition files for any start-up items it finds.
- There should be a Cancel button.
- Pushing Cancel stops the scan and takes the user to the Results screen.

Table 4: Scanning Process

Rev.	Condition	1	2
	Scan in progress	Y	Y

[2] See *Project Requirements: A Guide to Best Practices*, Appendix A, Traceability, for a thorough explanation of this technique.

	User Action		
	User cancels scan	N	Y
	Result		
	Display progress bar	X	
	Query definition files for startup items	X	
	Process scanning logic (Table #5)	X	
	Abort scan		X
	Display Results dialog at completion of scan	X	X

Here are the requirements related to scanning logic:

1. If the start-up item is not listed as Dangerous or Unnecessary, then it should not be displayed in the Results screen.
2. If the start-up item is Dangerous or Unnecessary, but is not currently enabled, it should be added to the Disabled group.
3. If the start-up item is Dangerous or Unnecessary and was not previously disabled AND was not previously kept on then it should be displayed in the Results screen in its designated group.
4. If the start-up item is Dangerous or Unnecessary and was previously kept on, then it should be displayed in its designated group and marked enabled.

"Kept on" means that during a prior scan, the Computer Security Monitor asked the user if they wanted to disable the item, and the user wanted it "kept on".

Table 5: Scanning Logic

Rev.	Condition	1	2	3	4
	Item is Dangerous or Unnecessary	N	Y	Y	Y
	Item is disabled		Y	N	
	Item was kept on			N	Y
	Result				
	Do not display in the Results dialog	X			
	Display in the Results dialog		X	X	X

	Add to the “Disabled” group		X		
	Display in the designated group			X	X
	Mark item as “Enabled”				X

Did you notice that the second and fourth requirement statements fail to mention the Results dialog? The author duplicated the error in the second requirement when writing the fourth. The author would have caught these errors if they constructed the logic in a table instead of text,

Event-Entity Matrix - Another Type of Decision Table

The Event-Entity Matrix or CRUD Matrix is another type of decision table. The name “CRUD” comes from the types of actions the table describes. These actions are “Create”, “Retrieve” “Update” and “Delete”.

Table 6: Data and Process Relationship

	Process 1	**Process 2**	**Process 3**	**Process 4**
Data Element 1	C,R	D	R, U	
Data Element 2	C,R	D	C, R, U	
Data Element 3	C	D	R, U	
Data Element 4				

In this table we learn the following:

- Process 1 creates data for all elements
- Process 2 deletes the data
- Process 3 retrieves and updates data for all elements
- Process 4 is not understood, or is not involved with this data
- Data Element 4 is not understood or not involved with these processes

I created a variation of this type of table to describe the relationship of user roles to employee records.

Table 7: Access Rights to Employee Records

	Create	**Retrieve**	**Update**	**Delete**
Employee		X	X	

Employee's Manager		X	X	
Indirect Managers[1]				
Human Resources Manager	X	X	X	
Human Resources Director	X	X	X	X
H.R. Compensation Specialist	X	X	X	

[1] An Indirect Manager is neither the employee's manager, nor an HR Manager.

This table tells us that:

- The employee and their manager can retrieve and update the employee's record.
- Indirect Managers have no access to the employee's record.
- The HR Manager can create, retrieve and update an employee record.
- The HR Director is the only role that can delete an employee record.
- The HR Compensation Specialist can create, retrieve and update an employee record.

The table identifies an opportunity for further analysis: Should we combine the HR Manager and Compensation Specialist roles? This would reduce complexity, but it could be the wrong decision if other business rules indicate that the roles should be separate.

Vehicle Refinishing Example

The following is an example of automated logic for the refinishing of automobiles and light trucks that were damaged and repaired. This table illustrates the situation where multiple conditions generate multiple results. Imagine describing this logic in paragraphs of text.

Panel size, location, and the selection of multiple panels affect the refinish allowances given.

As the user selects panels to be replaced or repaired, the software system automatically calculates the refinish labor time and material costs and adds them to the estimate. This is only a portion of the logic – if the user deletes a panel from their estimate, the system recalculates refinish allowances.

The Euro symbol in the Revision column identifies changes and ties them to a specific release.

Table 8: Vehicle Refinishing Logic

Rev.	User Action	1	2	3	4	5	6	7
	User selects an outer panel from the database	Y	Y	Y	Y	Y	Y	Y

	Condition							
	Panel has refinish time < 0.4	Y	N	N	N	N	N	N
	Panel is a Major Panel		Y	Y	Y			
€	Panel is a Minor Panel					Y	Y	Y
	Panel is adjacent to another Major Panel in the estimate		N	Y		N	Y	
	Panel is non-adjacent to another Major Panel in the estimate		N		Y	N		Y
	Result							
	Add an additional line to the estimate			X	X		X	
	Line Description = *Deduct for Adjacent Major Panel Overlap*			X				
	Line Description = *Deduct for Non-Adjacent Major Panel Overlap*				X			
	Line Description = *Deduct for Adjacent Minor Panel Overlap*						X	
	Refinish Labor Deduction = Adjacent Major Panel Overlap			X				
	Refinish Labor Deduction = Non-Adjacent Major Panel Overlap				X			
€	Refinish Labor Deduction = Minor Adjacent Panel Overlap						X	
	Do not apply refinish overlap	X	X			X		X

Summary

As system complexity increases, describing logic unambiguously becomes more difficult. Decision tables provide a technique for breaking complex logic into manageable chunks. Decision tables is an old technique that is largely forgotten, but the technique deserves a place in every analyst's toolbox. Increased use of decision tables would provide clarity that will help simplify complexity.

List of Acronyms Used in this Paper

Acronym	**Explanation**
HR	Human Resources

IEEE	Institute of Electrical and Electronics Engineers
QA	Quality Assurance

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About the Author

Robert Thomas has 25 years' experience developing software and managing projects with onshore and offshore teams. His experience includes: insurance, automotive, philanthropy, healthcare, PC utilities, and entertainment. He has extensive experience in systems analysis and he has presented at the Software Systems Best Practices conference, at chapter meetings of the International Institute of Business Analysis, and the Project Management Institute. Robert is a published author of articles on project and product management. He has a certificate in Business Analysis from California Polytechnic University, Pomona; is a Project Management Professional; a Certified Scrum Master; and a Certified Scrum Product Owner. He lives in Nashville, Tennessee.

3. ARTICLE

3.2 Integrating Program Management and Systems Engineering

by

Ralph R. Young

Editor, PPI SyEN

ryoung@ppi-int.com

Note: Be sure to review the paper included in the SE Publications section, below, "Collaboration across Linked Disciplines: Skills and Roles for Integrating Systems Engineering and Program Management".

This month we provide a summary of Chapter 12, The Impact of Effective Integration on Program Performance, in *Integrating Program Management and Systems Engineering* (IPMSE), a collaboration of the International Council on Systems Engineering (INCOSE), the Project Management Institute (PMI), and the Consortium for Engineering Program Excellence (CEPE) at the Massachusetts (USA) Institute of Technology (MIT). This is our thirteenth article in this series. Our objective in providing this series is to encourage subscribers to leverage the research base of this book that has provided new knowledge and valuable insights that will serve to strengthen performance of complex programs. "The Book" is highly recommended as professional development for all systems engineers and is available to members of INCOSE at a discount.

The five-year research program that was conducted in support of The Book found consistent evidence of the positive impact and contribution of greater integration to program performance. **Recall from Chapter 6 that integration is defined as alignment of program management and systems engineering practices, tools, and techniques, experience, and knowledge in a collaborative and systematic approach to increase team effectiveness toward achieving a common goal/objective in complex program development environments.**

One of the first steps in managing and improving integration is to define a set of variables and a systematic approach to assimilate them within a program. The following elements are a good starting point:

Integration Factors	Integration Variables	Key Indicators of Effective Integration
Rapid and effective decision making	Involvement of all members of the core program team in the decision making process when making decisions	All core program team members actively participate Program Managers (PMs) take into account technical goals Chief Systems Engineers (CSE) take into account management goals when making decisions
Effective collaborative work	Team members collaboratively tackle problems and challenges with enthusiasm and commitment Team members have a shared and common vision (set of priorities, benefits, and results of the program) of what shall be created Team members show commitment in executing and achieving overall high program performance, instead of just being focused on their own individual performance and results	The PM is positively engaged and committed to resolve CSE issues The CSE is positively engaged and committed to resolving PM issues. Team members collaboratively tackle problems and challenges with enthusiasm and commitment Team members have a shared and common vision of what shall be created in the program Team members show commitment in executing and achieving overall high program performance, instead of only focusing on individual goals
Effective information Sharing	The efficiency of communications between the CSE and the team members The efficiency of communications between the program manager and team members All team members have access to all program-related information that they need to perform their tasks successfully	Amount of time required of the PM to acquire information to perform his job Amount of time required of the CSE to acquire information to perform his job Communication effectiveness between the PM and the CSE Communication effectiveness between the PM and the team Communication effectiveness between the CSE and the team Communication effectiveness between team members PM has full and easy access to program information CSE has full and easy access to program information All team members have full and easy access to program information

Contextual variables that are specific to each type of program and industry sector will help to tailor the measurement approach to its specific application. Under a variety of conditions, integration may manifest itself differently. This will shape the specific management practices and techniques to be monitored for integration behaviors. The following points may help organizations to be purposeful in improving integration that leads to better program performance:

- **Understand integration.** The first step to measuring integration between program management and systems engineering properly is to develop a clear understanding of the meaning of integration as described in Chapter 6, along with the three key elements shown in Figure 12-3 – rapid and effective decision-making; effective collaborative work, and effective information sharing.

- **Develop an approach to assess and improve integration**. Measuring integration between program management and systems engineering can be a complicated task due to its various elements. Defining formal processes, tools, techniques, and metrics is important if this is to be part of a deliberate change program to improve integration. The integration improvement initiative should be linked with the overall program benefits achievement approach to demonstrate both quantitative and qualitative evidence of the value of greater integration for programs and business results.

- **Integration may have different levels of intensity and may impact programs in a wide range of ways.** Consider other dimensions and variables as drivers of integration between program management and systems engineering in a particular context, including program type, industry sector, and organizational environment and culture, as part of a tailoring the approach to assessing and improving integration.

- **Treat integration as a competence.** Integration between program management and systems engineering involves attitudes and skills supported by a carefully designed set of tools, management practices, and organizational factors. This broad perspective should be considered to develop successively higher levels of integration of these two disciplines in programs.

- **Integration requires strong leadership from both a management and a technical perspective.** Particularly within complex programs, program managers benefit significantly from having some technical background or experience. Chief systems engineers and program managers should recognize and appreciate their respective individual responsibilities and pressures, and consider the implications that their management and technical decisions will have on the overall program objectives and results.

Consideration of the following areas should help you leverage this knowledge on your project and in your organization:

1. What steps can you take to improve the awareness of the importance of integration between program management and systems engineering to program performance in your organization?

2. How has integration impacted performance in your organization, based on a program on which you have worked in the past? In which specific areas of program performance was it relevant for the PM or the CSE?

3. Which of the integration factors presented above were demonstrated in a program on which you worked in the past? Which of these variables had the greatest impact on program performance?

4. Considering the integration variables noted above, can you identify additional variables that might be relevant to measure these elements in your organization or program context?

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4. SYSTEMS ENGINEERING NEWS

4.1 INCOSE Renews Agreement with Systems Engineering Society of Australia

As the demand for complex high technology systems increases, the International Council on Systems Engineering (INCOSE) has signed an agreement with Systems Engineering Society of Australia (SESA) and Engineers Australia (EA) to continue SESA's relationship as the INCOSE Chapter within Australia for the next three years. SESA is also a technical society of Engineers Australia, providing expert opinion on systems engineering and helping influence professional practice in a changing world market.

Learn more about the agreement here

4.2 INCOSE Selects New Editor-in-Chief for Systems Engineering Body of Knowledge Wiki

by

Christine Kowalski | Jun 07, 2018

Robert J. Cloutier, Ph.D., to Oversee Award-winning Online Resource

The International Council on Systems Engineering (INCOSE), the Institute of Electrical and Electronics Engineers (IEEE-CS), and the Systems Engineering Research Center (SERC) have selected Robert J. Cloutier, Ph.D., as the new editor-in-chief for the "Systems Engineering Body of Knowledge" (SEBoK), a moderated wiki and online resource of industry information, practices and case studies. Cloutier is a professor and systems engineering program chair at the University of South Alabama and serves as director of graduate studies and programs for the University's College of Engineering.

Effective July 1, Cloutier will become the third editor-in-chief of the SEBoK, taking over from Rick Adcock, after his more than four years at the helm. Cloutier will be responsible for the technical content and strategic direction of the SEBoK, oversee the wiki publication process, and enhance the SEBoK's visibility and impact. He will also appoint and manage an editorial board and coordinate and process submissions and reviews.

"The Systems Engineering Body of Knowledge is arguably the most widely read resource on systems engineering in the world with an average of 50,000 visits monthly to hundreds of articles in its wiki," said Cloutier. "I am excited about the opportunity to manage this resource and act as a steward for the interests of the world-wide systems engineering community."

Before moving to South Alabama, Professor Cloutier was the director of systems engineering programs at Stevens Institute of Technology. He brings over 20 years of systems engineering industry experience to this position. His research interests include system architecting, concept of operations, model-based systems engineering and complex patterns for systems engineering. Cloutier has 21 published peer reviewed journal articles. In 2015, he authored a monograph titled "Systems Engineering Simplified" published by CRC Press, Taylor & Francis Group that is targeted toward those not familiar with systems engineering. He has also supervised nine systems engineering doctoral students. Dr. Cloutier is a member of INCOSE and senior member of both IEEE and the Institute of Industrial and Systems Engineers. Professor Cloutier received his Ph.D. from Stevens Institute of Technology School of Systems and Enterprises.

The SEBoK includes more than 200 articles on topics such as emergence, complexity, systems of systems, verification, enterprise systems engineering, and the relationship between systems engineering and software engineering, as well as short case studies and vignettes on the application of systems engineering knowledge. An extensive glossary of terms and primary references is also included.

The SEBoK is jointly managed by INCOSE, the Institute of Electrical and Electronics Engineers – Computer Society and the Systems Engineering Research Center. The wiki won "Product of the Year" at the 2013 INCOSE International Workshop held in Jacksonville, Florida as the INCOSE product that provided the most significant value to its members and the global community.

The original article can be read here

For more information, visit www.sebokwiki.org

4.3 New Purdue Center to Develop Scientific and Engineering Principles of Resilient Systems

Article available here.

What causes some systems — computing, cyber physical, or large-scale engineered systems — to be resilient to disruptions of various kinds? And what causes some systems to bounce back from a failure quickly?

A new Purdue University College of Engineering center has been unveiled to seek the foundational design principles that underlie resilient systems. The Center for Resilient Infrastructures, Systems and Processes (CRISP) was officially started in October 2017 and will run its seed grant competition for research proposals this summer.

The center involves faculty members in leadership roles from multiple engineering departments, including director Saurabh Bagchi, a professor of electrical and computer engineering; associate directors Jitesh Panchal, a professor of mechanical engineering, and Milind Kulkarni, a professor of electrical and computer engineering. Three thrust leads positions, including Gesualdo Scutari, a professor of industrial engineering, on optimization; Felix Lin, a professor of electrical and computer engineering on cyber-physical systems; and Srinivas Peeta, a professor of civil engineering on large-scale civil infrastructures.

Society is crucially dependent on several interdependent critical infrastructure systems and processes for operating these systems. These are subjected to various kinds of hazards and faults, both natural and malicious, often leading to user-visible failures. The CRISP center will provide scientific methods to analyze the failure modes of the infrastructures and provide engineering tools to systematically build in resilience. Initial focus areas will be resilient and adaptive cyberinfrastructures, resilient cyber-physical systems, and scientific foundations of resilient socio-technical systems. The researchers will develop techniques that apply broadly across multiple domains to complement existing domain-specific techniques.

"We know several design principles that enhance resilience, such as, composability and decoupling," Bagchi said. "We need to develop the scientific discipline of resilience as it applies to cyber, cyber physical, and socio-technical systems. Our center by bringing together the leadership team and approximately 20 affiliate faculty members is uniquely positioned to address the end-to-end resilience challenges. Such challenges are becoming more pressing as our society depends more heavily on these large-scale engineered systems."

Kulkarni, who will lead that thematic area of resilient cyber systems, stressed on the need to build adaptable software systems, such that they can adapt to new hardware platforms, including mobile platforms and large volumes of data.

"To complement the scientific principles, we have to develop practical techniques to make an existing system resilient to certain vulnerabilities, without significantly compromising the performance and the functionality of the system," Kulkarni said.

The result of CRISP's activities would be a building code for designing resilient systems, a task-oriented checklist for engineering resilient systems, and a wind tunnel for verifying that the system meets its resiliency and functional goals.

"How do we enable engineering enterprises to use a significant but underutilized mode of innovation by communities of employees within organizations, and of enthusiasts outside the organizations," Panchal said. "Through our efforts, we are establishing foundational techniques for modeling and analyzing the evolutionary dynamics of complex networked systems, such as digital distributed manufacturing and road transportation."

Two notable upcoming activities of the center are a seed grant competition and a workshop on resilience. The seed grant competition will accept research proposals from multi-disciplinary teams due on July 20. Each grant will fund one graduate research assistant for the 2018-19 academic year.

The second activity is a workshop to be held this fall on the Purdue campus with a set of distinguished as well as promising young researchers from academia and industry. There will be several opportunities through panels and poster sessions for the Purdue community to participate in the workshop.

The center is currently funded by Purdue and existing contracts in the labs of the leadership team members broadly focused on the topic of resilience.

4.4 Architecture, Engineering, Construction and Owner-operated (AECO) Industry Leverages Benefits of BIM for Life Cycle Operation and Maintenance

Building information modeling (BIM) has been used by the AECO industry for its benefits in facilitating the sharing of information. One area in which it has lagged is in application to life cycle operation and maintenance. Savvy facility owners and operators are now demanding a larger volume of more accurate data. Since the quality of data received can make or break the life cycle performance of a building, the advent and continued refinement of BIM processes and software empowers facility owners to be more effective and efficient in their operations across the duration of the life cycle. This evolution was seen when the Construction Operations Building Information Exchange (COBie) was adopted by the National Institute of Building Sciences for its National Building Information Model standard in 2011. This change was a turning point for facility owners- particularly those in healthcare and higher education. Many institutional owners began to develop their own deliverable requirements to inform designers and builders of what project data is expected as a standard to run their facilities. Comprehensive adoption of BIM will enable facility managers and owners to mature their in-house capabilities.

More information

4.5 Engineering the Future and Increasing Energy Efficiency

Mid-20th century methods and devices of mass production are being replaced with automated, flexible and controllable methods and sets of tools. For example, camera-equipped drones are implemented in small but efficient manufacturing cells (Construction Labs) that utilize advanced production machinery to produce custom-sized components. These camera-equipped drones inspect, monitor and measure concealed areas that are usually inaccessible through classical methods used in mass production.

Around 40% of the world's energy consumption is used by buildings. It is therefore a high priority to increase the efficiency of these buildings by implementing new methods and technologies to reduce risk and create more durable, more aesthetically pleasing and interesting buildings. In order to design more efficient buildings, the climate can be modeled in relation to the building by representing the thermal conductivity, weather tightness and airflow around the building. Andre Watts, CEO of international building engineering firm Newtecnic defines the following 10 tips for engineering the future and reducing environmental impacts:

1. Use automation to close the disconnect between design and manufacturing.
2. Embrace mass customization for innovative and better-made structures.
3. Deploy onsite construction labs for local fabrication.
4. Engineer buildings for the future of collaborative robotics.
5. Create digital twins of buildings as living user manuals.
6. Use fewer cranes during construction and maintenance by deploying robots to do the heavy lifting in hazardous conditions.
7. Inspect buildings by drones - this is safer and more accurate, with no cradles required.
8. Use Lidar-equipped drones to check the as-built condition against the digital twin.
9. Reduce waste by manufacturing and delivering components to order.
10. Calculate weight to better understand environmental impacts and true operating costs.

Watts states that in hot climates like the King Abdulla Financial District Metro Hub in Saudi Arabia, the common solution is to install air-conditioning as urban pollution levels mean that windows cannot be opened. However, buildings can successfully operate as their own cooling systems by allowing filtered air to circulate through the interior. This requires the building and its exterior to maximize airflow. By suitably modeling the building and the environmental conditions that it faces, unique designs that are beautiful to look at, as well as environmentally conscious, are possible. This is the way forward for building design.

More information

4.6 Clifford Whitcomb announced New Editor-in-Chief of 'Systems Engineering' Journal

On July, 13 INOCSE announced Clifford A. Whitcomb, Ph.D. as the new editor in-chief of the 'Systems Engineering' journal. The bimonthly publication by INCOSE and Wiley is widely respected and is focused on forward-looking publications in systems engineering and related fields. "The 'Systems Engineering' journal has been in publication for 20 years, and has become an insightful resource for professionals across the globe," said Whitcomb. "I look forward to collaborating with Wiley to increase the reach of the journal and further promote the research vision of the International Council on Systems Engineering."

Whitcomb succeeds Oliver L. de Weck who served as editor-in-chief since 2013. As editor-in-chief of the Journal, responsibilities include managing technical content and strategic direction of the Journal as well as management of the 'Best Papers' awards. Whitcomb is responsible for appointing new associate editors and an editorial board to serve the entire scope of the journal.

Whitcomb is a professor of systems engineering at the Naval Postgraduate School in Monterey, California and has 35 years' experience in defense systems engineering and related fields. Whitcomb's particular research areas include systems engineering competency modeling, design thinking and human-centered design, model-based systems engineering, defense systems of systems, naval construction and engineering, and leadership, communication, and interpersonal skills development for engineers. Whitcomb has co-authored over 60 papers for journals and conferences and written or edited a number of books including, 'Effective Interpersonal and Team Communication Skills for Engineers' published by Wiley in 2013 and the 'Modeling and Simulation—based Systems Engineering Handbook' publichsed by CRC Press in 2014.

The full article on Whitcomb's appointment is available here.

5. FEATURED ORGANIZATIONS

5.1 Systems Engineering Society of Australia (SESA)

From the SESA Website:

In recent years the demand for high technology systems has increased, and so has the complexity of these systems. Examples are IT & Telecommunications systems, air traffic control systems, intelligent transport systems (e.g. tolling), as well as a great variety of defense systems.

To match this demand, and to remain competitive internationally, Australia needs to establish and maintain systems engineering practices to world class standards. SESA acts as a catalyst in meeting this objective, providing a forum for the discussion and improvement of systems engineering practices in Australia, and a clearing house for Australian and international systems engineering information and trends.

SESA has its origins in the Victorian Systems Engineering Branch of the Institute of Engineers, Australia (IEAust) (Now known as Engineers Australia) which was formed in 1990. In September 1994, a small group of interested parties launched an initiative towards the formation of an Australian systems engineering association. The network quickly grew to exceed 250, and an informal inaugural meeting was held in Canberra on the 2 December 1994 to formulate the best way ahead. The meeting resulted in the formation of small working parties in several Australian cities to further develop a National position for an association for Systems Engineering in this country.

Several options were analyzed, and the best solution arrived at was the formation of a new Technical Society within the IEAust. The main reasons for this were:

- The Association needs to have national credibility in Australia in order to influence Systems Engineering Culture, and

- An international window is necessary for the Association to keep abreast of and contribute to world's best practice in systems engineering.

SESA was formalized as a Technical Society of the IEAust in October 1995 and was launched at a very successful one-day conference held in Sydney in October 1995.

Over the years, SESA has had various affiliation agreements with the International Council on Systems Engineering (INCOSE). At the SESA 2011 Annual General Meeting, a motion was put to the SESA membership for SESA to merge with the Australian Chapter of INCOSE, and for SESA to become the recognized INCOSE Chapter of Australia while remaining a Technical Society of Engineers Australia. This motion was passed and a Memorandum of Understanding between INCOSE and Engineers Australia was signed in January 2012 by Samantha Robitaille (INCOSE President) and John Anderson (Engineers Australia Director of Engineering Practice & CPD).

More Information

5.2 IEEE Standards Association (IEEE-SA)

From the IEEE Standards Association Website:

The IEEE Standards Association (IEEE-SA) is a leading consensus building organization that nurtures, develops, and advances global technologies, through IEEE. We bring together a broad range of individuals and organizations from a wide range of technical and geographic points of origin to facilitate standards development and standards related collaboration. With collaborative thought leaders in more than 160 countries, we promote innovation, enable the creation and expansion of international markets, and help protect health and public safety. Collectively, our work drives the functionality, capabilities, and interoperability of a wide range of products and services that transform the way people live, work, and communicate.

The IEEE-SA is governed by the Board of Governors (BOG) who are elected by IEEE-SA Members. The Board of Governors oversees committees that are dedicated to manage key operational aspects of the IEEE-SA. The IEEE-SA Standards Board reports directly to the BOG, and oversees the IEEE standards development process. Standards Board members are elected by IEEE-SA members as a privilege of membership, and all Board Members and Committee members must be IEEE-SA members in good standing.

The IEEE-SA standards development process is open to IEEE-SA Members and non-members, alike. However, IEEE-SA Membership enables standards development participants to engage in the standards development process at a deeper and more meaningful level, by providing additional balloting and participation opportunities. IEEE-SA members are the driving force behind the development of standards, providing technical expertise and innovation, driving global participation, and pursuing the ongoing advancement and promotion of new concepts.

More Information

6. NEWS ON SOFTWARE TOOLS SUPPORTING SYSTEMS ENGINEERING

6.1 New Report Focusing on Software and System Modeling Tools Market Trends, Analysis by Regions, Type, Application, Market Drivers, and Top Key Players – Forecast to 2023

This report offers a comprehensive evaluation of the market focusing on Top Companies such as Altia, The DiSTI, DSpace, Elektrobit, ESCRYPT, IBM, ETAS, MathWorks Inc., National Instruments, and No Magic. It outlines the market shares for key regions such as the North America, Europe, Asia Pacific (APAC), Middle East and Africa (MEA), and Latin America.

Modeling is the procedure of documenting design of a complex software system as an easily understood diagram, using symbols and text to represent the data flow. The diagram can be used as a blueprint for the construction of new software or for re-engineering a legacy application. System modeling is the interdisciplinary study of the use of models to conceptualize and construct systems in business and IT development. Software modeling is a computer program to build simulations or other models.

New market research report helps analyze the Software & System Modeling Tools market on a global basis and also offers forecast and statistics in terms of revenue for the anticipated forecast period. This research study offers a detailed overview of the market dynamics that are expected to affect the overall industry in the coming few years. In addition, the study explains the impact of the key factors on the development and growth of the global market through the forecast period.

Market study says about the vital role in the market and how the rising demand for Software & System Modeling Tools industry is taking place emerging economies is taking place. How in developing economies in Southeast Asia and Latin America the market has witnessed robust urbanization drives is included in this study report. The rising technology and developments taking place in the market is also depicted in this research report. Factors that are boosting the growth of the market, and giving a positive push to thrive in the global market is explained in detail.

The report provides insights on the following pointers:

- Market Penetration: Comprehensive information on the product portfolios of the top players in the Software & System Modeling Tools market.
- Product Development/Innovation: Detailed insights on the upcoming technologies, R&D activities, and product launches in the Software & System Modeling Tools market.
- Competitive Assessment: In-depth assessment of the market strategies, geographic and business segments of the leading players in the Software & System Modeling Tools market.
- Market Development: Comprehensive information about emerging markets. This report analyzes the market for various protein assay products across geographies.
- Market Diversification: Exhaustive information about new products, untapped geographies, recent developments, and investments in the Software & System Modeling Tools market.

Table of Contents - Global Software & System Modeling Tools Market Research Report:

Chapter 6 Global Production, Revenue (Value), Price Trend by Type

Chapter 7 Global Market Analysis by Application

Chapter 8 Manufacturing Cost Analysis

Chapter 9 Industrial Chain, Sourcing Strategy and Downstream Buyers

Chapter 10 Marketing Strategy Analysis, Distributors/Traders

Chapter 11 Market Effect Factors Analysis

Chapter 12 Global Software & System Modeling Tools Market Forecast

Source: http://www.digitaljournal.com/pr/3798623

More Information

Click here to obtain a sample of this report

6.2 Rommana ALM: An Integrated Application Lifecycle Manager

by

Alwyn Smit

Principal Consultant & Trainer, PPI

In 2013 a comprehensive study by RQX Global named this tool the "Best ALM Tool", certainly a significant feather in their cap.

Rommana consists of eight modules packaged into different licensing options. The modules include:

1. Requirement/User Story Management
2. Change Management
3. Collaboration Management
4. Test Management
5. Issue Management
6. Project Management
7. Use Case Management
8. Document Management

Any of the packages can be evaluated in the Cloud at no cost for 60 days.

If I were in the market for an ALM solution, I would certainly visit their website at https://rommanasoftware.com/

7. SYSTEMS ENGINEERING PUBLICATIONS

7.1 INCOSE Systems Engineering Handbook Fourth Edition July 2015

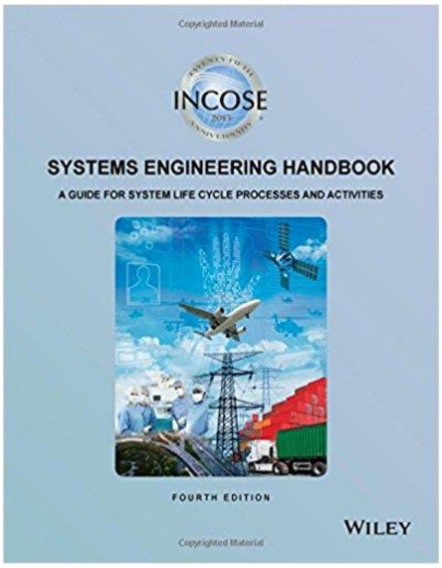


Image source

The hardcopy paperback edition of the INCOSE Systems Engineering Handbook is published for INCOSE by Wiley. A Member Discount code is also available.

Purchase the Handbook from INCOSE, here.

From the Amazon website:

The objective of the International Council on Systems Engineering (INCOSE) Systems Engineering Handbook is to describe key process activities performed by systems engineers and other engineering professionals throughout the life cycle of a system. The book covers a wide range of fundamental system concepts that broaden the thinking of the systems engineering practitioner, such as system thinking, system science, life cycle management, specialty engineering, system of systems, and agile and iterative methods. This book also defines the discipline and practice of systems engineering for students and practicing professionals alike, providing an authoritative reference that is acknowledged worldwide.

The latest (fourth) edition of the INCOSE Systems Engineering Handbook:

- Is consistent with ISO/IEC/IEEE 15288:2015 Systems and software engineering—System life cycle processes and the Guide to the Systems Engineering Body of Knowledge (SEBoK)
- Has been updated to include the latest concepts of the INCOSE working groups
- Is the body of knowledge for the INCOSE Certification Process

This book is ideal for any engineering professional who has an interest in or needs to apply systems engineering practices. This includes the experienced systems engineer who needs a convenient reference, a product engineer or engineer in another discipline who needs to perform systems engineering, a new systems engineer, or anyone interested in learning more about systems engineering.

Format: Kindle, paperback

Publisher: Wiley; 4th edition (July 7, 2015)

ISBN-10: 1118999401

ISBN-13: 978-1118999400

More Information

7.2 Research and Publications in Systems Engineering Worcester Polytechnic Institute

The research areas include artificial intelligence, business applications of logistic regression, emergent properties of corporations and society, machine learning, model based systems engineering, modeling system policy, multi-criteria decision analysis, operations risk analysis, project risk management, self-organization of complex systems, software metrics, engineering and quality factors, system architecture, system dependability, system optimization, systems engineering and technical leadership, systems engineering competencies and competency frameworks, systems of systems, and the integration of art, science, and psychology. Publications of the WPI systems engineering faculty are listed at the website.

More Information

7.3 Systems Engineering Analysis, Design, and Development

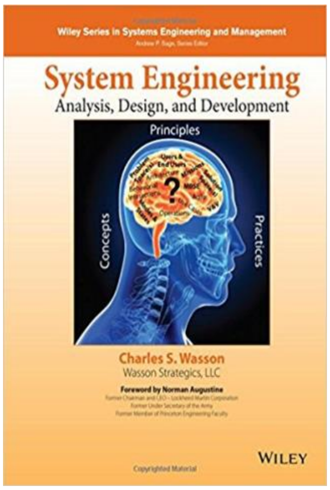


Image source

by

Charles S. Wasson

From the Amazon website:

As a landmark text in Systems Engineering (SE), Systems Engineering Analysis, Design, and Development is an authoritative and comprehensive compilation of SE concepts, principles, and practices.

If you are: (1) an instructor striving to produce world-class students and leaders, (2) a seasoned engineer seeking to learn SE problem-solving and solution development methods, (3) an SE developing a competency in in the discipline, or (3) an enterprise executive or manager developing multi-discipline SE organizational capabilities, this text is for you.

Finally, Someone Has "Codified" Systems Engineering as a Discipline ...

Whereas most textbooks are written to satisfy a "publish or perish" academic mission, Systems Engineering Analysis, Design, and Development is written as a solution to project performance issues traceable to deficiencies in engineering education. Exacerbating the problem are, industry and government managers who are unaware of why and how outdated engineering and SE methods contribute to poor project performance issues.

This new 2nd Edition presents and explains SE concepts and practices via icon-based breakout principles, author's notes, mini-cases, and examples supported by over 250 color figures and over 300 references. Collectively, the concepts, principles, and practices equip the reader with most comprehensive set of SE discipline knowledge including Model-Based Systems Engineering (MBSE) and agile development methods and enables them to transition into industry and government to perform on multi-discipline teams and complex projects.

Format: e-textbook and hardcover

Publisher: Wiley; 2nd edition (December 2, 2015)

ISBN-10: 1118442261

ISBN-13: 978-1118442265

More Information

7.4 Using Systems Thinking to Solve Real-World Problems

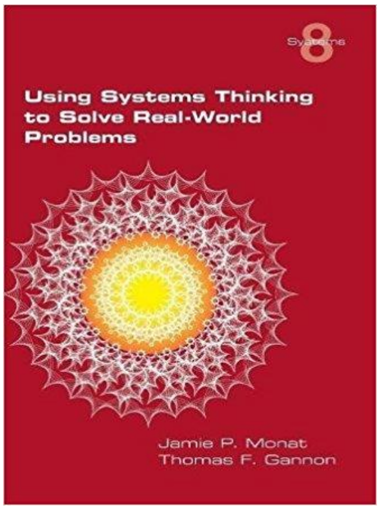


Image source

by

Jamie P. Monat

and

Thomas F. Gannon

From the Amazon website:

Systems Thinking has great power in solving complex problems that are not solvable using conventional reductionist thinking. Systems Thinking is a perspective, a language, and a set of tools. It can help to explain non-linear behaviors like market reactions to new product introductions or the spread of disease; to understand complex socioeconomic problems such as the effects of charter schools or legalized gambling; and to understand the seemingly illogical behaviors of individuals and organizations such as ISIS.

However, there is no step-by-step procedure that has been established to facilitate the use of Systems Thinking in solving real-world problems. The authors hope that this handbook fills that gap and that the tools and approach provided facilitate the use of Systems Thinking in addressing systemic issues of interest to you, whatever they may be.

A recommended sequence of steps to use Systems Thinking is discussed:

Step 1. Develop and articulate a problem statement.

Step 2. Identify and delimit the system.

Step 3. Identify the Events and Patterns.

Step 4. Discover the Structures.

Step 5. Discover the Mental Models.

Step 6. Identify and Address Archetypes.

Step 7. Model (if appropriate).

Step 8. Determine the systemic root cause(s).

Step 9. Make recommendations.

Step 10. Assess Improvement.

A set of tools to utilize in performing and providing Systems Thinking is described, including The Iceberg Model; Causal Loop Diagrams and Feedback; Behavior-Over-Time Graphs; Stock-and-Flow Diagrams; Dynamic Modeling; Archetypes; Systemic Root Cause Analysis; Systemigrams; and Interpretive Structural Modeling (ISM).

Format: Paperback

Publisher: College Publications (February 23, 2017)

ISBN-10: 1848902352

ISBN-13: 978-1848902350

Editor's Note

The authors of this book published a paper, "What is Systems Thinking? A Review of Selected Literature plus Recommendations" in 2015. In this article, the authors assert that Systems Thinking is the opposite of linear thinking; holistic (integrative) versus analytic (dissective) thinking; recognizing that repeated events or patterns derive from systemic structures which, in turn, derive from mental models; recognizing that behaviors derive from a structure; a focus on relationships versus components; and an appreciation of self-organization and emergence. The authors provide a review of 30 of the more popular works of systems thinking literature that they interpret to be “key” contributors to the understanding of Systems Thinking. They collaborated with 14 published experts in the field of Systems Thinking, nine of whom provided input. The result is an edited list of 33 references deemed important to the understanding of Systems Thinking. The authors conclude that Systems Thinking is 1) a perspective that recognizes systems as collections of components that are all integrated and necessary, and whose inter-relationships are at least as important as the components themselves; 2) a language centered on the Iceberg Model, unintended consequences, causal loops, emergence, and system dynamics; and 3) a collection of tools comprising systemigrams, archetypes, causal loops with feedback and delays, stock and flow diagrams, behavior-over-time graphs, main chain infrastructures, system dynamics/computer modeling, interpretive structural modeling, and systemic root cause analysis. They note that the real measure of any definition of Systems Thinking is its ability to help understand and address systems issues.

This paper is available at http://www.sapub.org/journal/articles.aspx?journalid=1058

More Information

7.5 Has the Value of Engineers Been Disrupted?

by

Dr Sophie Hancock, CORE Skills Catalyst and Pilot Lead

and

Eric Jas, Atteris General Managers

This article explores why the future of engineering will require a combination of machine and human computation approaches, from an ethical but also a technical perspective. How can engineering professionals contribute value to their organizations through digital technologies and ensure their skills remain relevant and valuable?

More Information

7.6 Collaboration Across Linked Disciplines: Skills and Roles for Integrating Systems Engineering and Program Management

A paper presented at the 122nd American Society for Engineering Education (ASEE)

Annual Conference & Exposition

June 14-17, 2015

by

Dr. Eric Scott Rebentisch, Research Associate, Massachusetts Institute of Technology,

Stephen Townsend, Director for Global Alliances & Networks, Project Management Institute

and

Dr. Edivandro Carlos Conforto, Research Associate, Massachusetts Institute of Technology

Editor's note

Among the actions you can take on your project and in your organization to further strengthen integration that are identified in this paper are the following: 1) Leadership and stakeholder management skills are critical to bring together diverse interests in order to embrace a common objective and work collaboratively; 2) Systems thinking and requirements management skills are critical to the ability to link overarching objectives to detailed elements in a holistic integrated perspective; and 3) Formal (documented) integration across functional and organizational boundaries appears to be an important element of engineering program success. The roots of unproductive tension between the Program Manager (PM) and Chief Systems Engineer (CSE) may ultimately lie with poorly defined roles and relationships in the program and organization. As engineering efforts become more integrated, and as relationships become more explicit and formally-defined, the unproductive tension in organizations is seen to decrease. This suggests that organizational or program design may play a significant role in shaping the effectiveness of engineering efforts. Areas that can be addressed proactively include: joint PM and CSE integrated planning of the program; clearly defined authority for specific roles and responsibilities; job position of the PM and the CSE clearly spelled out and documented; clearly defined expectations from the executive sponsor; and de-conflicting practices for program management and systems engineering.

Abstract

In new product development programs, systems engineers and program managers must often work together closely to define the product, the program structure and objectives, and allocate and define the focus of work effort. Poor communication and lack of integration between these two critical functions can often spell the difference between success and disappointment for the program and its stakeholders. Despite common and sometimes overlapping skills required for both disciplines, and their respective extensive practice and process models, effective integration and collaboration continues to elude many engineering efforts. Unfortunately, this failure of collaboration and integration negatively impacts program performance and outcomes. This study draws upon a large global survey of program managers and systems engineers to better understand the backgrounds, training, roles, and responsibilities of program managers and systems engineers. The analysis of the data identifies systems engineering and program management capabilities that are considered critical to program success, as well as those areas where both roles share key responsibilities. The implications of these findings for engineering students and for their engineering curricula will be discussed. For systems engineering students and future engineering leaders, having learned these principles and concepts may be critical to them as they prepare to enter a highly competitive workforce.

This paper may be downloaded here.

7.7 Future Directions for Scientific Advice in Europe

by

James Wilsdon, Robert Doubleday, and James Hynard

From the Book

The second in a two-part collection, *Future Directions for Scientific Advice in Europe* was published in April 2015 and updated in June 2015 to take account of developments in the European Commission. In May 2014, the Centre for Science and Policy (CSaP) and the European Commission co-hosted a Brussels workshop on 'New technologies and better evidence for EU policymaking'. One of its conclusions was the need to better connect the latest theory, policy, and practice in this field. Building on our 2013 essay collection on Future Directions for Scientific Advice in Whitehall, we felt it would be useful to produce a similar collection exploring the future of scientific advice at the European level, during a period of transition to the new European Commission. We knew this was a topical and important issue, but we didn't anticipate how much debate it would provoke over recent months, linked in large part to the role of Chief Scientific Adviser (CSA), which Anne Glover occupied from 2012 to 2014. So it is through a combination of serendipity and design that this collection has emerged at an important juncture in these debates. We hope it makes a constructive contribution to discussions about the structures, processes, and politics of scientific advice within the Commission and other European institutions.

Across Europe, science policy controversies – whether over climate, crops, fracking or food safety – regularly ripple across the headlines. But debates over the institutional arrangements for bringing scientific expertise into policy are more commonly confined to bureaucratic corridors, think tanks and seminar rooms. So it has been fascinating (and no doubt, for some inside the Berlaymont, rather surprising) to observe the intensity of discussion that has been generated over the past year about the structures and procedures for scientific advice within the European Commission. The choice by President Juncker not to renew the post of chief scientific adviser (CSA) – a role created by his predecessor in 2012 and occupied for three years by the molecular biologist Anne Glover – was criticized by some as a backwards step, out of line with the broader march in many EU member states towards modern, evidence-informed policymaking. Others saw the move as an overdue recognition of the diversity of Europe's decision-making cultures – what Sheila Jasanoff calls "civic epistemologies". 1 While the model of a presidential or prime ministerial science adviser is firmly established in countries like the US, UK, Ireland and New Zealand, it sits more awkwardly with the political cultures of Germany, France and other EU member states, which tend to rely on committees and more distributed sources of expertise.

The CSA will be replaced by a new "Scientific Advisory Mechanism", consisting of a seven-strong "high level group" of experts, who will be appointed before the end of the year. These experts, described by a senior official as "watchdogs of the system", will be fully independent but supported by a team of around twenty-five staff. This semi-autonomous secretariat will be based in DG Research and Innovation (rather like the Economic Policy Committee's relationship to ECOFIN). Further resources of "up to €6 million" will be offered to Europe's national academies to enable them to play a greater role in the provision of advice.18 Good working links will also be developed to the Commission's in-house science service, the Joint Research Centre. The overall objectives of the new advisory mechanism are:

- to ensure that scientific advice given to the Commission is independent of institutional or political interests;
- brings together evidence and insights from different disciplines and approaches;
- takes into consideration the specificities of EU policy making (e.g. different national perspectives and principles of subsidiarity); and
- is transparent.

Download a free copy of the book here.

7.8 Emergent Behaviour in Complex Systems Engineering

by

Saurabh Mittal

and

Saikou Diallo

From the Amazon website:

In *Emergent Behavior in Complex Systems Engineering*, the authors present the theoretical considerations and the tools required to enable the study of emergent behaviors in manmade systems. Information Technology is key to today's modern world. Scientific theories introduced in the last five decades can now be realized with the latest computational infrastructure. Modeling and simulation, along with Big Data technologies are at the forefront of such exploration and investigation.

The text offers a number of simulation-based methods, technologies, and approaches that are designed to encourage the reader to incorporate simulation technologies to further their understanding of emergent behavior in complex systems. The authors present a resource for those designing, developing, managing, operating, and maintaining systems, including systems of systems. The guide is designed to help better detect, analyze, understand, and manage the emergent behavior inherent in complex systems engineering in order to reap the benefits of innovations and avoid the dangers of unforeseen consequences. This vital resource:

- Presents coverage of a wide range of simulation technologies.
- Explores the subject of emergence through the lens of Modeling and Simulation (M&S).

- Offers contributions from authors at the forefront of various related disciplines such as philosophy, science, engineering, sociology, and economics.
- Contains information on the next generation of complex systems engineering.

Written for researchers, lecturers, and students, *Emergent Behavior in Complex Systems Engineering* provides an overview of the current discussions on complexity and emergence, and shows how systems engineering methods in general and simulation methods in particular can help in gaining new insights in complex systems engineering.

Format: Kindle, hardcover

Publisher: Wiley; 1 edition (April 17, 2018)

ISBN-10: 1119378869

ISBN-13: 978-1119378860

More Information

8. EDUCATION AND ACADEMIA

8.1 Systems Engineering at the University of Lagos, Nigeria

"The Systems Engineering Department of the University of Lagos is indeed an extraordinary one in this great institution, known for its academic excellence and beneficial national service. Unilag Systems Engineering is well equipped and poised to disseminate knowledge for technological growth and advancement in this millennium."

The Systems Engineering program of the University of Lagos was established in 2000. It is a hybrid program in which materials are selected from the classical Engineering programs of Mechanical and Electrical Engineering as well as Computer Science. Systems Engineering was developed in response to the challenges faced by today's scientific and Engineering community that require the ability to handle large or complex systems. The present Department of Systems Engineering evolved out of the teaching and research activities of the Engineering Analysis Unit (EAU) which was established early in the 1970/71 session as a sub-unit within the Civil Engineering Department for the study and development of mathematical techniques in the modeling and solution of Engineering problems. The Department is led by Dr. Fashanu TA.

The objectives of the program are:

- To bridge the gap between management/decision science and the Engineering profession through the integration of decision Science/Management courses to the traditional engineering discipline.

- To produce engineers with multidisciplinary skills for today's complex economy.
- To impart analytical and cutting-edge computing skills in engineering training.
- To initiate and carry out engineering design.
- To engage in management and to pursue research and development.

The undergraduate program in Systems Engineering provides students with basic training and skills in analysis, design, monitoring and control of engineering systems. The program stresses the importance of humanistic and societal concerns as they shape the designer's approach to solution of problems confronting the modern society. Undergraduate courses offered in the department lead to the award of the B.Sc. (Honors) in Systems Engineering. The graduate program has five areas of specialization from which the student is expected to select one viz: Engineering Analysis, Modeling and Simulation, Artificial Intelligence, Information Technology and Engineering Systems Management.

More Information

8.2 Open Research Positions- Nanyang Technological Univeristy (NTU), Singapore

NTU (Singapore) have several position openings for a new project funded by National Research Foundation (NRF), Singapore. The project is about using agent-based modelling and simulation technologies to optimize the preparation and operation of emergency medical services (EMS). The following three specific problems will be addressed in the project : i) EMS provision for incidences at crowded places; ii) evacuation of Emergency Department (ED); and iii) placement of Automated External Defibrillators (AEDs) in housing estates. The project is in collaboration with Singapore General Hospital (SGH) and Singapore Civil Defense Force (SCDF).

They are recruiting Research Fellows, Research Associates, and Software Engineers who have background in agent-based modelling and simulation or 3D modeling and visualization. Details of the positions can be found from the following URLs:

http://www.ntu.edu.sg/ohr/career/CurrentOpenings/ResearchOpenings/ComplexityInstitute/Pages/Mas-Comp-Sci.aspx
http://www.ntu.edu.sg/ohr/career/CurrentOpenings/ResearchOpenings/ComplexityInstitute/Pages/Dr-Comp-Sc.aspx
http://www.ntu.edu.sg/ohr/career/CurrentOpenings/ResearchOpenings/ComplexityInstitute/Pages/software-Bac.aspx

If you know of any suitable candidate, please ask him/her to contact Professor Wentong Cai at ASWTCAI@ntu.edu.sg directly.

9. SOME SYSTEMS ENGINEERING-RELEVANT WEBSITES

The Engineering Design Process

This page is dedicated to teaching young learners Engineering Design Process by breaking down each step of the design process and offering accompanying detail for each step. The site offers examples, workloads and checklists for each step to help with thorough learning of the engineering process; a useful site for any aspiring engineer or science student.

https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-process-steps

Systems Engineering Scholarships

This website contains a list of financial aid opportunities for aspiring system engineering students. The page states that employment opportunities for system engineers are found in a wide range of technology-heavy industries like manufacturing, communications and the military where students exercise skills such as analysis, management, design and integration in all aspects of business and industry. The site lists both college scholarships and professional organizations scholarships.

http://www.collegescholarships.org/scholarships/engineering/systems.htm

Spec Innovations- Can One Tool Do Everything?

Article write-up on the commonly debated topic of whether one tool can do everything required in Model Based Systems Engineering (MBSE) processes. The page discusses broadly the SE process as described by the MIL-STD-499B and the capability of Innoslate to meet the needs of the process through MBSE, specifically.

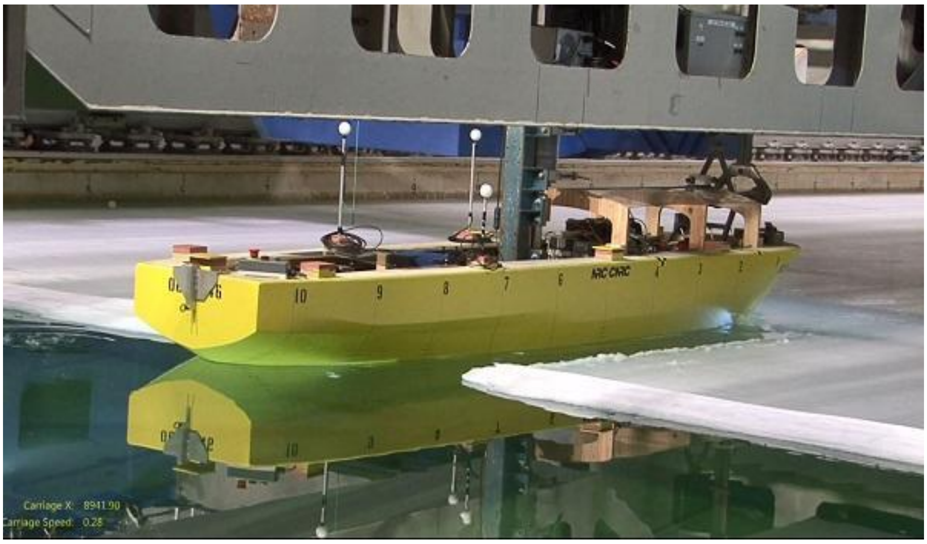
https://www.specinnovations.com/can-one-tool-do-everything-that-systems-engineers-need/

10. STANDARDS AND GUIDES

10.1 Developing Tests, Evaluations, Standards, and Systems Engineering

at the

Department of Homeland Security Science and Technology Directorate, USA



USCG Polar Icebreaker Testing video

When members of the Homeland Security Enterprise (USA) acquire a new type of equipment or resource, they need to know it will meet their usability and safety needs. The Department of Homeland Security Science and Technology Directorate (S&T) assists operators by helping them define and understand their requirements and the technology's performance capabilities. This ensures they select the right tool for the job. S&T provides the capability development and support throughout the development and acquisition process.

S&T's work in standards, test and evaluation, systems engineering and operational analysis has made them a trusted resource for operators across DHS and the Homeland Security Enterprise. S&T works with government labs, such as the National Institute of Standards and Technology, and other academic partners to conduct thorough testing and evaluation and ensure performance standards are consistently applied. S&T also provides technology testing and evaluation to better understand and mitigate homeland security threats, especially for the first responder community. S&T's laboratory staff and partners provide a critical scientific interface with first responders and end-users in the field for accelerated delivery and deployment of technologies and systems across the country. This information is vital when determining which equipment is worth the investment, since many items can have similar descriptions but varying costs. S&T's expertise and trusted evaluation provides a firm foundation for good acquisition decisions by helping operators understand which resources are most effective for their needs.

Questions? Email S&T at stcds@hq.dhs.gov.

Article source

10.2 The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems Announces Two New Standards Projects

The projects focus on rating trustworthiness of news sources and establishing machine readable personal privacy terms.

From the Business Wire website:

https://www.businesswire.com/news/home/20180523005138/en/IEEE-Global-Initiative-Ethics%C2%A0of-Autonomous-Intelligent-Systems

IEEE, the world's largest technical professional organization dedicated to advancing technology for humanity, and the IEEE Standards Association (IEEE-SA), today announced the approval of two new standards projects inspired by work being done by The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems ("The IEEE Global Initiative"). Sponsored by The IEEE Society on Social Implications of Technology, the new standards projects are the latest additions to the IEEE P7000™ standards family, which supports a principal goal of IEEE to prioritize ethical concerns and human wellbeing in the development of standards that address critical aspects of autonomous and intelligent technologies.

"Explicitly including ethical values in the design and development of human-aligned autonomous and intelligent systems is essential, and IEEE is helping to facilitate this action across a wide range of focus areas," said Konstantinos Karachalios, managing director for IEEE-SA. "With the foreseeable continued growth and associated impacts of autonomous and intelligent systems in play, it is critical to engage the best and brightest individuals from human science and technical disciplines to help ensure that these systems incorporate broadly accepted ethical considerations through a transparent, globally open, bottom-up standardization system."

The new IEEE P7000 standards projects are chaired by leading subject matter experts in their respective fields of study and include:

IEEE P7011™— Standard for the Process of Identifying and Rating the Trustworthiness of News Sources

IEEE P7011 aims to provide semi-autonomous processes using standards to create and maintain news purveyor ratings for purposes of public awareness. It standardizes processes to identify and rate the factual accuracy of news stories in order to produce a rating of online news purveyors and the online portion of multimedia news purveyors. The standard will define an algorithm using open source software and a scorecard rating system as methodology for rating trustworthiness. Joshua Hyman, Public Policy & Management Student & Staff member at the University of Pittsburgh will serve as chair of the IEEE News Site Trustworthiness Working Group.

IEEE P7012™— Standard for Machine Readable Personal Privacy Terms

Initiated by David Searls, co-author of The Cluetrain Manifesto and author of The Intention Economy: When Customers Take Charge, IEEE P7012 aims to change the dynamic of peer-to-peer engagement on the Internet, where server operators proffer all terms of engagement, including respect for privacy, forcing individuals to agree to all terms, with no alternative but to decline in totality. IEEE P7012 proposes to provide individuals with means to suggest their own terms respecting personal privacy, in ways that can be read, acknowledged and agreed to by machines operated by others in the networked world. In effect, the purpose of the standard is to enable individuals to operate as first parties in agreements with companies operating as second parties. David Reed, Department of Aerospace Engineering, University of Michigan will serve as chair of the IEEE Working Group on Machine Readable Privacy Terms.

According to Searls, “It is only because standard-form 'contracts of adhesion' became the norm in the industrial age, and were borrowed for use in client-server settings starting with dial-up, that they continue to be the box outside of which developers have a hard time thinking. But a simple fact remains: we need a way for machines to hear and agree to terms proffered by individuals, in a way that accords with freedom-of-contract as it has been understood and practiced throughout the history of civilization. I expect this working group to provide the standard required for that new norm.”

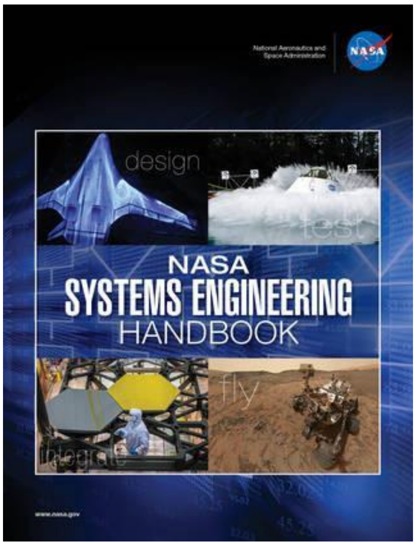
“IEEE P7011 and IEEE P7012 address societal level trust and privacy issues that have become increasingly sensitive in recent times due to previously undisclosed exploitation and abuse of personal data. This has resulted in heightened public awareness and concern about how personal data is stored and managed by Internet server operators and the ways in which social media platforms, advertisers and other organizations have been shown to exploit personal data including Internet use and search histories,” said Paul Cunningham, president, IEEE Society on Social Implications of Technology.

More Information:

To learn more about these new standards projects, or to join one of the respective working groups, visit the IEEE P7011 or IEEE P7012 project page.

11. A DEFINITION TO CLOSE ON

11.1 Systems Engineering: A great definition



NASA Systems Engineering Handbook – Rev 2, October 29, 2017

Source

Systems engineering is a methodical, disciplined approach for the design, realization, technical management, operations, and retirement of a system. A "system" is a construct or collection of different elements that together produce results not obtainable by the elements alone. The elements, or parts, can include people, hardware, software, facilities, policies, and documents; that is, all things required to produce system-level results. The results include system-level qualities, properties, characteristics, functions, behavior, and performance. The value added by the system as a whole, beyond that contributed independently by the parts, is primarily created by the relationship among the parts; that is, how they are interconnected. It is a way of looking at the "big picture" when making technical decisions. It is a way of achieving stakeholder functional, physical, and operational performance requirements in the intended use environment over the planned life of the systems. *In other words, systems engineering is a logical way of thinking.*

Systems engineering is the art and science of developing an operable system capable of meeting requirements within often opposed constraints. *Systems engineering is a holistic, integrative discipline, wherein the contributions of structural engineers, electrical engineers, mechanism designers, power engineers, human factors engineers, and many more disciplines are evaluated and balanced, one against another, to produce a coherent whole that is not dominated by the perspective of a single discipline.*

Systems engineering seeks a safe and balanced design in the face of opposing interests and multiple, sometimes conflicting constraints. The systems engineer must develop the skill and instinct for identifying and focusing efforts on assessments to optimize the overall design and not favor one system/subsystem at the expense of another. The art is in knowing when and where to probe. Personnel with these skills are usually tagged as "systems engineers." They may have other titles—lead systems engineer, technical manager, chief engineer— but for this document, we will use the term *systems engineer*.

The exact role and responsibility of the systems engineer may change from project to project depending on the size and complexity of the project and from phase to phase of the life cycle. For large projects, there may be one or more systems engineers. For small projects, sometimes the project manager may perform these practices. But, whoever assumes those responsibilities, the systems engineering functions must be performed. The actual assignment of the roles and responsibilities of the named systems engineer may also therefore vary. The lead systems engineer ensures that the system technically fulfills the defined needs and requirements and that a proper systems engineering approach is being followed. The systems engineer oversees the project's systems engineering activities as performed by the technical team and directs, communicates, monitors, and coordinates tasks. The systems engineer reviews and evaluates the technical aspects of the project to ensure that the systems/subsystems engineering processes are functioning properly and evolves the system from concept to product. *The entire technical team is involved in the systems engineering process.*

I would imagine that successful organizations understand this concept of systems engineering, but I don't think I've ever seen it put so well. PPI SyEN Ed Note: The view expressed is that of the NASA author this piece.

NASA's engineers have both common and conflicting goals, just like we do in web operations. They weigh trade-offs in efficiency and thoroughness, and wade into the constraints of better, cheaper, faster, and hopefully: more resilient.

The *NASA Systems Engineering Handbook*: NASA/SP-2016-6105 Rev2 - Full Color Version Paperback – October 19, 2017 is available here

12. CONFERENCES AND MEETINGS

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

13. PPI AND CTI NEWS

PPI participation in the INCOSE 2018 International Symposium (IS) in Washington, D.C., July 2018

Cross-continental representation on behalf of the PPI team was brought by Victoria Huang from China, Suja Joseph-Malherbe and René King from South Africa and Robert Halligan (Managing Director) and Joshua Freeman (General Manager - Corporate) from Australia. The team was delighted to engage with long-standing and new members of the Systems Engineering community through a variety of interactions and experiences. Whether it was a friendly conversation at our exhibitor stand, a thought-provoking debate over some delicious treats or a productive discussion in a Working Group meeting, a wonderful time was had by all.
The theme of the conference, 'Delivering Systems in the Age of Globalization', was addressed with substantial depth and creativity through the plenary sessions, the papers/presentations and working group sessions. It is exciting to see Systems Thinking applied across multiple industries to both harness the opportunities, and mitigate the threats that the human population faces as globalization rises. The IS was a welcome indicator of the significance of sound systems engineering practices in addressing the challenges arising from the rapidly increasing integration of global socio-technical, economic spaces.

14. PPI AND CTI EVENTS

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

Systems Engineering 5-Day Courses

Upcoming locations include:

- London, United Kingdom
- Eindhoven, the Netherlands

Requirements Analysis and Specification Writing 5-Day Courses

Upcoming locations include:

- Melbourne, Australia
- Wellington, New Zealand

Systems Engineering Management 5-Day Courses

- Upcoming locations include:
- Ankara, Turkey
- Münich, Germany

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

Upcoming locations include:

- Amsterdam, the Netherlands
- Washington, D.C., United States of America

Architectural Design 5-Day Course

Upcoming locations include:

- Stellenbosch, South Africa
- London, United Kingdom

Human Systems Integration Public 5-Day Courses

Upcoming locations include:

- Melbourne, Australia

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

Upcoming locations include:

- Laurel, MD, United States of America
- Madrid, Spain

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

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

15. UPCOMING PPI PARTICIPATION IN PROFESSIONAL CONFERENCES

PPI will be participating in the following upcoming events.

The International Symposium on Military Operational Research

(Sponsoring)

17 - 20 July 2018

Surrey, UK

SWISSED
(Sponsoring)

3 September 2018

Zurich, Switzerland

Land Forces 2018

(Exhibiting)
4 - 6 September 2018
Adelaide, Australia

INCOSE Western States Regional Conference

(Sponsoring)

20 - 22 September 2018

Ogden, Utah, USA

4th IEEE Symposium on Systems Engineering

(Sponsoring)

1 - 3 October 2018

Rome, Italy

INCOSE SA 2018

(Exhibiting & Sponsoring)

3 - 5 October 2018

Pretoria, South Africa

INCOSE Great Lakes Regional Conference

(Sponsoring)

17 - 20 October 2018

Indianapolis, IN, USA

EnergyTech Conference 2018

(Exhibiting?)

22-26 October 2018

Cleveland, OH, USA

New Zealand Defence, Industry & National Security Forum

(Exhibiting)

31 October – 1 November 2018

Palmerston North, New Zealand

The INCOSE International Symposium 2019

(Exhibiting)

July 2019

Orlando, USA

The INCOSE International Symposium 2020

(Exhibiting)

18-23 July 2020

Cape Town, South Africa

Kind regards from the PPI SyEN team:

Robert Halligan, Editor-in-Chief, email: rhalligan@ppi-int.com

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

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

Project Performance International

2 Parkgate Drive, Ringwood North, Vic 3134 Australia Tel: +61 3 9876 7345 Fax: +61 3 9876 2664

Tel Brasil: +55 12 9 9780 3490

Tel UK: +44 20 3608 6754

Tel USA: +1 888 772 5174

Tel China: +86 188 5117 2867

Web: www.ppi-int.com

Email: contact@ppi-int.com

Tell us what you think of PPI SyEN. Email us at syen@ppi-int.info.