System Complexity, the "ilities," and Robustness

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Problem

- Budgetary constraints will force systems to have an increased life cycle and be adaptable to a variety of missions not envisioned when the system was initially being developed.
- Systems, and systems of systems, must accommodate new opportunities that arise due to shortened technology development cycles.
- Systems engineers need to understand why successful systems perform well in the “ilities” (flexibility, adaptability, upgradeability, reliability, scalability, and robustness) and others don’t so that they can incorporate that successful thought process into the design, development, and spiral development of new systems.
- Program managers need a framework to price an option for incorporating one, some, or all of the ilities into their systems to meet evolving user requirements while minimizing life cycle costs.

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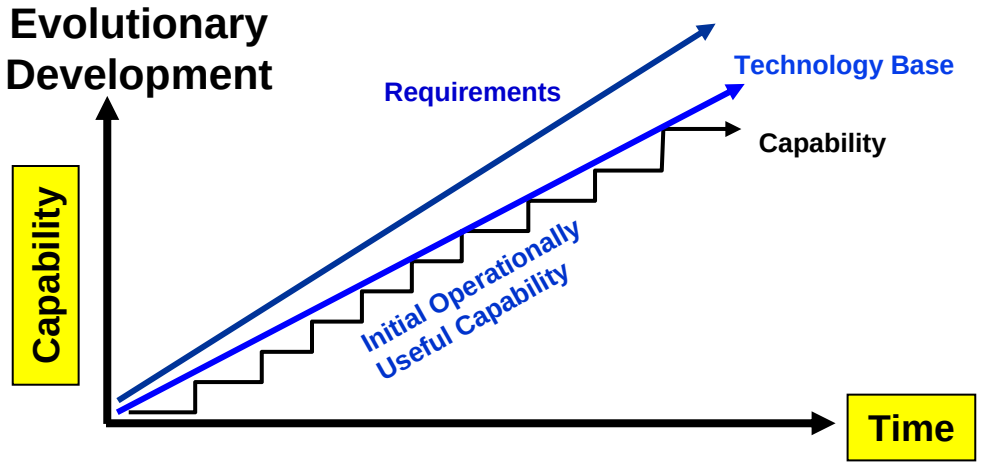
Background

- The DoD has adopted the Joint Capabilities Integration and Development System (JCIDS) process for developing and acquiring systems in a more rapid and efficient manner



- Real Options offers a possible design and systems engineering paradigm for spiral development of government and commercial systems

- Want options IN a project, not ON (go/no go) a project

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Objective

- Develop a framework to enable systems engineers to identify the initial design decisions that will support spiral development as requirements are better defined
- Determine how to invest in individual attributes (options) and groups of attributes (nested options) to possibly exercise in the future
- In essence, help the program manager make wise short-term and long-term design and investment decisions
- Extend the applications to processes and organizations

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Activities

- Experimenting with design structure matrices (DSMs) to identify platforms, where to insert interfaces, and components that require additional design margin
- Analyzing microUAVs for hot/cold spot analysis
- Developing “top down” methodology to identify options early in system definition
- Experimenting with loose coupling formula
- Analyzing SATCOM as a total system
- Analyzing Real Options in organizations

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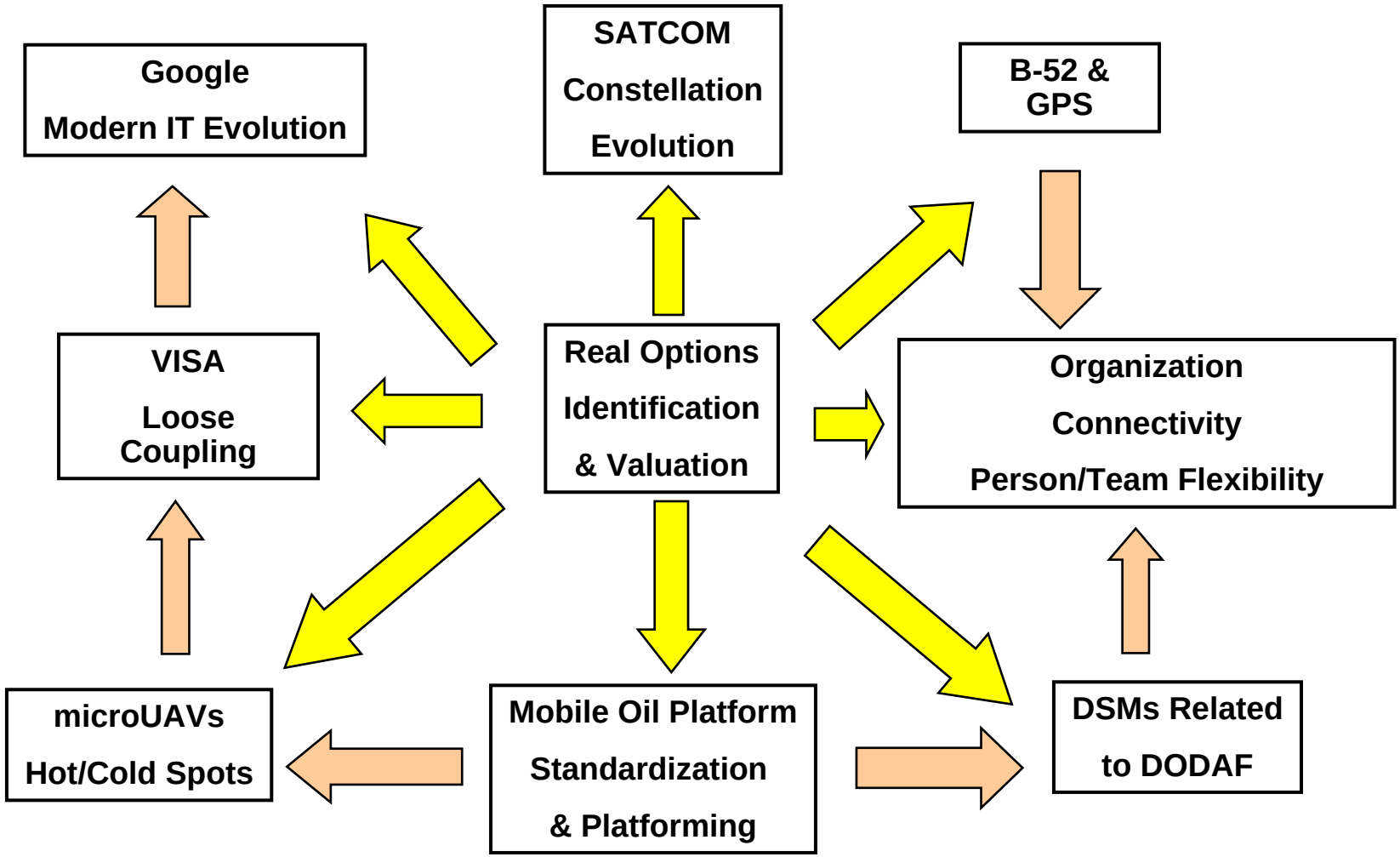
Highlight: Research Areas



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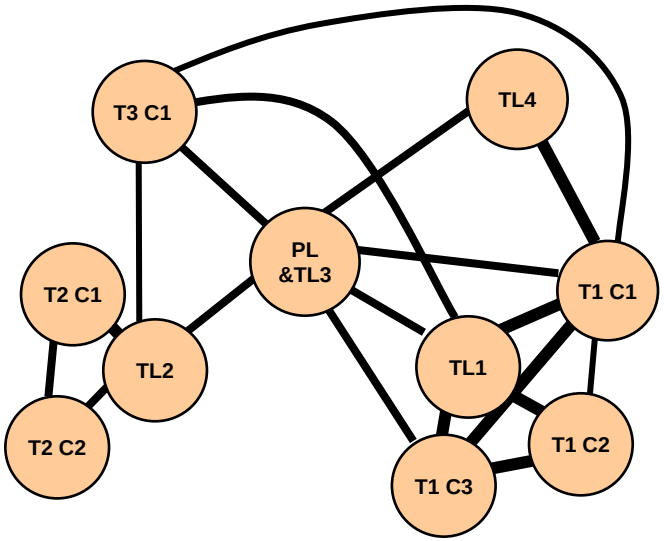
Highlight: DSM Analysis



Task, system, and team relationships are complex. It's difficult to recognize patterns that indicate potential timing, upgrade, and turnover problems.

	1	2	3	4	5	6	7	8	9	10
1! PL - TL3	*	3	3	2				3	3	3
2! T3 C1	3	*	2	2				3		
3! TL2	3	2	*			3	3			
7! T1 C1	2	2		*	1			3	3	3
8! T1 C2				1	*			3	3	
4! T2 C1			3			*	3			
5! T2 C2			3			3	*			
6! TL1	3	3		3	3			*	3	
9! T1 C3	3			3	3			3	*	
10! TL4	3			3						*

DSMs organize relationships so that practitioners can easily visualize them. Automated DSM analysis visually highlights problematic patterns.

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Impact

- Can influence the design of the vast majority of government projects
- Supports near-term goals of a PM (1–3 year horizon) who must show impact while in charge, while also supporting society's long-term goals
  - PM can decrease initial and long-term costs
  - System meets user demand when needed – good for PM and customers
  - PM avoids excessive costs when user demand is inaccurate
  - Extends usable life of systems and mission applications
- Program's initial required investment and life cycle costs should decrease

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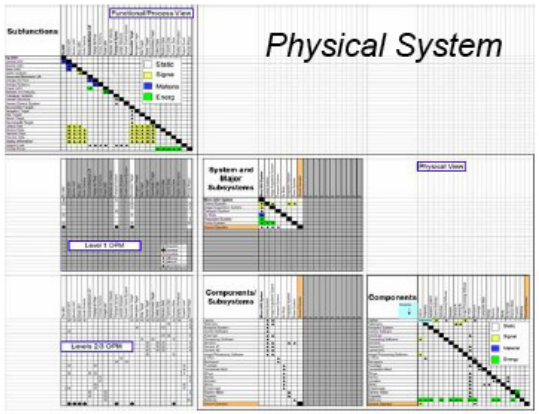
Future Plans

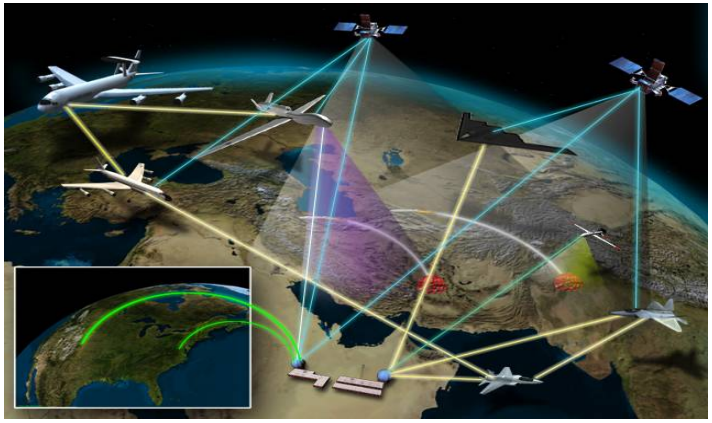


+ $$$

Identify & Value Real Options

State-of-the-Practice IT System

Systems Engineering Handbook



Airborne Network

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