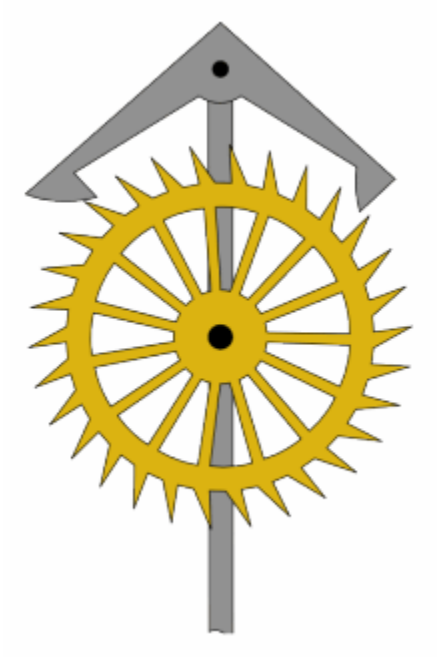


Timing it Right for Successful System Developments

Robert (Bob) Scheurer
Associate Technical Fellow
Boeing Defense, Space and Security **| Systems Engineering**

Topics for Discussion

1. Time in Our Changing Times
2. Making Sense of Patterns
3. New Insights for Realizing a Capability
4. Improving Time-Dependent Outcomes
5. Summary & Conclusions

Goal: Understand How Different Contexts of Time Can Affect System Decisions & Outcomes

Why Worry About Time and Timing?

"*Time is Money.*"
Benjamin Franklin

"*This Time, Like All Times, is a Very Good One if We But Know What to Do With It.*"
Ralph Waldo Emerson

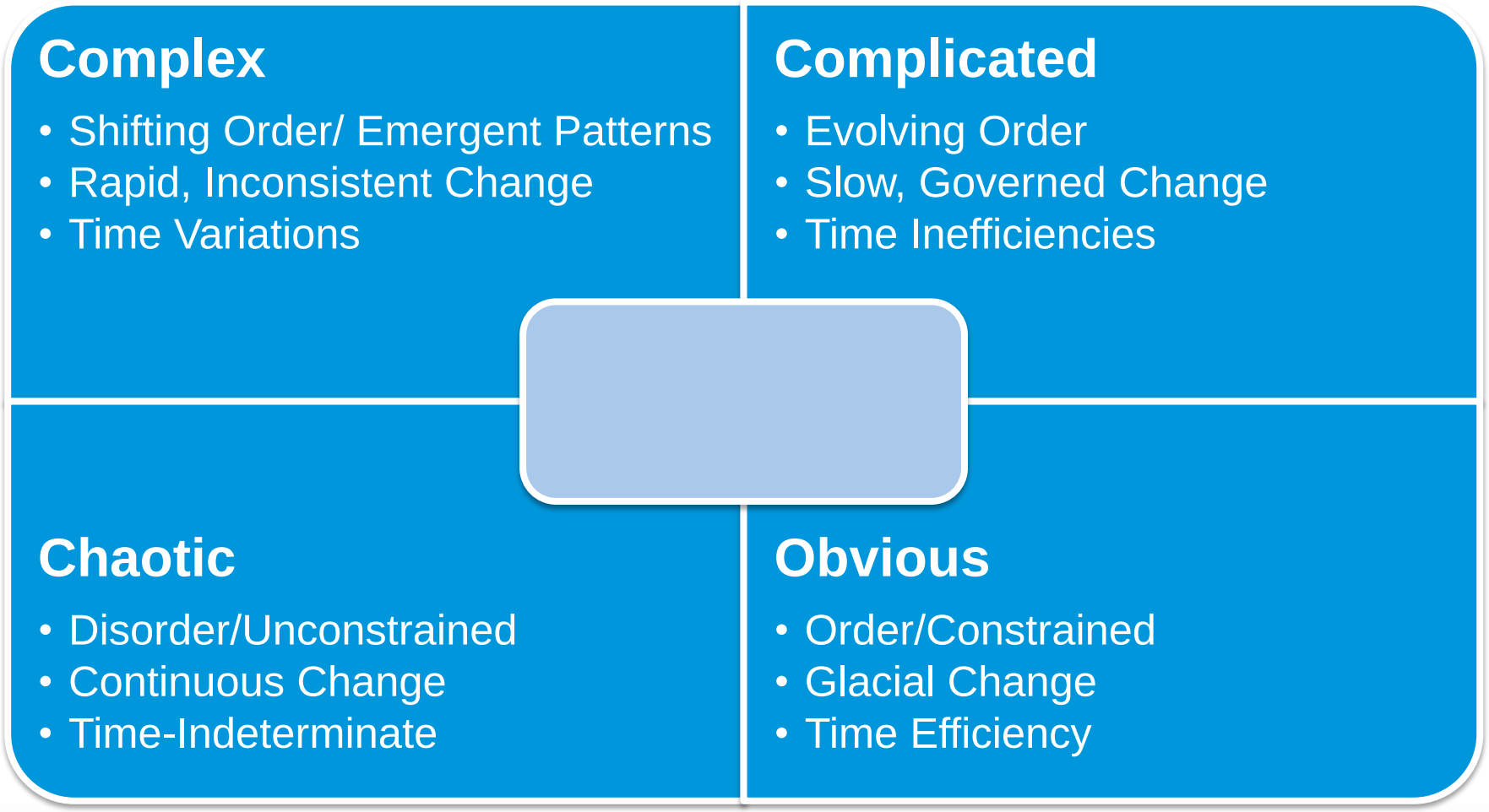
"*The Early Bird Gets the Worm, But the Second Mouse Gets the Cheese*."
Willie Nelson

Event Time, Timing, and Order are Essential to Technical and Financial Success

Today's Defense Environment: Shifting Patterns

Time and Time-Critical Decisions are Central in Today's System Developments

Recognizing Patterns of Time, Order, & Change by Domain[1, 2]

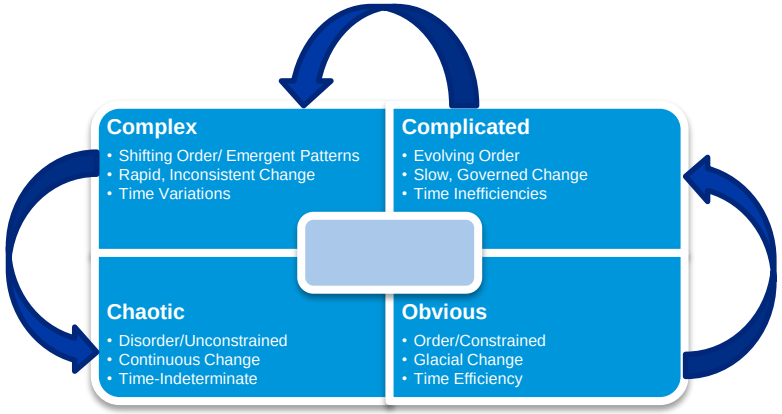


Patterns and Domains Provide Insights Regarding Time and Timing Decisions

Today's Outcomes: Volatility[3]

Instability and Conflict

- System Design Activities/Maturation Overlap with Proposal Creation
- System Architecture Incomplete Before System Design/Development Begins
- Design Maturations/Changes Cross into Production Producing Conflict with Program Execution
- Potential Inefficiencies and Risks Resulting from Schedule Compression & "Activity Tailoring"



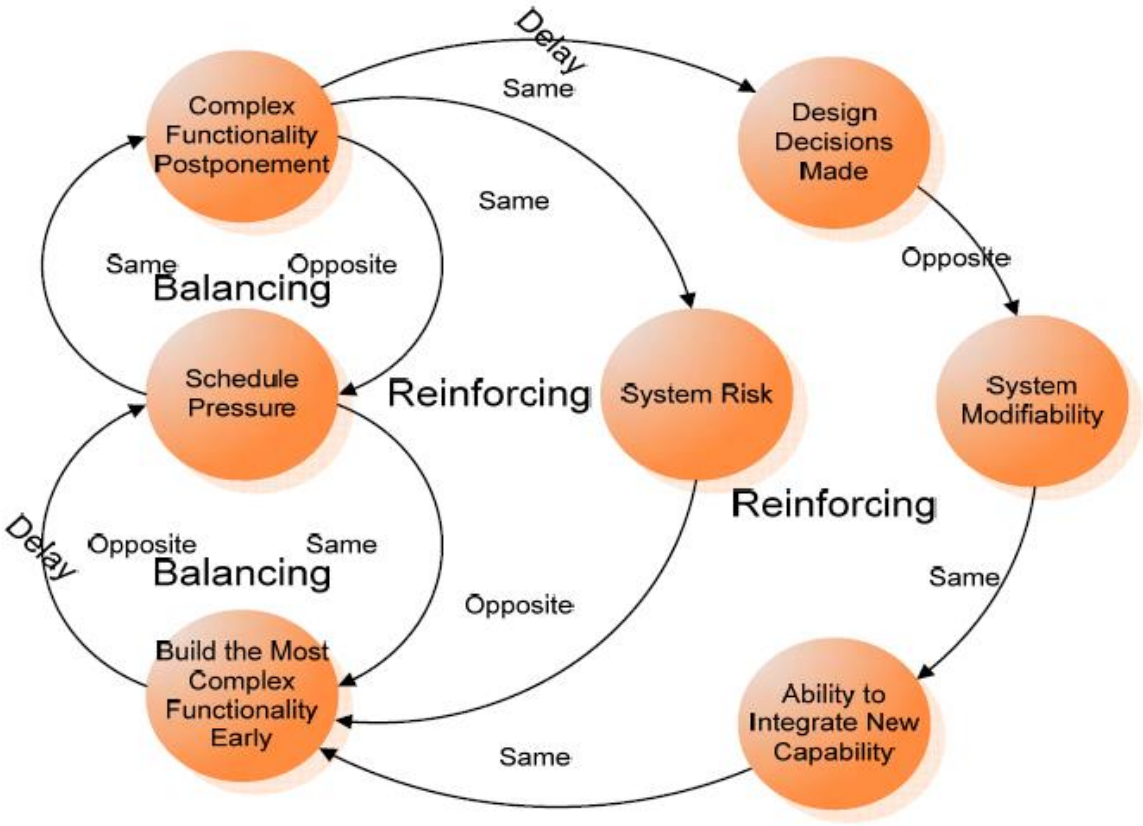
Inefficiencies and Risk Emerge from Timing/Order Issues

Today's Outcomes: Time Delays[4]

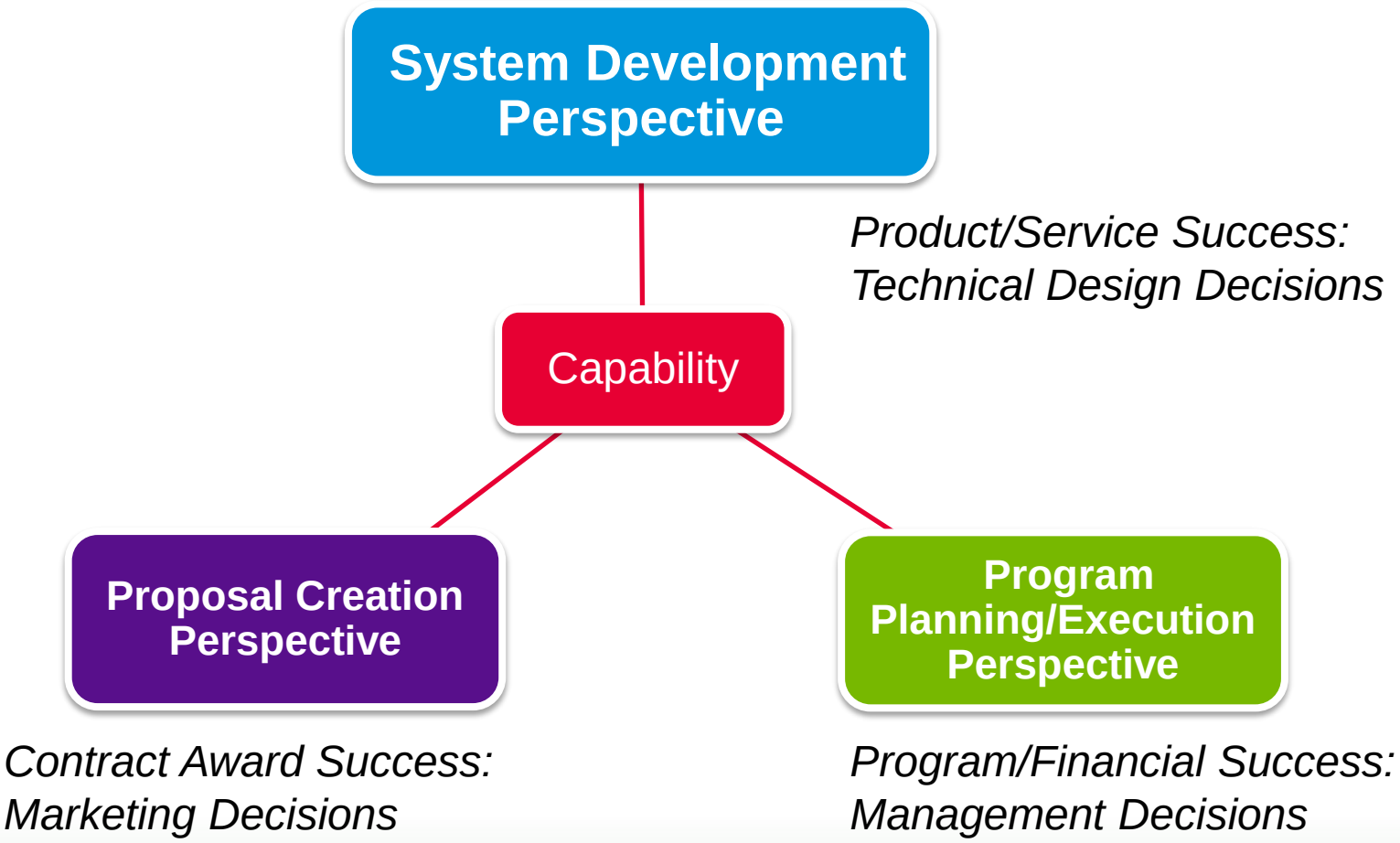
Bow Wave Effect

- Compounding of Assumptions / Delayed Decisions
- Approved Requirements Before Understanding of Cost
- Accumulation of Deferred Functionality
- Failure to Account for Complexity

A Causal Loop Diagram of the bow wave effect.



Realizing a Capability: Three (3) Interdependent Perspectives



Each Perspective Entails Different Planning Mentalities and Decisions Involving Time & Timing

Classifying Patterns for New Insights

Domain:	Obvious	Complicated	Complex	Chaotic
Environment:	• Rigid Constraints • Best Practice • Well-Defined Threat • Slow Pace of Technological Change	• Governing Constraints • Good Practice • Evolving Threats • Evolving Technology	• Enabling Constraints • Emergent Practices • New Threat-Emergence • Technology Emergence	• No Constraints • Novel Practice • Continual Threat Evolution & Emergence • Rapid Technological Change
Perspective System Development:	• Established w/minor variants • Predictable Results	• Fail-Safe Design • Repeatability • Consistent Results	• Volatile • Emergent Properties • Potential Varying Results	• Level of Effort Response • Real-Time Discovery • High Risk
Program Execution:	• Stable, Defined • Low Risk	• Predictability • Managed Risk	• Expert Judgment • Parallel Experimentation • Modeling	• Level of Effort Response • Real-Time Discovery • High Risk
Proposal Creation:	• Standard Templates	• Tailored Offers	• Multi-Dimensional Offer w/Options	• Interchangeable Conditions • Multiplicity of Alternatives
Addressing the Timing Challenges:	• Lean Principles • Rigid Plans	• Modularity • Standards Adherence	• Agile Techniques • Safe-to-Fail Experiments • Models / MBSE	• Hybrid/Flexible Plans & Schedules • Continuous Monitoring /Reporting
Example(s):	• JDAM • IDIQ Contracts	• KC-46A Tanker • IDIQ Contracts	• Bomber / F-35 • System of Systems	• Cyber Systems • System of Systems

Aligning Perspectives of a Capability and Time Domains

	Perspective / Domain Misaligned	Perspective / Domain Aligned
System	• Flawed Design • Inconsistent Performance • Undesired Behavior	• Balanced Design • Reliable Operation • Compliant Solution
Program	• Bad Decisions / Rework Strategy - Needs Disagree • Mis-Ordered Events • Compounding Costs	• Optimum Decisions • Seamless Execution • Orderly Transitions • Efficient Performance
Proposal	• Missed Urgencies • Inconsistent Messaging • Incomplete Coverage • Flawed Rationale	• Timely Delivery • Compelling Messaging • Compliant & Efficient Offer • Winning Result

Making Up Time

Information Shortcomings

- Systems Thinking Techniques / Causal Loop Diagrams
- Safe to Fail Experiments
- Internet / Crowd-Sourcing

Skillset Shortages

- Journeyman/ Apprentice Pairing
- Just in Time Training
- Rapid Skills Acquisitions (Consultants)
- Talent Pool

Judgment Shortcomings / Bad Decisions

- Adapting Decisions for Changed Environment (ala Cynefin)
- Redundancy / Back-Ups in Resources and Talent
- Use Expert Opinion (e.g., In Complex Environment)

Timing Better Outcomes[5]

Agile Design of Systems

- Development & Integration in **Time Increments** (a.k.a. Sprints)
- Identification **of Iteration Loops** and Work Done in Each
- **Continuous Verification** of Work Products
- **Project Control Adjustments** Based on Tighter Feedback Cycles/Iterations

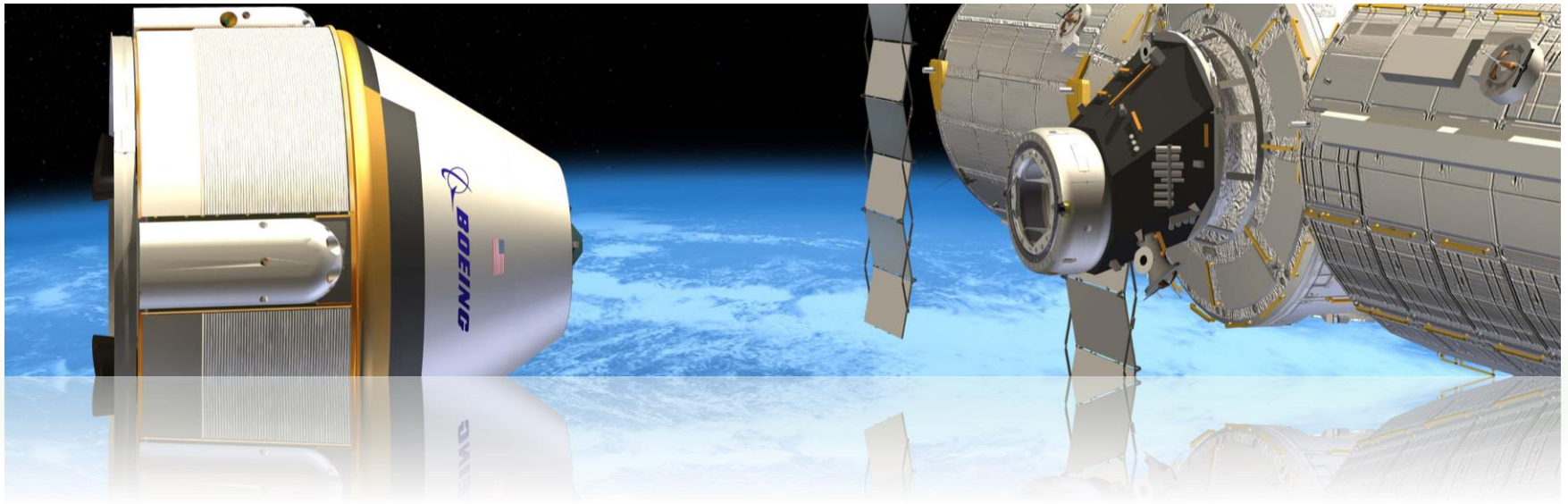
Dynamic Planning *or* *Dynamic Project Enactment*

- **Dynamically Re-Plan** as More is Learned and as Things Change
  - Identify Tasks to Be Performed
  - Determine 50%, 80%, and 20% Estimates
  - Highlight Task Dependencies and Assign Resources
  - Construct “Working Schedule”, “Customer Schedule”, & “Goal Schedule”
  - Incentivize the Goal Schedule
  - Adapt to Changes, Update, and Re-compute the Schedule

Agile Design and Dynamic Planning Enable Schedule Flexibility and Potential for Better Outcomes

More Time Saving and Recovery Methods

- Resiliency in System Design: Accommodate Unexpected Inputs
- Adaptability: Deal with Unanticipated Environments
- Higher-Level System Safeguards: Address Emergent Behaviors
- Schedule “Crashing” or “Fast Tracking”: Over-come Schedule Delays and Manage Accelerations
- Urgency/Importance Determinations: Enable Prioritization of Activities



Summary & Conclusions

1. **System Development Success via**
   - **Interdependent Perspectives** of System Design, Program Plan/Execution, and Proposal Creation
   - **Domain Patterns** in Obvious, Complicated, Complex, and Chaotic
   - **Aligning Perspectives with Domains**
2. **Planning and Recovery Techniques**
3. **Time and Timing Matter:**
   - Time is Money
   - Know What to Do With Time …at Any Time
   - Good Timing is No Accident (i.e., the Early Bird and the *Second* Mouse)


BOEING

References

1. "Using Cynefin to Solve Problems While Navigating Uncertainty", http://www.lean.org/LeanPost/Posting.cfm?LeanPostId=444
2. "People Issues and Solutions to Use or Avoid; Synthesis Using the Cynefin Framework" https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjB5Yrv7fNAhVB8mMKHb8ECKcQFggeMAA&url=https%3A%2F%2Fwww.northumbria.ac.uk%2Fstatic%2F5007%2Fceispdf%2Fdelpecf.pdf&usg=AFQjCNGovMyrbu6FjffggX_7F1dvlwIsSw
3. Holt, Steven; Collopy, Paul; DeTurris, Dianne; "So it's Complex, Why do I Care?, Trans-disciplinary Perspectives on Complex Systems", 2017
4. Carnegie Mellon Software Engineering Institute; "Acquisition Archetypes: The Bow Wave Effect"; 2007
5. Douglass, Bruce Powel; Agile Systems Engineering; 2016
6. Project Management Institute, "Guide to the Project Management Body of Knowledge (PMBOK) – 5th Edition", 2013
7. INCOSE; Systems Engineering Handbook, 4th Edition; 2015

Abstract

For systems engineering success on programs, timing is everything. Whether it be timing risk reduction activities in preparation of an RFP response, scheduling the right skills at the right time during an execution, or implementing earlier verification activities to expedite a system completion, timing matters. That fact coupled with the costs of development resources for proposals and programs means that any misuse or loss of resources due to bad timing contributes to waste, which simply cannot be tolerated in today's age of tight schedules and cost constraints.

Getting the timing and order of events right to maximize success implores a disciplined and thoughtful application of classic and new systems principles to the problem; a problem that's well-understood in regard to timing needs, with solution components properly planned and sequenced for all stakeholder interests. When combined with the possibility of what works in one instance may not work in another, what and how much systems engineering is needed may vary for different situations and domain complexities.

This presentation will explore contributors to program risks arising from timing matters. It will examine the differences in timing and planning mentalities for proposal preparation, program planning, and system development. It will also examine how the decision-making environment and other complexities must be considered to appropriately adjust activity timing and plan tailoring. Finally, it will examine what can be done to overcome shortcomings in information, skillsets, judgments, and other factors contributing to undesirable results, ---ultimately turning a difficult, unpredictable situation into a successful outcome.