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## Correlation of System Complexity With System Engineer Effectiveness

Jeffrey O. Grady  
President JOG System Engineering  
(858) 458-0121, [jgrady@ucsd.edu](mailto:jgrady@ucsd.edu),  
[jeff@jogse.com](mailto:jeff@jogse.com)

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## Central Question

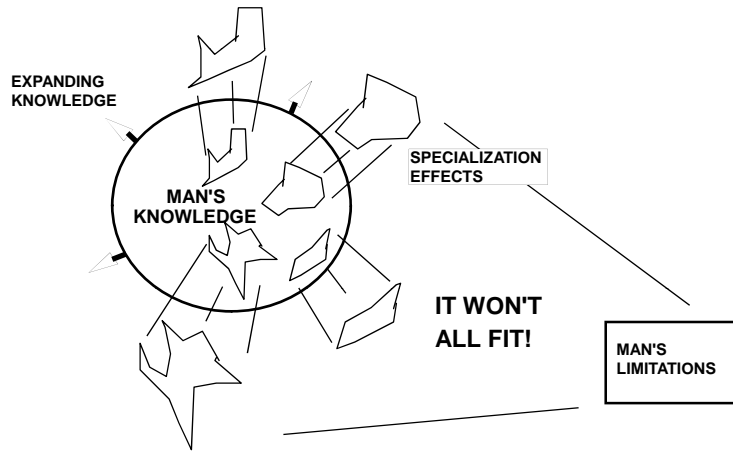
- The central question is the extent to which systems engineering applies to system development and employment today and in the future.
- I admit to a prejudice in this discussion of - OF COURSE IT DOES!
- The case is made that we system engineers will have to make some adjustments but in general the process we now understand will serve us well.
- But how will we know our people have made these adjustments?

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## Knowledge Drives System Development

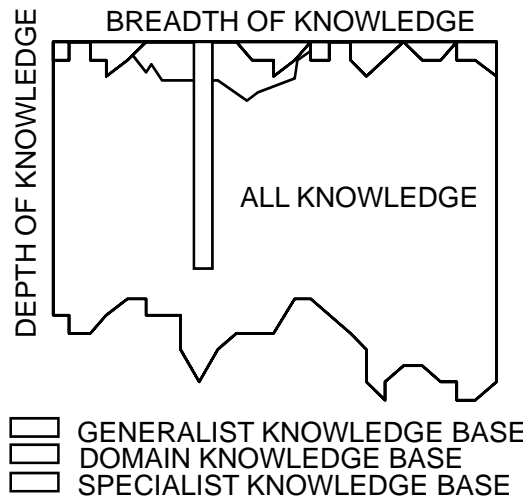


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## This Knowledge is not Necessarily Packaged in People for Easy Access



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## **Decomposition is Fundamental to Our Methods**

- **Our current methods apply decomposition to knowledge, functionality, and product structures**
- **This requires excellent integration and optimization applied in a coordinated way**
- **There are no good alternatives at present but it is not clear that we need an alternative**

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## **System Complexity Versus System Employment Ease**

- **A more complex system does not necessarily result in a more difficult operational employment so permit me to focus on development and exclude employment**
- **A case can be made that recent systems that are very complex from a development perspective can be quite easy to employ**

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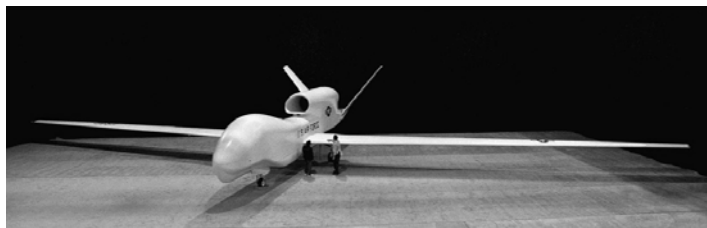
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## Past Products Provide a Foundation for Future Growth



But an increase in complexity does not always result in an increase in operational complexity – ideally it would not.



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## System Engineer Characteristics

- Wholeness rather than parts
- Knowledge breadth
- Mental agility and ability
- Communication skills
- Modeling skills
- Relationship classes
- TBD
- TBD
- TBD
- TBD

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## Characteristics of a System Engineer - Range of Interests

- System engineers are more interested in the whole than the parts
- System engineers would measure high on a scale oriented toward the system scope



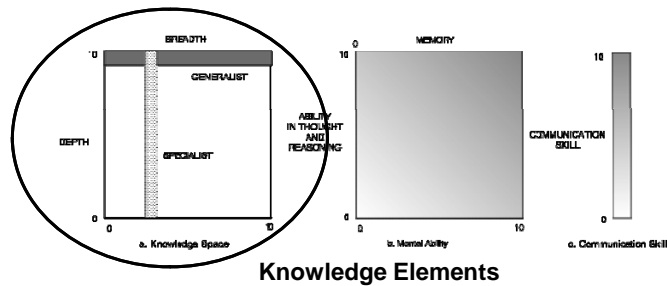
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## Characteristics of a System Engineer- Knowledge Space

- System engineers benefit programs due to their ability to cross domain boundaries and think cross functionally
- System engineers are said to be T-shaped



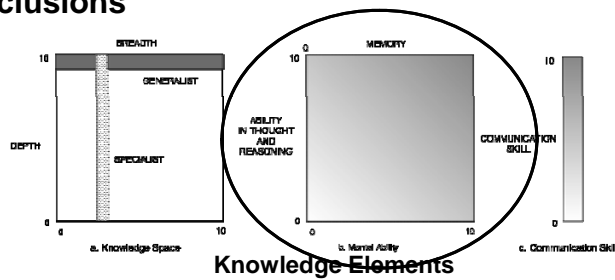
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## Characteristics of a System Engineer- Mental Ability

- A good memory helps but we may not be able to say that it is a characteristic of a good system engineer
- A system engineer should certainly possess an agile mind capable of reasoning and drawing valid conclusions



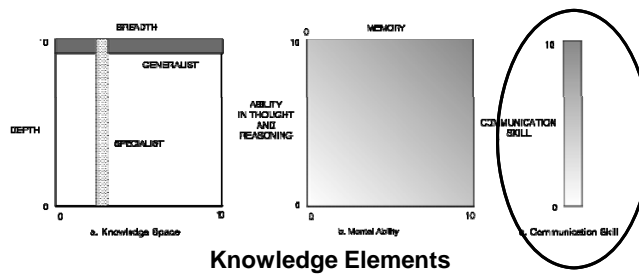
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## Characteristics of a System Engineer- Communication Skill

- System engineers should be capable of expressing themselves well, understanding others in conversation, and responding with useful ideas



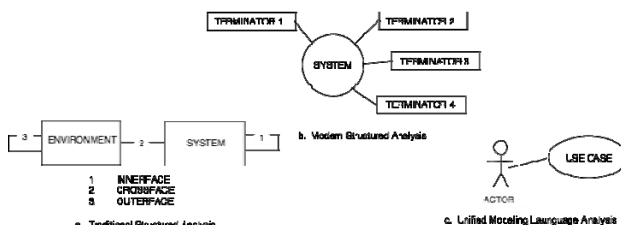
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## Characteristics of a System Engineer - Modeling

- Modeling is extremely important in the early development work of systems and system engineers should be capable of using any of these models



Ultimate Systems Views

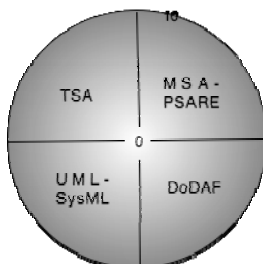
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## Characteristics of a System Engineer - Modeling

- A system engineer should be able to apply any of these modeling methods to good effect



Modeling Capabilities

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## Characteristics of a System Engineer – Relationship Classes

- **Most system engineers can handle a deterministically driven set of interfaces**
- **Future systems will call for a wider range of possibilities including:**
  - random
  - probabilistic
  - chaotic
  - 
  -

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## How Could We Score a System Engineer?

- **We Have Identified Six Characteristics**
  - Range of Interests
  - Knowledge Space
  - Mental Ability
  - Communication Skill
  - Modeling Capability
  - Relationship Class Expansiveness
- **Let us say we have missed four others**

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## Proficiency Scale

SCALE	PROFICIENCY SCALE DEFINITION	EVIDENCE
0	Not Applicable to this individual or role.	
2	Introductory	None required.
4	Basic	Training certificates or transcripts showing knowledge courses and grades. Project documentation showing successful application of knowledge and skills.
6	Skilled	Documentation showing application of knowledge and skills.
8	Advanced	Documentation showing success at the application of this competency in a team leadership position.
10	Expert	Recommendations from leaders of the business and the company attesting to the individual's expertise and providing examples of successful application of the competency.

Derived from Wells, Brian H., A Multi-dimensional Hierarchal Engineering Competency Model Framework, 2009

**Ten characteristics x 10 =100, the perfect score  
for a system engineer but 6 to 10 not bad**

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## But How About Your Future Programs?

- Will future systems be required by users/acquirers with limited funds and urgent needs?
- Will these systems require the applications of multiple technologies some of which are immature?
- Will it be necessary to solve any new problems not previously solved?
- Will man evolve possessing tremendously broader knowledge capacity?

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