

Quantitative Model Olympics

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Agenda

- Business Environment
- Raytheon IDS Organization and Products
- Model Pentathlon Overview
- Target the Important
- Attack Performance
- Dive In and Swim Through the Test Data
- The Long Run
- Negotiate the Course
- Model Pentathlon Summary
- Questions
- Presenters' Biographies

Business Environment

- New acquisition model
- Memos from Ashton Carter
- Budget concerns from our customers
- Firm Fixed Price
- Sole Source are now competitive bids

Business Environment

“ we must put our fiscal house in order here at home and renew our long-term economic strength. To that end, the Budget Control Act of 2011 mandates **reductions in federal spending, including defense spending.**”

- President Obama on the Defense Strategic Guidance (1-3-2012)

“**“Mandate affordability as a requirement”** is the first initiative in the first area of the Better Buying Power initiatives “target affordability and control cost growth”. Better Buying Power defines affordability as **getting more warfighting capability without spending more money.** Affordability means to manage programs for weapons or information systems without exceeding our available resources. Those resources include funding, schedule, and manpower.”

- Integrated Product Support Element Guidebook, 2011 Defense Acquisition University

Business Environment

**ENVIRONMENT DICTATES
HIGHEST PERFORMANCE
AT THE LOWEST COST**

**HOW DO WE LOOK AT THINGS
DIFFERENTLY?**

Raytheon IDS Organization

Integrated Defense Systems is Raytheon's leader in Global Capabilities Integration through connected people, performance, relationships and solutions.

IDS MISSION CENTERS



Raytheon IDS Products

Raytheon
Missile Defense Solutions
Sensing



Raytheon
Missile Defense Solutions
Command & Control

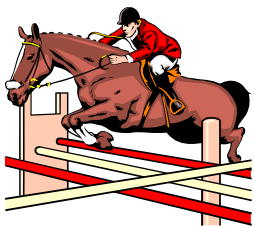


<http://www.raytheon.com/capabilities/missiledefense/>

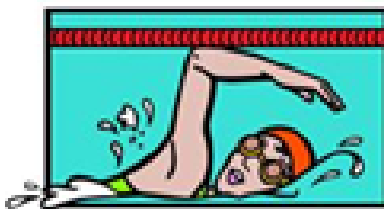
Missile Defense Solutions
Interception



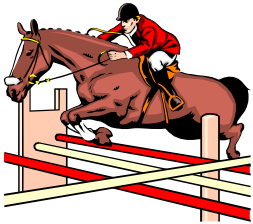
Modern Pentathlon



- Equestrian
- Cross Country
- Fencing
- Shooting
- Swimming



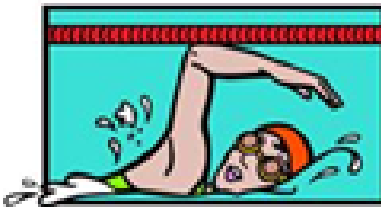
Model Pentathlon Overview



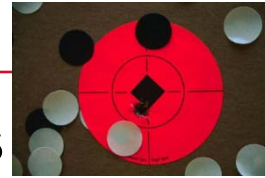
Raytheon IDS

Quality & Process Performance Objectives:

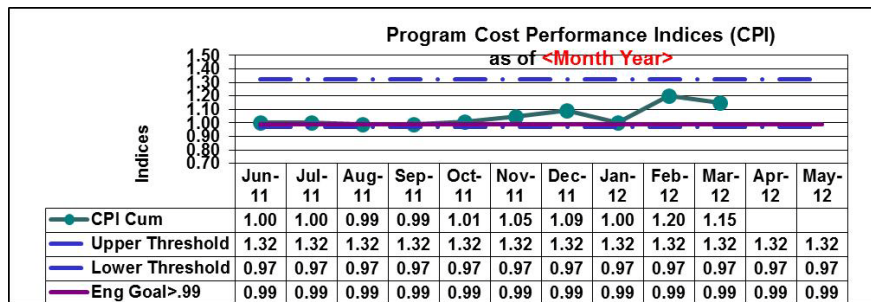
- On-time Deliverables
- Cost and Schedule Performance
- Engineering Productivity
- Reducing Rework



Target the Important



- Goal – Actual – Outlook – Observe – Further Analysis
 - First set up Measurement & Analysis and Project Monitor & Control
 - Look for the measures that have the biggest impact on achieving business goals and then look for the best opportunities to improve.



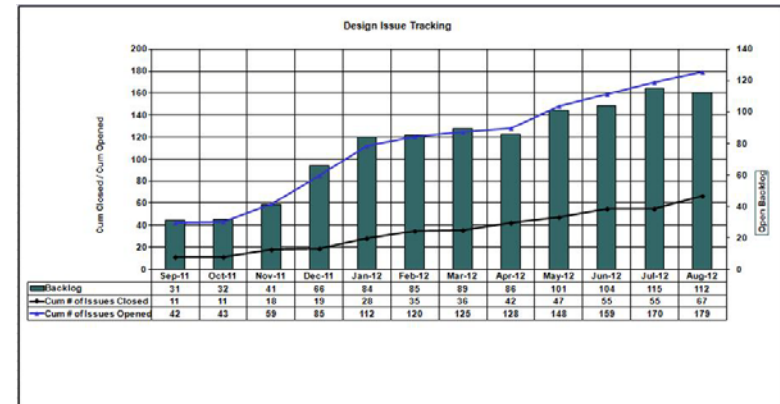
CPI Question: Is the project performing to plan in achieving anticipated progress for the current WLED program expenditures?

Observation: Is Cum value within the upper and lower thresholds? Does it meet the Eng. goal of >.99? Is there a trend? Are there Data Integrity issues?

Root Cause: Determine the underlying cause. Use NA only when meeting/exceeding the Eng. goal, within the WLED thresholds, and not exhibiting negative trend.

Impact to Project: State Short and Long term Cost and Schedule Impact; any Cost and Schedule Impact to next higher assembly. Use NA only when meeting/exceeding Eng. goal, within thresholds, and not exhibiting negative trend.

Corrective Action: Addresses root cause. Addresses project Cost and Schedule Impact when mitigation is required. Use NA only when meeting/exceeding Eng. goal, within thresholds, and not exhibiting negative trend.



Observations: Is Cum Opened 20% greater than Cum Closed? Has Backlog continuously increased for the past 3 months? Has Backlog increased from last month's Backlog by > 20%?

Root Cause: Determine underlying reason. Use NA only when Cum Opened < 20% greater than Cum Closed, and when Backlog has not continuously increased for the past 3 months, and when current Backlog is < 20% increase from previous month.

Impact to Project: Short and Long term customer Cost and Schedule Impact. Use NA only when Cum Opened < 20% greater than Cum Closed, and when Backlog has not continuously increased for the past 3 months, and when current Backlog is < 20% increase from previous month.

Corrective Action: Addresses root cause. Addresses project Cost and Schedule Impact when mitigation is required. Use NA only when Cum Opened < 20% greater than Cum Closed, and when Backlog has not continuously increased for the past 3 months, and when current Backlog is < 20% increase from previous month.

Direct your efforts for higher ROI

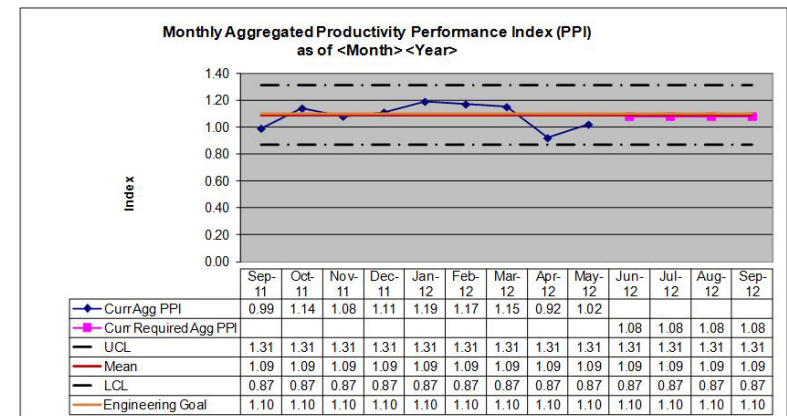
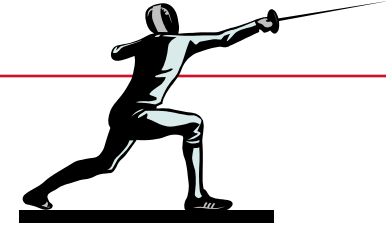
Define the Bullseye

- Goal – A performance target. Chosen by the program or the organization and can be found in a plan.
- Threshold – An upper or lower bound beyond which corrective action must be investigated. Chosen by the program or the organization and can be found in a plan.
- Baseline* - A documented characterization of process performance, which can include central tendency and variation.
- Quality and process performance objectives* - Quantitative objectives and requirements for product quality, service quality, and process performance.

Where do you expect your performance to hit?

Attack Performance

- Collect data – Cleanse – Process Performance Baselines – Actuals – Improve – Re-Baseline
 - Statistical Process Control
 - Watch our natural tendencies
 - How are we performing compared to:
 - Our Historical Distribution
 - The Business Objectives
 - Attack the Special Causes of Variation
 - Attack the Common Causes of Variation to increase predictability



PPI Question: Is the project achieving planned WLED Program Productivity improvement?	
Observations:	Is process stable? Is it capable of meeting goal? How does current month data point compare to goal? Is process capable of meeting Required Productivity? If process not stable, which WE rules apply (Test 1 is one point outside a Control Limit)? Is there a trend (Comparison of current data point to previous data point(s)? Data Integrity issues?
Root Cause:	Determine underlying reason. NA only when process is stable, and capable of meeting goal and meeting Required Productivity.
Impact to Project:	Short and Long term Cost and Schedule Cost and Schedule Impact; any Cost and Schedule Impact to next higher assembly. NA only when process is stable, and capable of meeting goal and meeting Required Productivity.
Corrective Action:	Addresses root cause. Addresses project impact when mitigation is required. NA only when process is stable, and capable of meeting goal and meeting Required Productivity. Include outlook date for expected recovery.

Use your historical data to tell you where your tendencies are



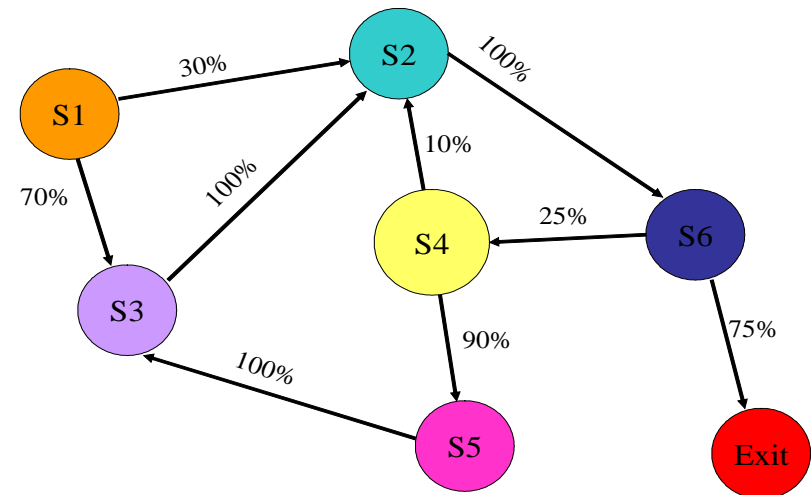
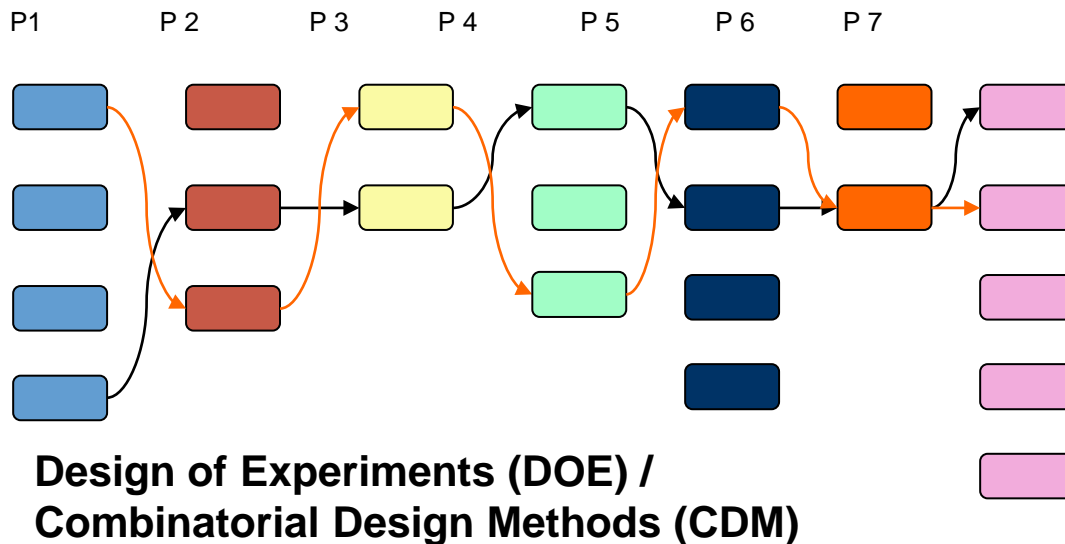
Dive In and Swim Through the Test Data

- Industry studies have estimated test and rework to represent between 30 and 50% of product development costs. Given this investment, test represents fertile ground for high maturity optimization techniques.
- When you must test a subset of all combinations, how do you choose an appropriate subset?
- The integrated application of statistical methods, most notably Design of Experiments (DOE) & Combinatorial Design Methods (CDM), has been cited by the Department of Defense as an industry best practice in this space.

Testing all possible combinations may be infeasible!

Swim Through the Test Data and Identify Lanes

A quantitative assessment of existing test coverage and statistical generation / analysis of alternative highly efficient and effective test plans.



Use-Case Stochastic Modeling

The model will direct you to the right focus lanes

Swimming Tools (rdExpert2™)

- Utilizes mathematical foundations of DOE & Applied Statistics
- Test & Evaluation Assessment
 - Analytically assesses existing test plan for its critical domain coverage utilizing Combinatorial Design Methods
 - Identifies specific test gaps
- Test & Evaluation Optimization
 - Generates balanced and optimized orthogonal test cases that reduce T&E cost, schedule and risk using d-optimal design algorithms
 - Prioritizes test cases for technical importance, cost, and/or schedule
 - Automatically generates test scripts/procedures ready for execution
 - Orthogonal array test design enables isolation of potential root causes of failure

**Increase Critical Domain Test Coverage
Effectiveness & Efficiency**

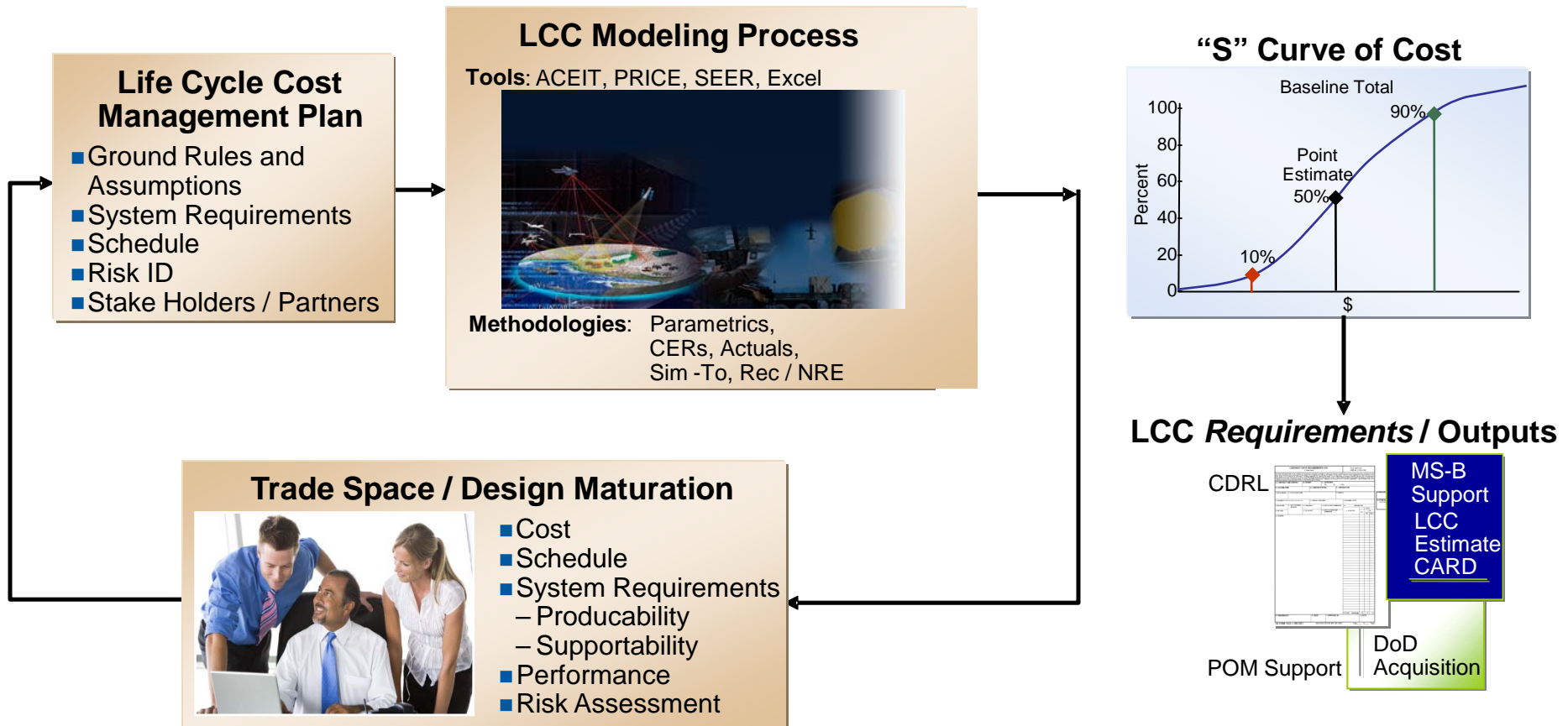
Winning the Swim

- Side-by-side program comparison vs. traditional methods across six programs has resulted in an **overall average test case and cycle time reduction of 30+ %** while maintaining or improving upon existing test coverage.
- Use of rdExpert™ suite of test optimization tools & techniques achieved benefits of:
 - Increased Mission Assurance
 - Optimized performance
 - Improved cycle time
 - Increased productivity
 - Reduced cost

Better test coverage with fewer cases



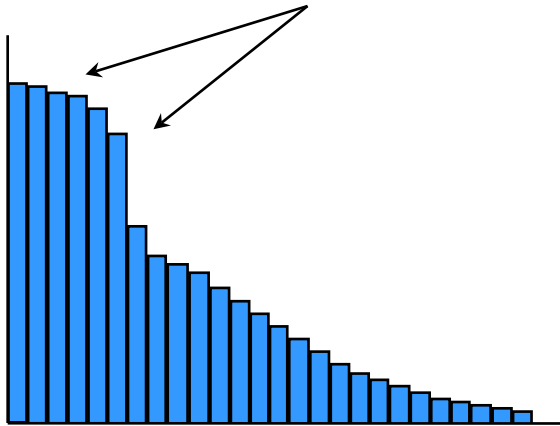
The Long Run



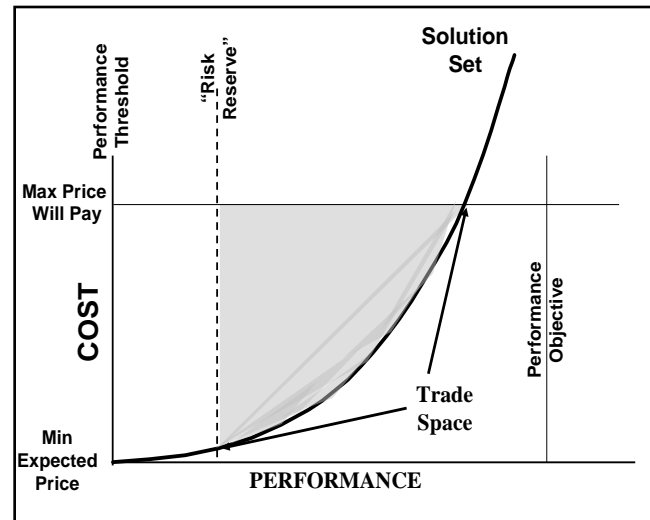
Raytheon IDS Process – O & S

- O & S estimates are developed with the primary focus on the top cost drivers – typically energy and manpower
 - Energy cost estimates are discreetly calculated using power demands and required power source (commercial or generated)
 - Operations and maintenance manpower is estimated by comparison with similar systems with consideration on reducing manpower through system automation
 - Use predictive estimates for depot level reparable based on logistics failure rates and average repair costs considering replenishment due to toss and condemnation rates
 - Estimates of technology refresh, modernization, and obsolescence based on historical data from similar systems
- Evaluate the O & S contribution to total ownership cost and determine if it is within the expected range for the type of program
- Conduct cost reduction initiatives to reduce O & S on selected drivers

Trading Cost and Performance

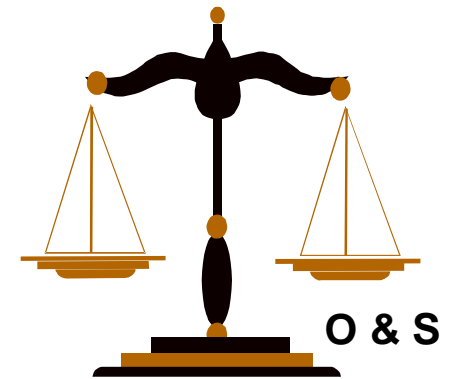


- System Spec Trades
 - Radar Power
 - Number of Objects
 - Radar Cross Section
- Architecture Trades
- Technology Trades



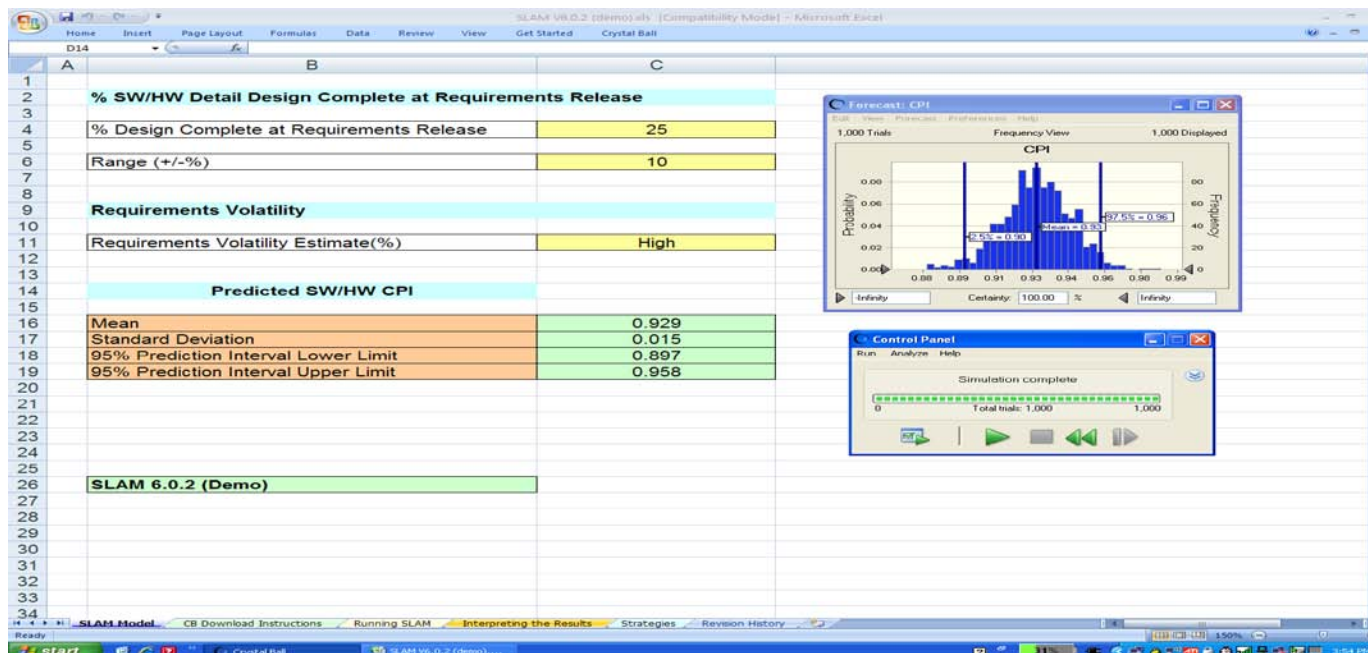
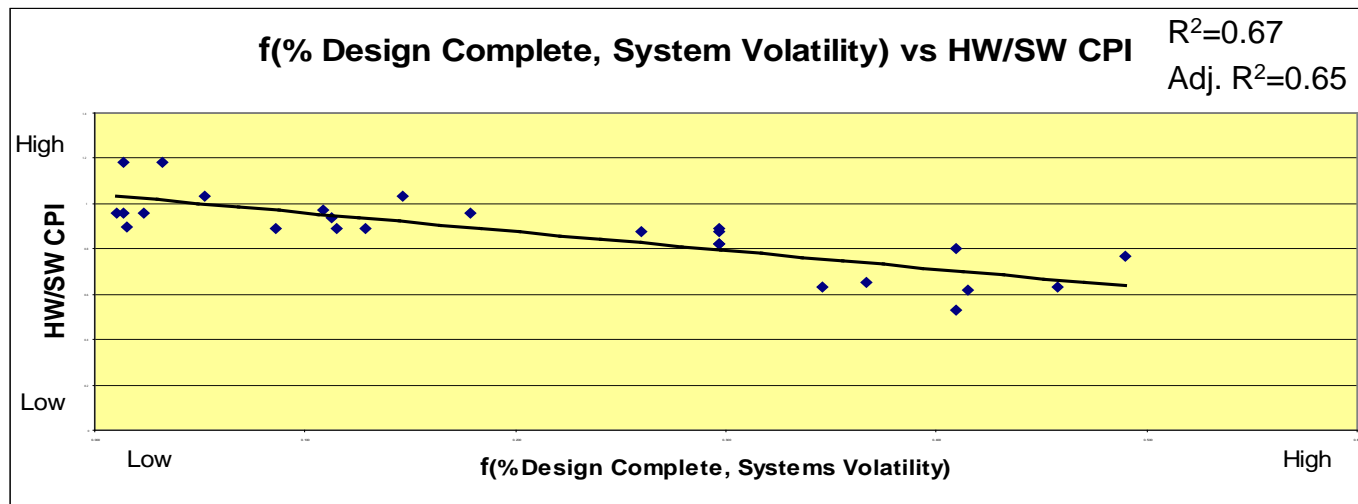
- Perform Trade Studies
- Evaluate LCC impact through excursions and scenarios in ACEIT
- Combine scenarios to develop optimal solutions
- Track and identify impacts to LCC

Balance potential solutions for optimal LCC affordability

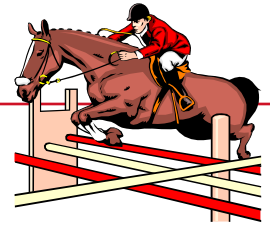


- Maintain LCC Model which can quickly reflect results of Trade Study excursions
- Multiple “what ifs”

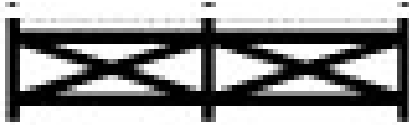
System Lifecycle Analysis Model (SLAM)



Negotiate the Course



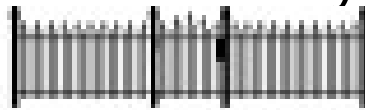
Performance



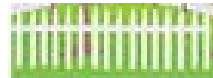
Human Systems Interface



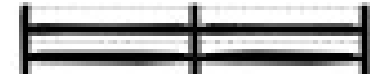
Affordability



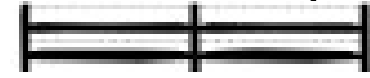
Cost



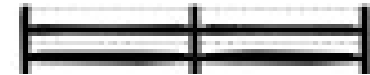
Availability



Reliability



Maintainability



Safety



Optimize Competing Requirements

Negotiating the Course

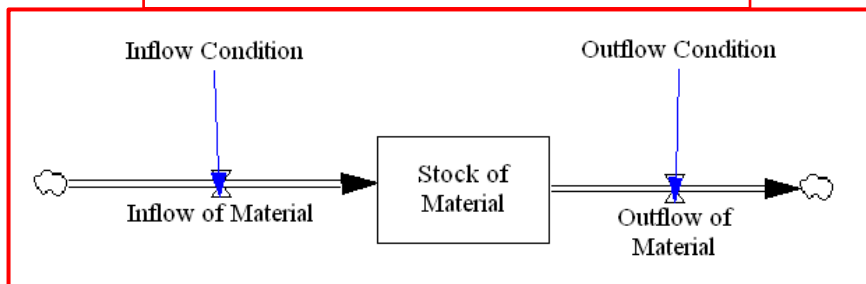
- Performance and Cost
 - Performance requirements
 - Number of targets simultaneously tracked
 - Timeliness of target acquisition
 - Power aperture size
 - Number of defects
 - Turn-around time
 - Data throughput
 - Number of systems needed to be deployed versus mission requirements
 - Staffing
 - Operational footprint
 - Operational availability

Program Objectives

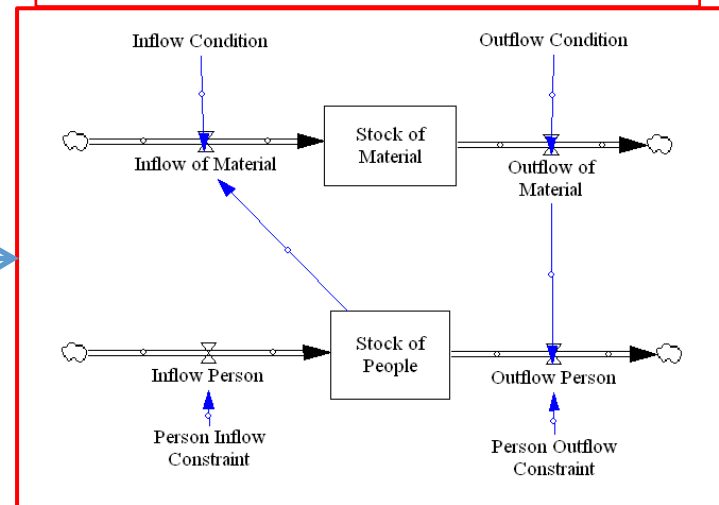
System Integration Application

- System Dynamics (SD) is an established simulation methodology that incorporates time-based, discrete events
- Detailed interdependencies provide realistic models

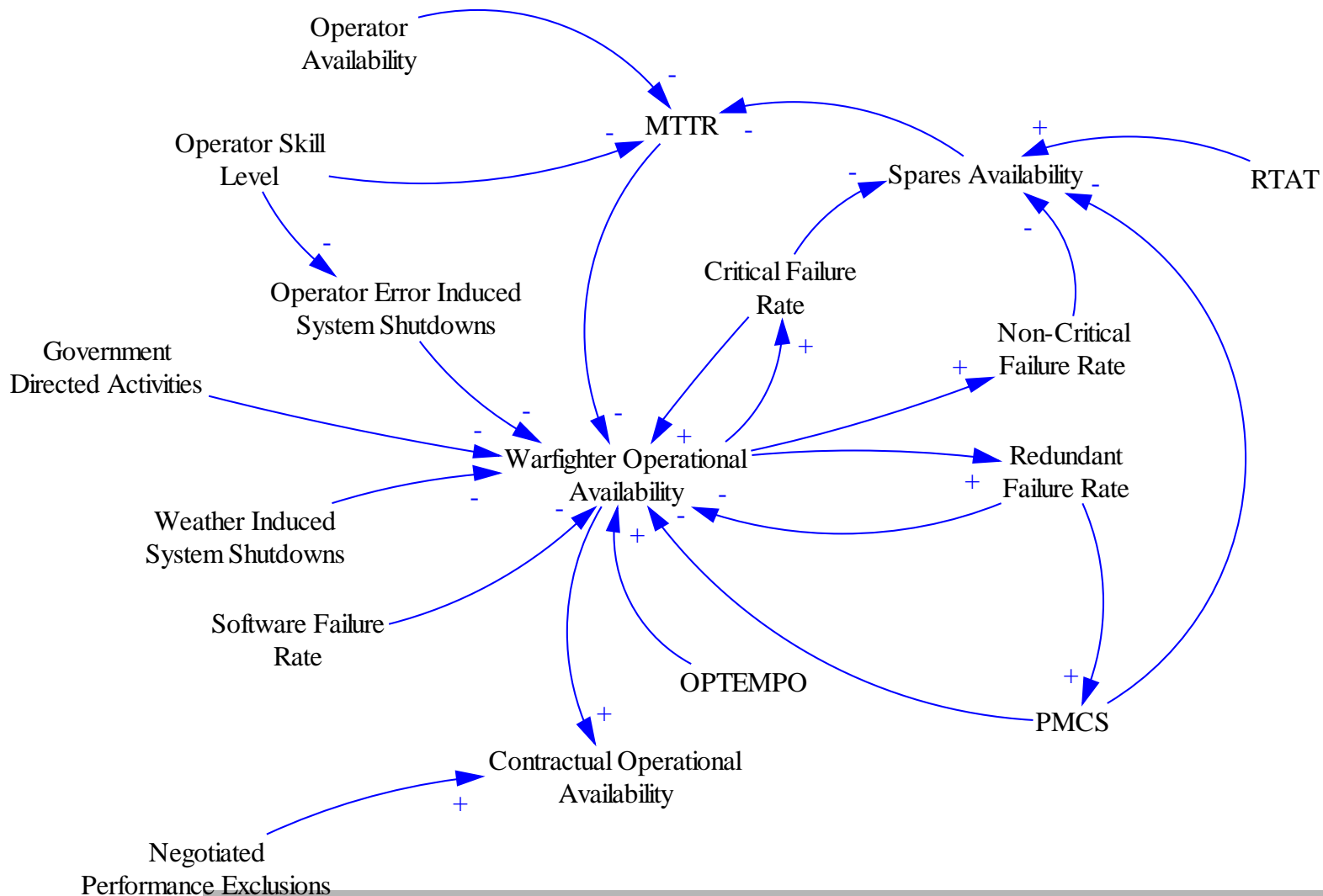
Models use the flow of materials, people, information, etc. The larger structure is called a Stock and Flow Diagram



Multiple structures can be linked together using detailed interdependencies. These interdependencies can be inventory constraints, personnel availability, etc.

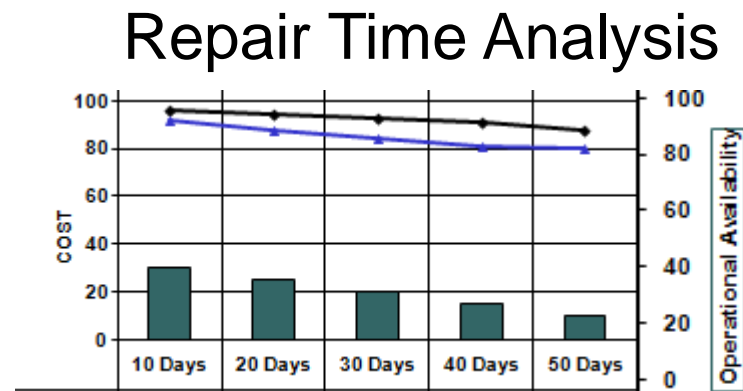
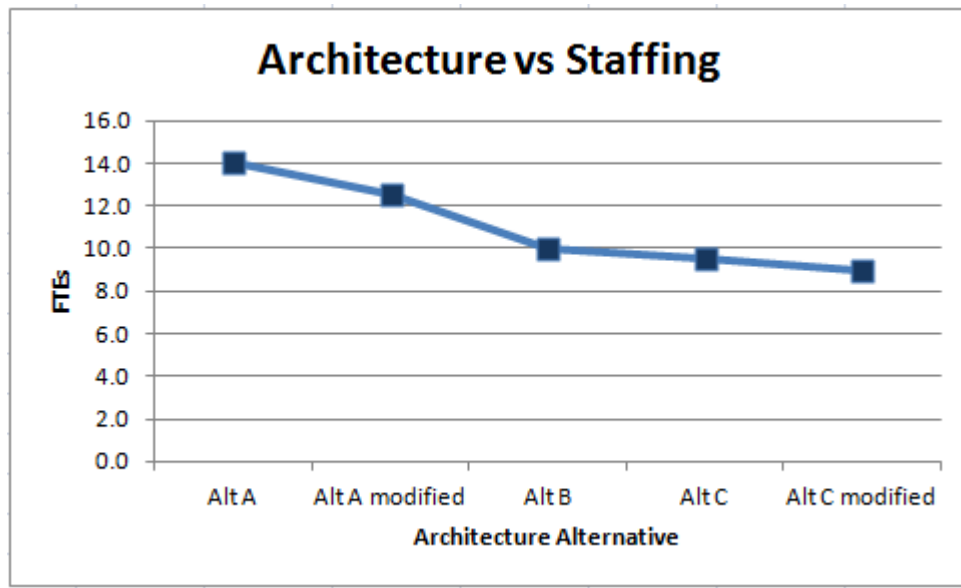


System Dynamics Model



Model the key interactions through the system

Sample Analyses



- Inputs
- Assumptions
- Timing
- Level of Analysis

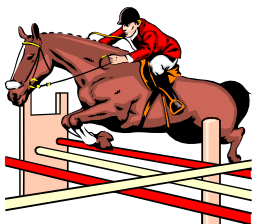
Flexibility

Enabling Customer Success

- Provides an integrated solution space that allows rapid investigation into the balance of cost and performance
 - Allows for quick turnaround results in the face of customer requests/requirement changes
- Provides an optimal set of design choices under a large number of requirements changes
- Provides a transparent look into the entire system trade space

Optimization of trade space affordability is key to future contracts and benefits Customers

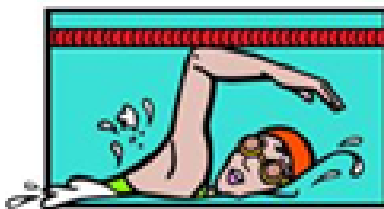
Model Pentathlon Summary



Raytheon IDS

Quality & Process Performance Objectives:

- On-time Deliverables
- Cost and Schedule Performance
- Engineering Productivity
- Reducing Rework



Questions



Presenters' Biographies

- **Debbie Smith – Raytheon Integrated Defense Systems**
 - Debbie has worked more than 15 years in commercial and government contractor environments. Her roles have included Process Group Lead, Metrics Lead, project manager, IPT Lead, Six Sigma Black Belt, software engineer, and research biologist. Debra is currently working on business improvement initiatives that involve both CMMI for Development and CMMI for Services.

- **Kerry Trujillo – Raytheon Network Centric Systems**
 - Kerry has experience in multiple CMMI models, in commercial production, and as an Officer in the US Navy. He has worked in Hardware Engineering to achieve a CMMI for Development Maturity Level 5 and led a CMMI for Services Maturity Level 3 initiative. While at Raytheon Kerry has been a process engineer, Process Group Lead and an Affordability Engineering Section Manager. Affordability Engineering has been a key contributor to many of IDS' strategic program proposal efforts. Prior to joining Raytheon, Kerry worked at Motorola as a Mechanical Engineer and manager involved in production equipment design and optimization. Kerry is currently the CMMI Lead for Raytheon Network Centric Systems.

Back-up

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