

Patterns of Success in Systems Engineering *Acquisition of IT-Intensive Government Systems*



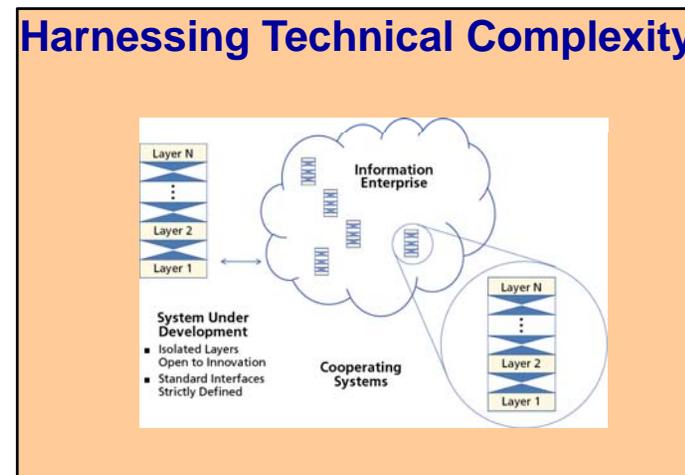
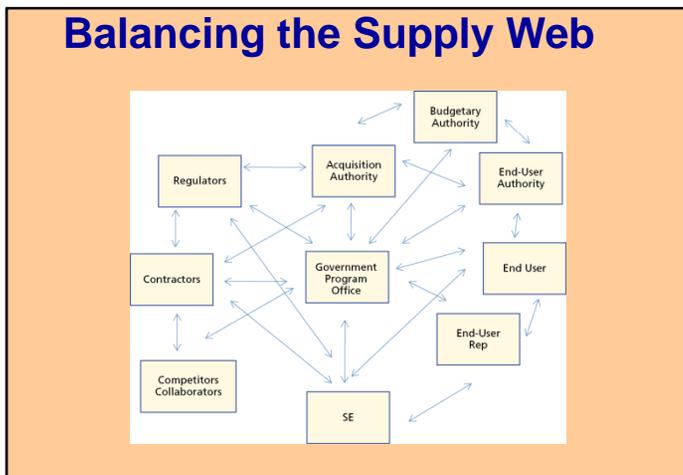
*Presentation to System of Systems Engineering Collaborators
Information Exchange*

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14 August 2012

Summary

- **Complex IT acquisitions stubbornly resist improvements**
 - In spite of progress in technology and processes
- **We applied the method of positive deviance**
 - To identify and amplify successes
- **Results captured as Design Patterns**



+ 15 sub-patterns

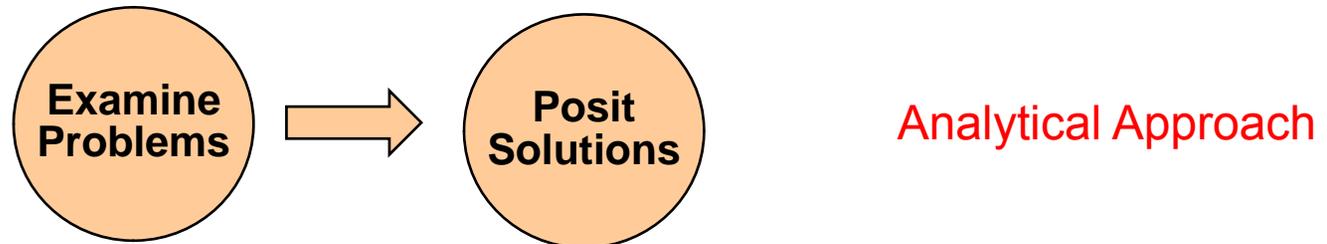


SE & Acquisition of IT-Intensive Systems

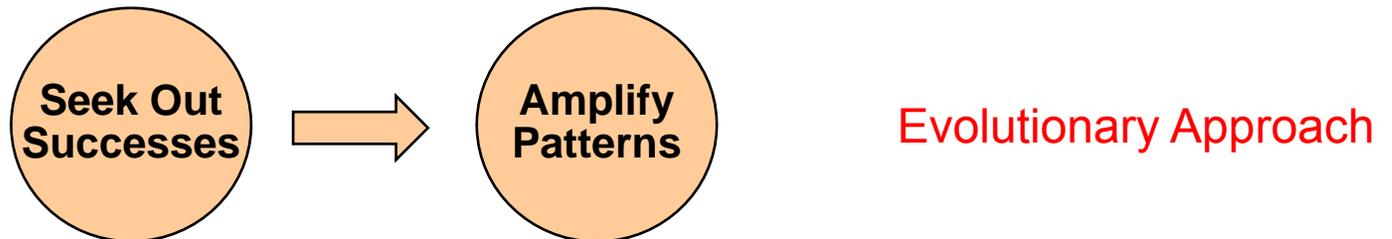
- Complex environments ... resist improvement



- Common Approach



- Positive Deviance Approach



Positive Deviance: An Evolutionary Approach to Improvement

- **Some within a community function more effectively**

- Because of their attitudes, practices, strategies or behaviors
- With the same resources & environmental conditions

- **Variation**

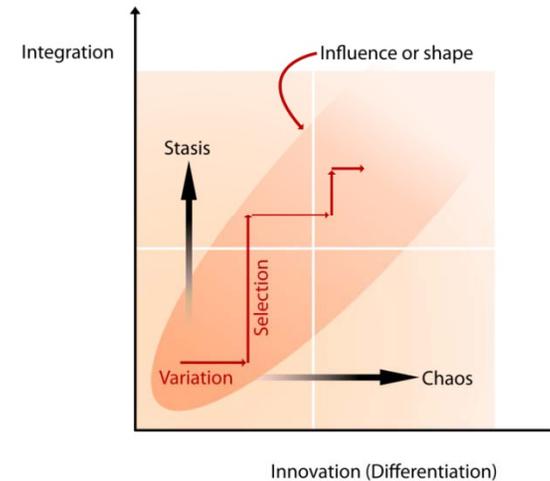
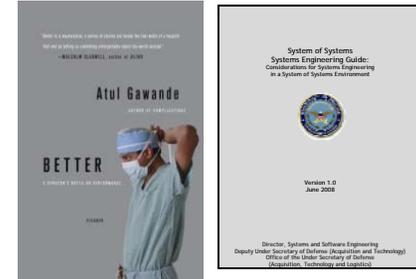
- Occurs in government department or agency SE/acquisition practices, processes & procedures
- Misunderstanding of inexperienced team
- Shortcuts to meet deadlines or other pressures
- Deliberate attempts to innovate

- **Selection**

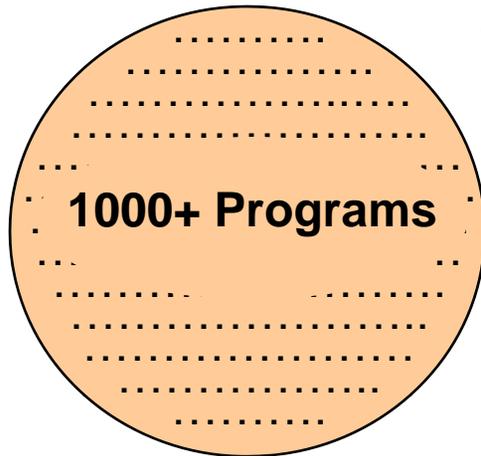
- Identify the few who have succeeded
- Determine how they do what they do
- Synthesize and package their ideas

- **Amplification**

- Communicate the ideas across the enterprise
- Set expectations that the ideas will be considered by the rest of the enterprise
- Measure and reward change in outcomes and communicate the results across the enterprise

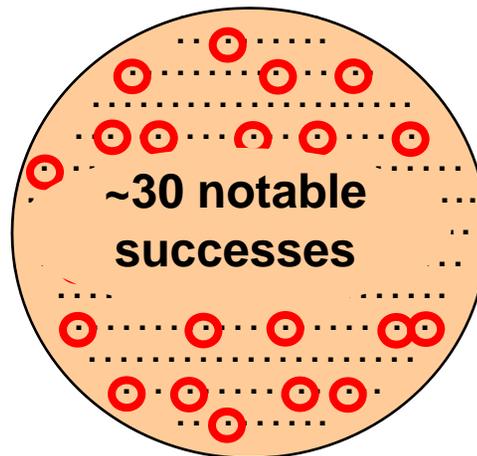


Sought Out Successes



Government IT-intensive Programs embedded in larger information enterprise

Defense, Intelligence, Aviation, Enterprise Modernization

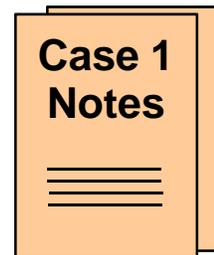


Dealt with uncertainty and conflict

-- not just program survival

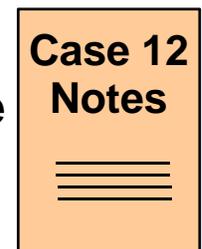
Success identified by SE community

**In-depth interviews (What U did & how U did it?)
No leading questions or shaping of discussion**



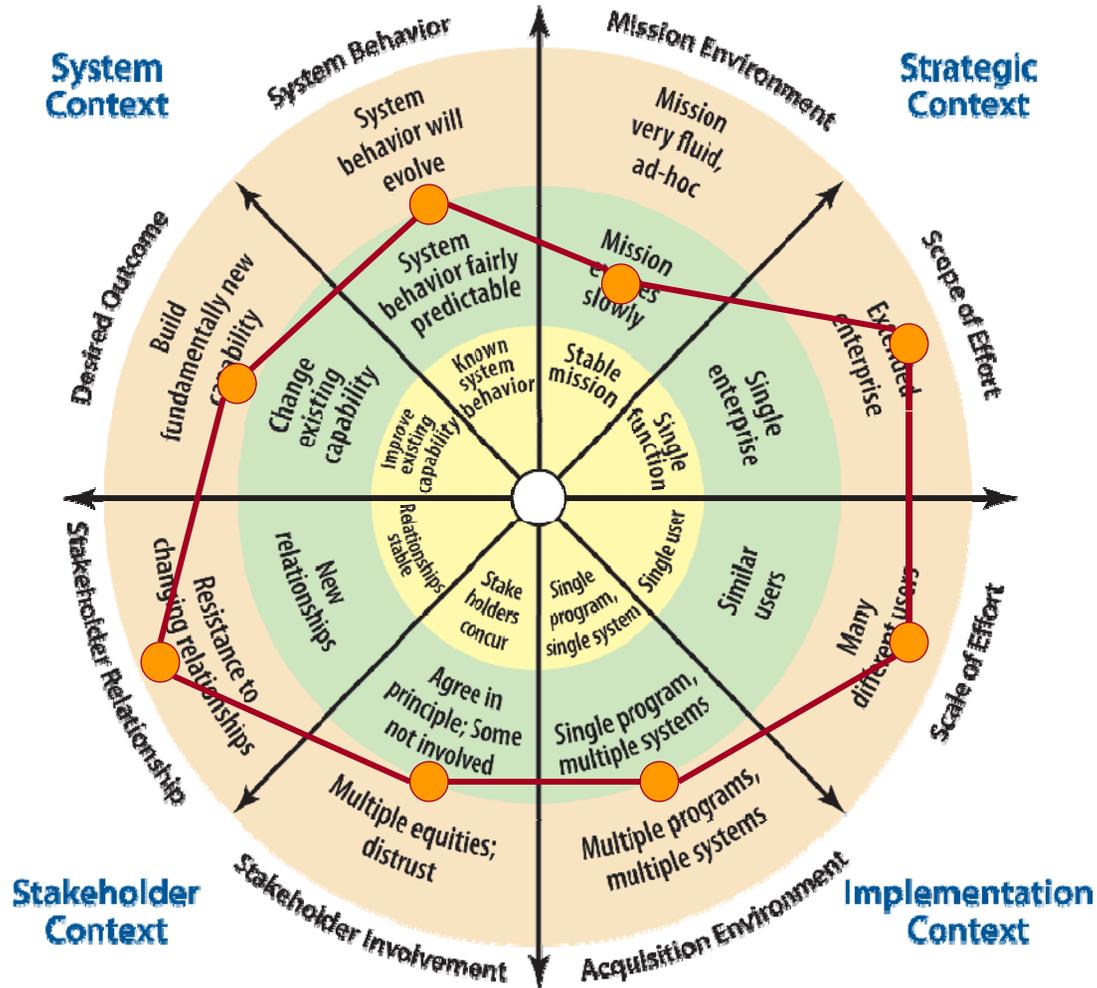
Selected 12 representative

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Profiling the Programs

Greater Complexity at Periphery

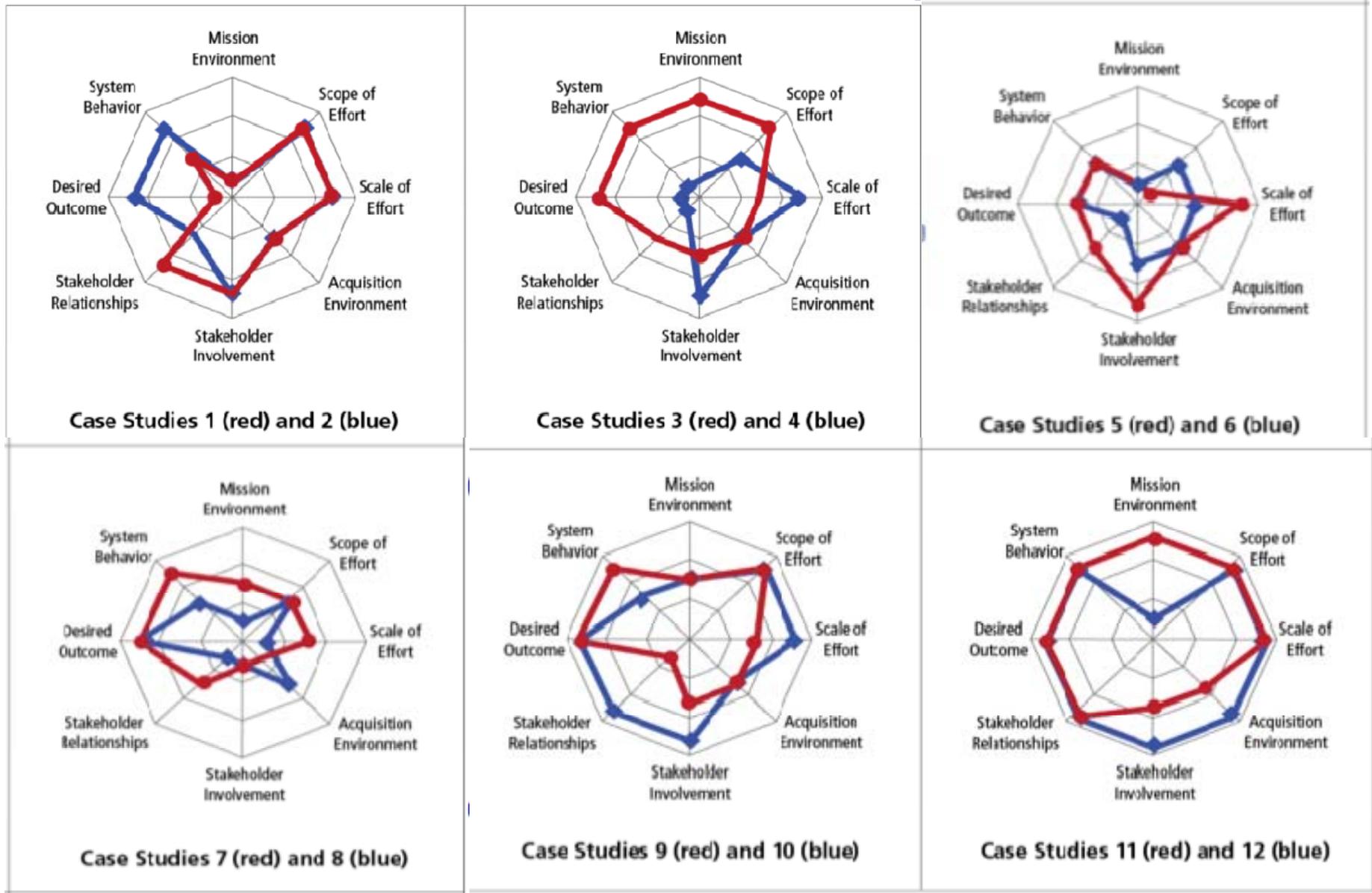


Dimensions

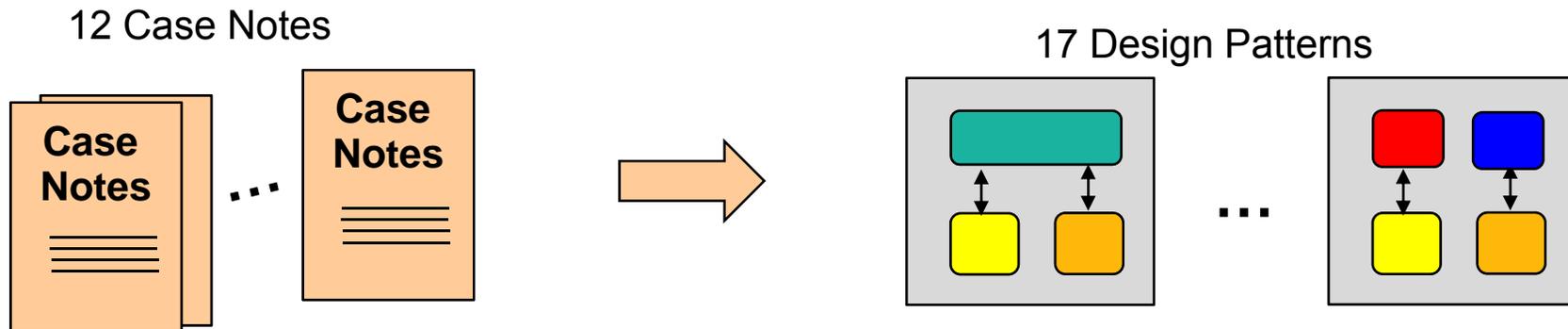
- Mission Environment
- Scope of Effort
- Scale of Effort
- Acquisition Environment
- Stakeholder Involvement
- Stakeholder Relationships
- Desired Outcome
- System Behavior

See R.Stevens, Engineering Mega-Systems: The Challenge of Systems Engineering in the Information Age, Boca Raton, Fla.: Auerbach/Taylor & Francis, (2011), pp. 118–120.

Program Complexity Profiles



Captured Successful Practices as Design Patterns



■ Design Patterns

- Used in building design, software, systems engineering
- Presents Context, Forces at work and Solution
- Capture essential nature of a design, are re-usable

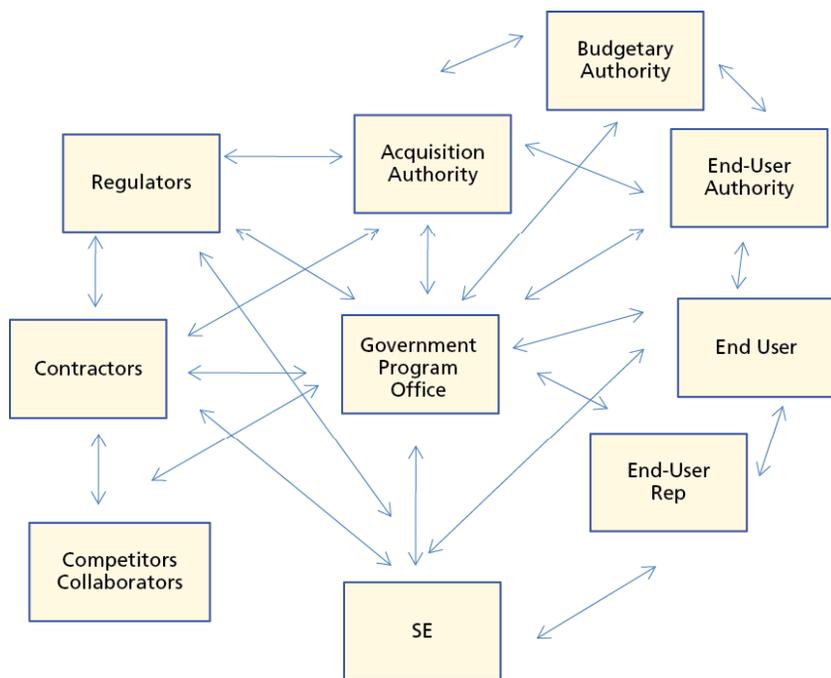
■ Key Principles

- Provide tested methods – incorporates past experience
- Latitude for innovation – to tailor to situation at hand
- Improvement via adaptation – communicability enables evolution

Large-Scale Patterns of Success

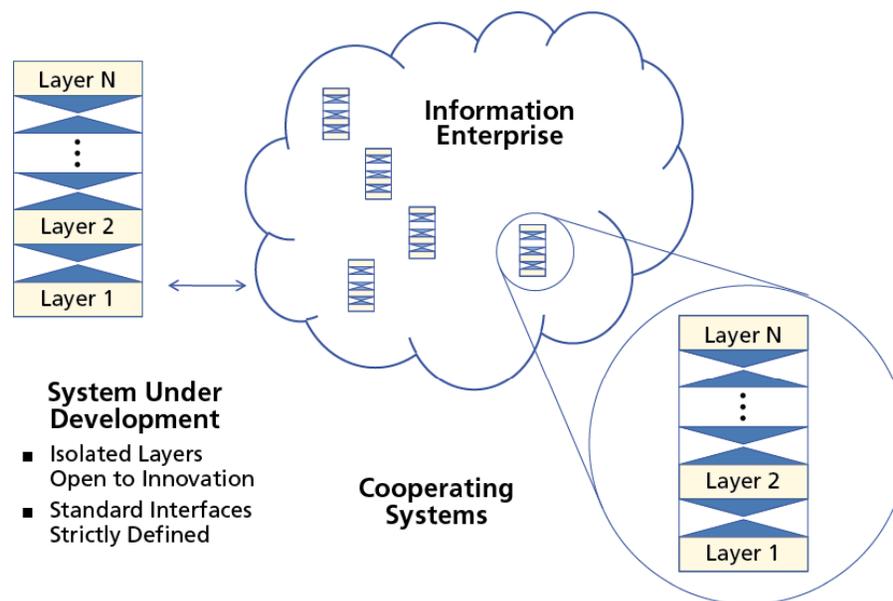


Balancing the Supply Web



Addresses “social” interdependencies among enterprise stakeholders with different equities in and influence on the capability under development

Harnessing Technical Complexity



Addresses technical interdependencies among system components that together deliver an operational enterprise capability....

Balancing the Supply Web Sub-Patterns

Sub Pattern	Description
<i>Up Close and Personal</i>	Establishes strong and intimate ties with end users to ensure satisfying a high-priority, pressing need
<i>Close, But Not Too Close</i>	Concentrates on getting a large number of end users to accept a standard set of capabilities and compensating them with rapid deliveries of their most valued capability
<i>Divide and Conquer</i>	Deals decisively with all stakeholders by dividing them into groups and satisfying each group's interests separately
<i>Circle of Trust</i>	Fosters positive social interactions among stakeholders to improve the willingness of opposing factions to compromise
<i>Role and Responsibility Subnets</i>	Clearly defines subnets within the stakeholder community for each decision or product to be supplied
<i>Seek Secondary Sources</i>	Seeks small flows of resources from secondary sources that have large impact on robustness of program and capability delivered
<i>Network Beats the Node</i>	Deliberately takes advantage of relationships in the network of stakeholders to create a resource greater than the sum of the parts
<i>Top Cover</i>	Uses informed acquisition authorities to shape the stakeholder environment

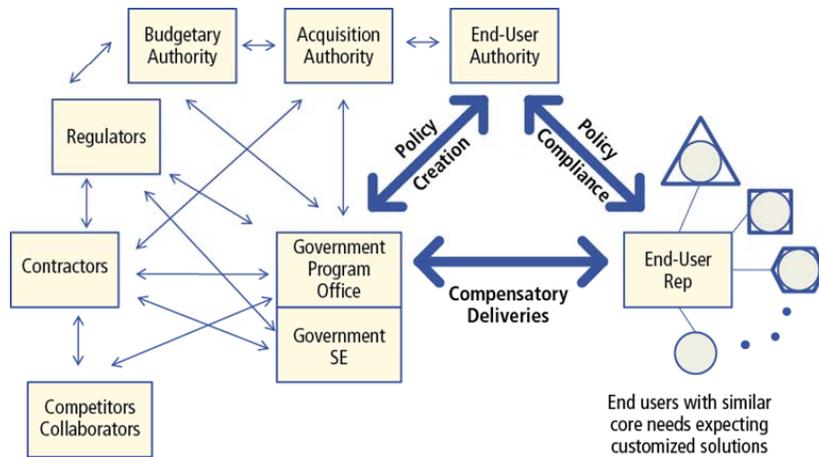
Full paper available on MITRE web site: http://www.mitre.org/work/tech_papers/2011/11_4659/

Harnessing Technical Complexity Sub-Patterns

Sub Pattern	Description
<i>Seeing Is Believing</i>	Builds a capability reference implementation for the enterprise that shows what can be done, how it works, and what it should do when done
<i>Riding on the Infrastructure</i>	Builds new capabilities on top of the existing infrastructure
<i>Loose Couplers</i>	Establishes isolation between layers and integration across the enterprise
<i>Social and Technical Alignment</i>	Aligns people, processes, and technologies to match development and acquisition to the enterprise structure.
<i>Plan to Re-plan</i>	Stimulates desired behavior through feedback and incentives, and then learns from results what behavior is desired next
<i>Technology Surfing</i>	Uses an ongoing process of identifying new and emerging technologies, experimenting with them, and integrating what works into the evolving enterprise—“catch the next technology wave” rather than “create or wait for the big one”
<i>Architect.org</i>	Government program office team assumes full responsibility for architecting and overseeing development of the system capability

Full paper available on MITRE web site: http://www.mitre.org/work/tech_papers/2011/11_4659/

“Close But Not Too Close” Pattern



<i>Close, But Not Too Close</i>	
Summary	Concentrates on getting a large number of end users to accept a standard set of capabilities and compensating them with rapid deliveries of their most valued capability.
Context	<ul style="list-style-type: none"> • Sub-pattern of Balancing the Supply Web. • A large number of users with similar needs expect customized solutions. • Users accustomed to meeting their IT needs in isolation and in their own way.
Problem	<ul style="list-style-type: none"> • Program office must deliver an enterprise solution and sufficiently satisfy independent users. • Users do not want to relinquish control. • Users acting independently will come up with different solutions. • Satisfying any one user is usually at the expense of another. • Up Close and Personal doesn't scale to a large number of different users.
Forces	<ul style="list-style-type: none"> • Pressure to drastically reduce costs and improve interoperability. • Budget is shifted from user organizations to program office. • Users believe their capabilities will be diminished and resist change. • Users retain strongly held desires for tailored design solutions. • Insufficient resources for customized solutions. • User authority sets policy and issues waivers and sanctions. • Culturally entrenched user attitudes.
Solution	<ul style="list-style-type: none"> • Stay close enough to users to understand their legitimate needs. • Not so close as to get bogged down with individual users. • Divert resources to establish good relationship with user authority. • Secure top-down pressure from user authority. • Compensate users for lack of direct control by delivering early on capabilities valued most.
Outcome or Resulting Context	<ul style="list-style-type: none"> • Substantially reduced cost and improved integration of new systems. • Users sacrificed independence for speed of delivery. • Established credibility of the program office and the enterprise approach. • Close, But Not Too Close is an expedient way to navigate a contentious supply web.

Informal Comparison to Recent GAO Report



- Similarly titled GAO report recently published
 - **GAO-12-7: INFORMATION TECHNOLOGY: Critical Factors Underlying Successful Major Acquisitions**
- Good agreement between GAO's 9 critical success factors and our report's *Balancing the Supply Web* patterns
- Less focus in GAO report on technical considerations when embedding a capability in an information enterprise
 - Our *Harnessing Technical Complexity* patterns
- Audience
 - GAO Report more directed towards policy makers and high levels of acquisition authorities
 - Our report more directed towards program office SEs and PMs
- Bottom line
 - Complementary views
 - Reading both provides a more complete picture



Summary

- **Complex IT acquisitions continue to stubbornly resist improvements**
 - In spite of substantial progress in technology, processes and efficiencies
- **A positive deviance-inspired approach has potential for reversing this trend**
 - Based on an evolutionary improvement strategy
 - Focuses on identifying and amplifying success in an environment instead of solving failures
- **Electronic version of report:**
http://www.mitre.org/work/tech_papers/2011/11_4659/



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Backups



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About the Programs: Case Studies (Renamed)

- Ground rules: authors will not publish the program names or the people interviewed.
- We renamed the programs as follows:

- Case 1: *High Priority and Expensive*
- Case 2: *Centralized Like Never Before*
- Case 3: *Large Program in Trouble*
- Case 4: *Integrating Disparate Systems*
- Case 5: *U.S. Development of International System*
- Case 6: *Bogged-Down Stakeholders*
- Case 7: *The System No One Was Using*
- Case 8: *One Cutting-Edge Technology*
- Case 9: *A Product Line Tailored for Users*
- Case 10: *Sophisticated Worldwide Planning*
- Case 11: *Worldwide Support Services*
- Case 12: *Expedition into the Unknown*



Frequency of Occurrence of Patterns

