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CUST101 - Systems Engineering Beyond Aerospace and Defense

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June 8, 2015

WPI

Objectives

- Explore why and how companies outside of Aerospace and Defense can successfully implement Systems Engineering
- Facilitate audience discussions

Outline

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- Myths vs. Facts
- Three Views of Systems Engineering
- Examples of Systems Engineering in Industry
- Phased Approach to Adopting Systems Engineering
- Summary

The Myths – Barriers to “Yes”

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- Systems Engineering only works for large scale complex aerospace and defense systems.
- Systems Engineering costs too much to implement.
- It takes too long to educate and train Systems Engineers.
- We’re unique, Systems Engineering won’t work for us.

Just The Facts

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- Systems Engineering can be scaled and tailored to benefit all types of products and services.
- Recent studies have shown that Systems Engineering can:
  - Decrease program cost and schedule
  - Improve product performance and reliability
- Companies working on medical devices, lab instrumentation, the power grid and digital storage devices are already adopting Systems Engineering.

Three Views of Systems Engineering

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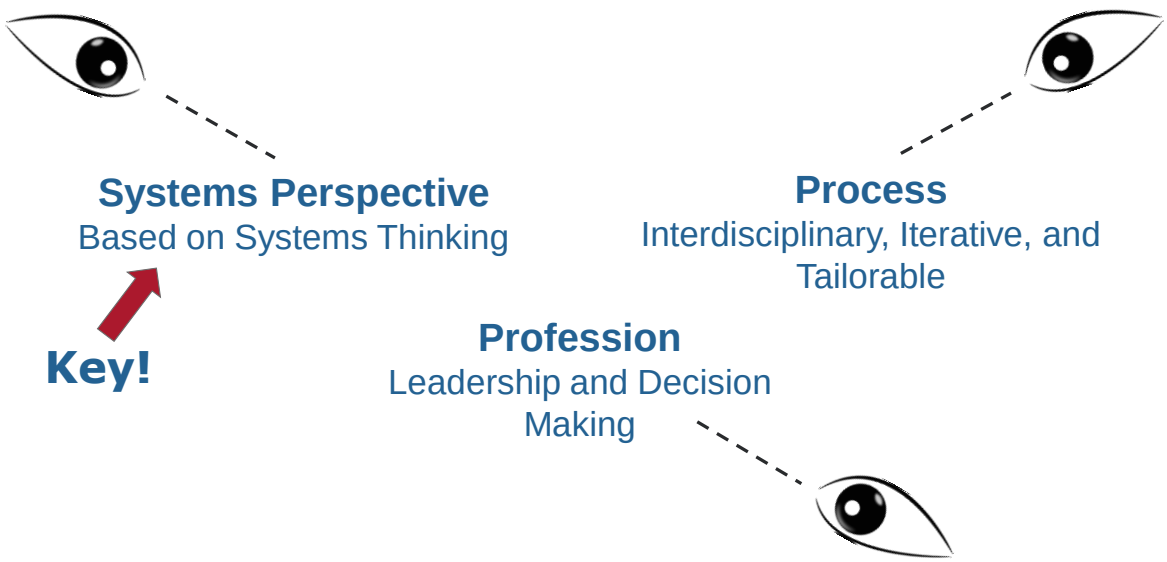

Three Views of Systems Engineering

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Systems Engineering is a broad discipline that can be tailored and applied to virtually any field to provide leadership, manage risk, and deal with complexity

Holistic / Systems Perspective

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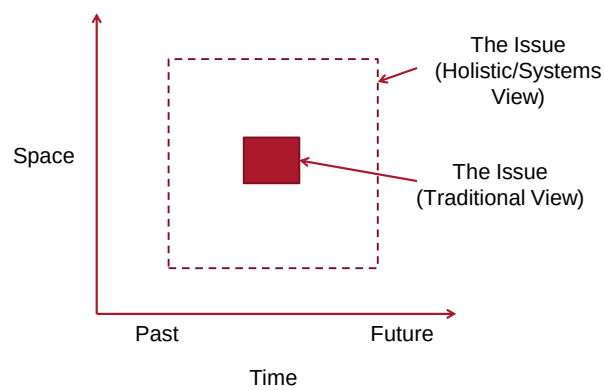

A Great Systems Thinker

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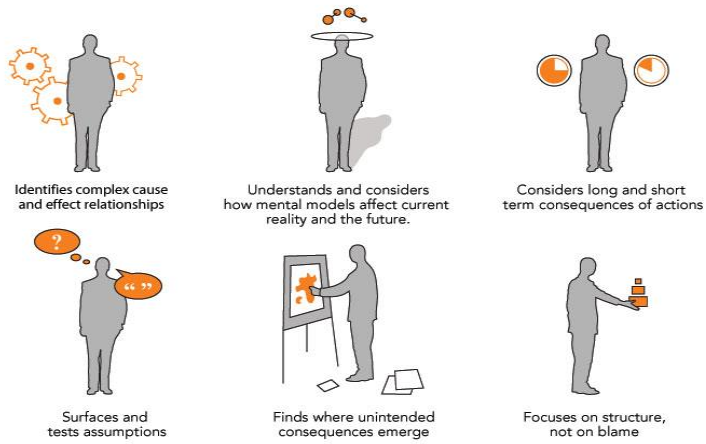

Standard Systems Engineering Life-Cycle Processes

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Technical Processes		Technical Management Processes	Agreement Processes	Organizational Project-Enabling Processes
Business or Mission Analysis Process	Integration Process	Project Planning Process	Acquisition Process	Life Cycle Model Management Process
Stakeholder Needs & Requirements Definition Process	Verification Process	Project Assessment and Control Process	Supply Process	Infrastructure Management Process
Systems Requirements Definition Process	Transition Process	Decision Management Process		Portfolio Management Process
Architecture Definition Process	Validation Process	Risk Management Process		Human Resource Management Process
Design Definition Process	Operation Process	Configuration Management Process		Knowledge Management Process
System Analysis Process	Maintenance Process	Information Management Process		Quality Management Process
Implementation Process	Disposal Process	Measurement Process		
		Quality Assurance Process		

Source: ISO/IEC/IEEE 15288

Tailoring Systems Engineering by Balancing Risk and Process

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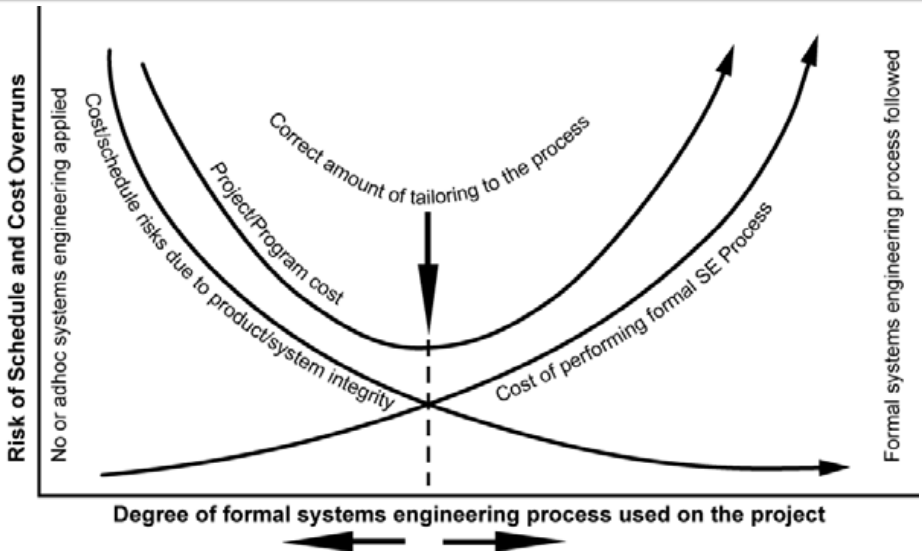

Figure 8-1 Tailoring requires balance between risk and process

Source: INCOSE SE Handbook, 2011

Systems Engineering Profession

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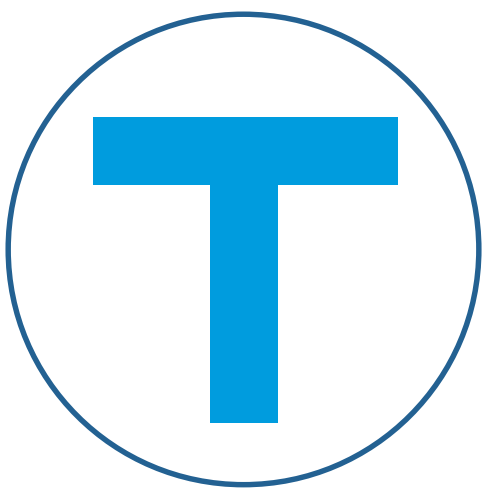

Depth

Breadth

Leadership

Critical Thinking!

Audience Discussion

Examples of SE in Industry

Schedule vs. SE Effort

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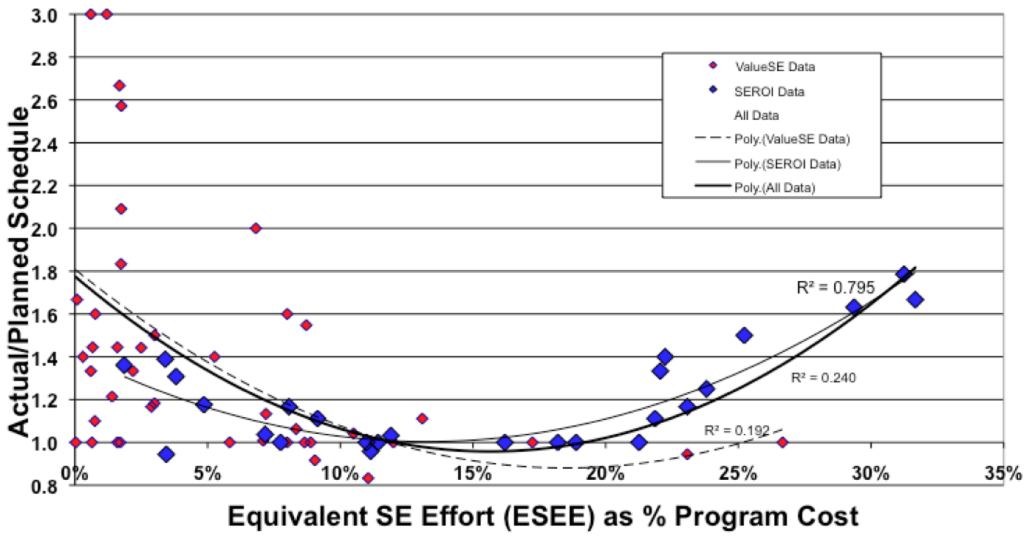

Honour, EC, Systems Engineering Return on Investment
PhD Thesis, University South Australia 2013

Cost vs. SE Effort

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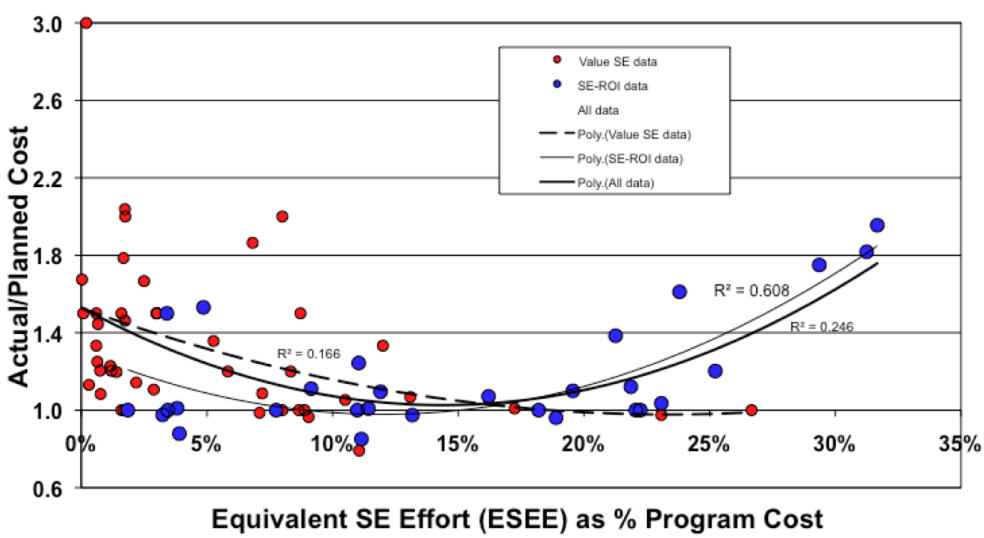

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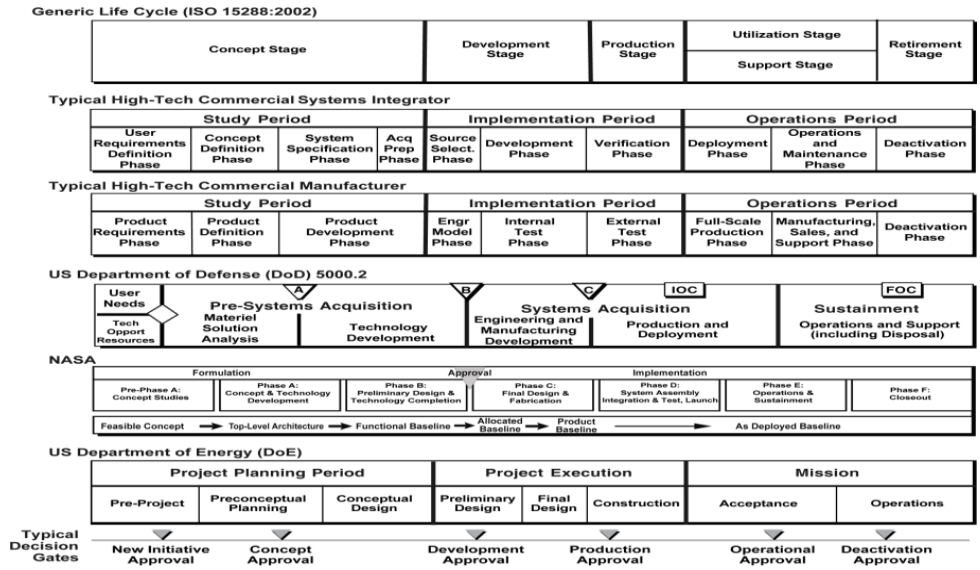
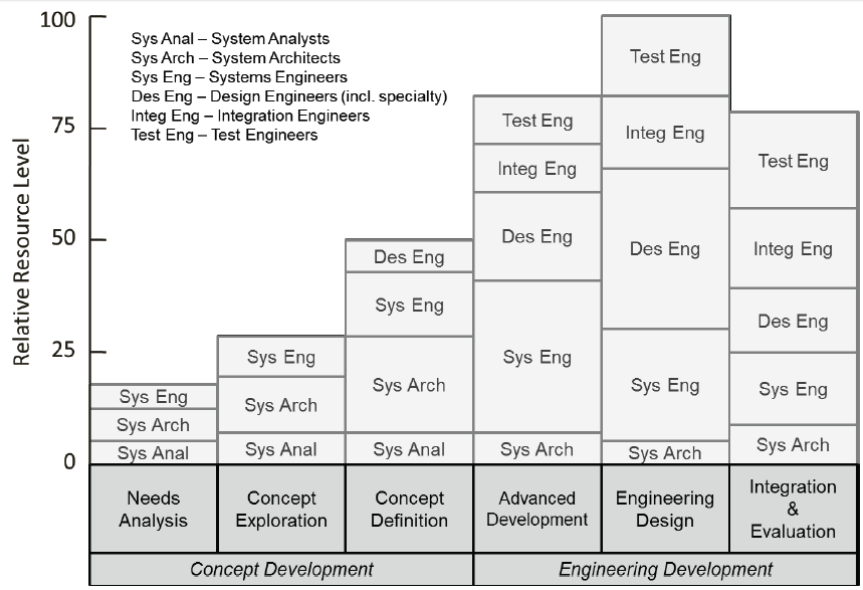
Comparisons of Life Cycle Models



Source: INCOSE SE Handbook. 2011.

Typical Aerospace Staffing Profile



Source: WPI SYS 501: Concepts of Systems Engineering

Audience Discussion

Phased Approach to Adopting Systems Engineering

Phased Approach to Adopting Systems Engineering

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- **Initial Awareness**
  - Policy and guidance, workshops, white papers, conference presentations and papers…
- **Education and Training**
  - One day seminars, technical short courses, workshops…
- **Experiment, Analyze and Repeat…**
  - Pilot projects, get metrics, analyze results, determine what went right and what went wrong and why …
- **Shift the Culture!**
  - Begin to embrace the value and essence of Systems Thinking and Systems Engineering across the company

Example Course for Digital Storage Devices

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- Module 1 – What is Systems Engineering?
- Module 2 – Examples of Systems Engineering in Industry
- Module 3 – Professional Skills for Systems Engineers
- Module 4 – The Importance of Requirements
- Module 5 – Tailoring Systems Engineering
- Facilitated Discussion on Implementing Systems Engineering

Example Course for Lab Instrumentation

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- Module 1 – What is Systems Engineering and its Value?
- Module 2 – Examples of Systems Engineering in Industry
- Module 3 – The Importance of Requirements
- Module 4 – The importance of Integration
- Module 5 – The Importance of Risk Management
- Module 6 – Tailoring Systems Engineering
- Facilitated Discussion on Implementing Systems Engineering

Follow Up Course for Lab Instrumentation

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- Session 1 – Introduction, Overview and Concepts
- Session 2 – Stakeholder Needs
- Session 3 – Systems Requirements
- Session 4 – Systems Architecture and Design
- Session 5 – Systems Integration and Test
- Session 6 – Capstone Presentations

Power Grid Regulator 16 Key Management Practices*

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1. Asset and Configuration Management
2. Information Management
3. Workforce Management
4. Implementation
5. Integration
6. Grid Operations
7. Grid Maintenance
8. Work Management
9. External Interdependencies
10. Measurement and Analysis
11. Verification
12. Validation
13. Reliability Quality Management
14. Risk Management
15. Structured Decision Making
16. Planning

**Derived from the standard INCOSE SE Processes*

Categories of Key Management Practices

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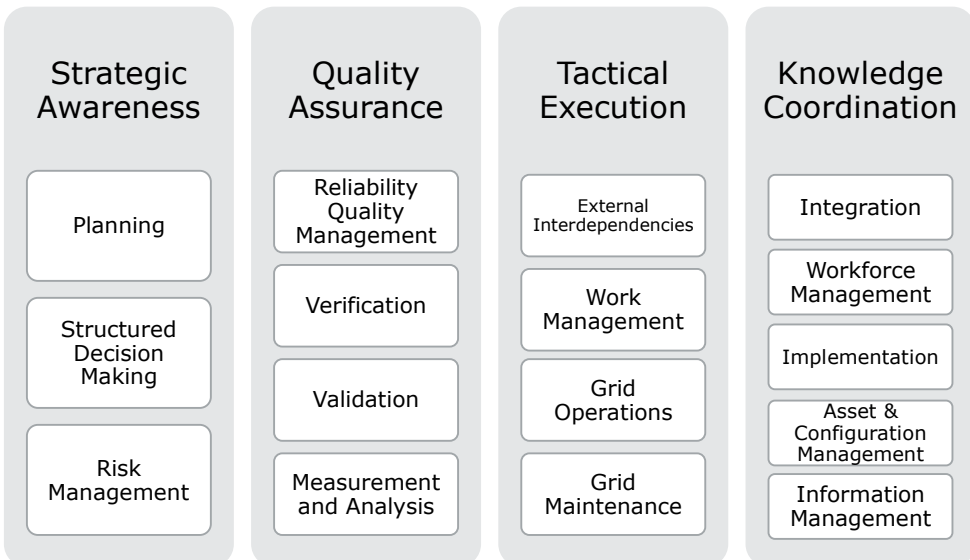

Summary

- It is possible for companies outside Aerospace and Defense to successfully adopt Systems Engineering – some are already doing it.
- Using a Systems Thinking approach is key.
- You have to be careful when you tailor Systems Engineering.
- Implementing a phased approach is a good way to start.
- The Systems Engineering Team at WPI can help you be successful!

WPI

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Questions?

References

- INCOSE. 2011. Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities, version 3.2.2. San Diego, CA, USA: International Council on Systems Engineering (INCOSE), INCOSE-TP-2003-002-03.2.2.
- Honour, E., “Systems Engineering Return on Investment” PhD Thesis, Defence and Systems Institute, University of South Australia. 2013 http://www.hcode.com/secoe

Thank you!

For more information please contact:

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