INCOSE CoA Chapter

Panel Discussion,

14 August 2018

Andy Pickard, Rolls-Royce Corporation

Q1 Value of SE - how would you articulate the value of using a Systems Engineering approach?

Q2 How to do an effective but minimalist SE approach to a design with a very limited budget

Q3 Verification and Validation - what's the difference and does it matter?

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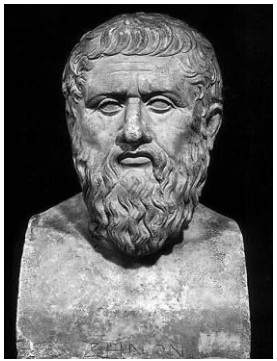
Value of SE - how would you articulate the value of using a Systems Engineering approach?

- Start Right: “The beginning is the most important part of the work” (Plato, c. 380 B.C.)
- Stakeholders, stakeholders, stakeholders! Early simultaneous influence and involvement
- Simulations and models – understand the human-systems integration (Guy Andre Boy, INCOSE Webinar 114)
- Use Systems Engineering to avoid Late Stage Engineering Change Notifications (Beasley et al, SPOT paper, IS 2016)
- Systems Engineering applies to complex and complicated systems and provides value by increasing the probability of success (Beasley et al, SPOT paper, IS 2016)



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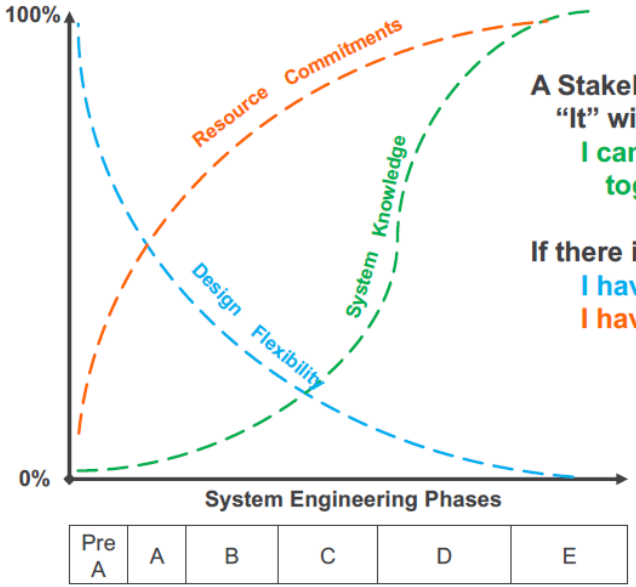
Value of SE - how would you articulate the value of using a Systems Engineering approach?

Late in life cycle …



A Stakeholder wants to know what "It" will look like.

I can show them pieces going together and tour the floor

If there is a change:

I have no design flexibility

I have no money

(Conroy, 2016)

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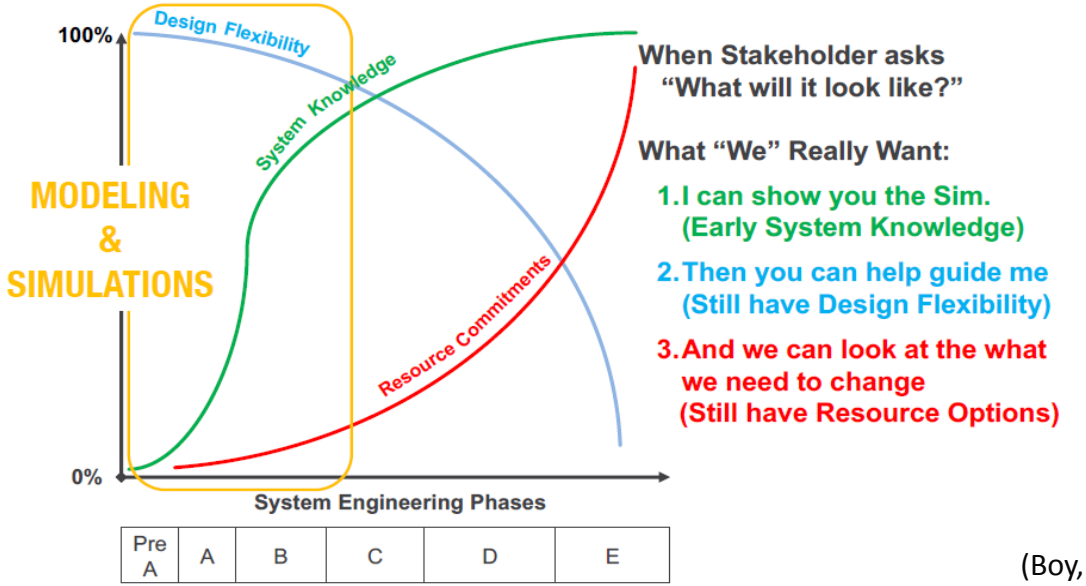
Value of SE - how would you articulate the value of using a Systems Engineering approach?

What we Really Want …



(Boy, 2018)

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Value of SE - how would you articulate the value of using a Systems Engineering approach?

SPOT Area	*Leading Indicator* **Late Stage Engineering Change Notices**	ECNs	Cost	Innovation	Cost, Time, Quality & Innovation
S	A. Strategy Engagement				
P	B. Requirements Management				
P	C. Process Improvement				
O	D. Early Simultaneous Influence				
O	E. Downstream Engagement				
O	F. Decentralized Decisions				
O	G. Role Ambidexterity				
T	H. Agility of Operations				
S	I. Innovative Knowledge Search				
O	J. Lean/Concurrent Product Development				

= Very Strong Correlation

= Strong Correlation

= Moderate Correlation

= Weak Correlation

Leading Indicator (Late Stage Engineering Change Notices, ECN) and Ten SPOT Practices (from the SPOT evaluation)

Late stage changes are expensive waste!

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How to do an effective but minimalist SE approach to a design with a very limited budget?

- Example – making modifications to legacy products
- Follow some basic Systems Engineering principles:
  - Identify the Stakeholders
  - Understand and agree the problem/opportunity (the need for change)
  - If a problem, do a proper Root Cause Analysis
  - Identify interfaces
  - Identify functions
  - Document the functional requirements
  - Identify the non-functional requirements
  - Document the non-functional requirements
  - Review the requirements
  - Identify what has changed

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How to do an effective but minimalist SE approach to a design with a very limited budget?

- Follow some basic Systems Engineering principles (continued):
  - If any functional requirements have changed, perform a Functional Failure Modes and Effects Analysis
  - Investigate solution concepts – do a proper trade study (see Parnell et al paper at IS 2014)
  - Perform Design Failure Modes and Effects Analyses on the solution concepts
  - Check for impacts on interfaces
  - Select the preferred concept
  - Document the design
  - Implement the design
  - Verify the design
  - Release the design

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Verification and Validation - what's the difference and does it matter?

Definition of requirement

A statement that identifies a system, product, or process characteristic or constraint, which is unambiguous, clear, unique, consistent, stand-alone (not grouped), and verifiable, and is deemed necessary for stakeholder acceptability

INCOSE SE Handbook, V4 2015

Or

"what's wanted?"

(Beasley, "Requirements to V and V", INCOSE IS 2015)

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Definition of verification process

The purpose of the Verification process is to provide objective evidence that a system or system element fulfils its specified requirements and characteristics

INCOSE SE Handbook, V4 2015, and ISO/IEC/IEEE 15288

Or

"Did we design it right? Does it meet requirements?"

(Beasley, "Requirements to V and V", INCOSE IS 2015)

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Verification and Validation - what's the difference and does it matter?

Definition of validation process

The purpose of the Validation process is to provide objective evidence that the system, when in use, fulfils its business or mission objectives and stakeholder requirements, achieving its intended use in its intended operational environment

INCOSE SE Handbook, V4 2015, and ISO/IEC/IEEE 15288

Or

"Does it actually work for the customer? Is it the right system?

Or

"Were the requirements actually right, and did the verification accurately test them?

(Beasley, "Requirements to V and V", INCOSE IS 2015)

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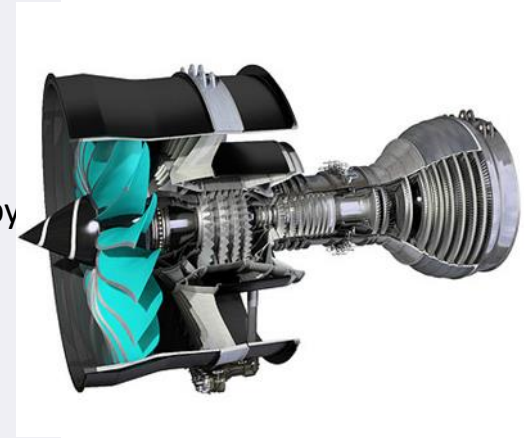
Verification and Validation - what's the difference and does it matter?

- For Gas Turbines, is engine testing performed for Verification or Validation?



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Verification and Validation - what's the difference and does it matter?

- Plato, circa 380 B.C., *The Republic*, see http://www.idph.net/conteudos/ebooks/republic.pdf, 230
- Guy André Boy, INCOSE Webinar 114, "Human-Systems Integration – An Evolution", 26 July 2018, https://connect.incose.org/Library/Webinars/Pages/INCOSE-Webinars.aspx
- Richard Beasley, Andrew C Pickard, Andy J Nolan and Frank M Hull, "SPOTing Best Approaches to Enable SE in Enterprises", INCOSE International Symposium 2016
- Parnell, G., Cilli, M. and Buede, D. "Tradeoff Study Cascading Mistakes of Omission and Commission", INCOSE International Symposium 2014
- Walden, D., Roedler, G., Forsberg, K., Hamelin, R. and Shortell, T. (Eds.), 2015, Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities (4th Edition); San Diego, CA, International Council on Systems Engineering, INCOSE, published by John Wiley and Sons, Inc., ISBN 978-1-118-99940-0
- Richard Beasley, Systems Engineering 101 Presentation, "Requirements to V and V", INCOSE International Symposium 2015