Modeling and Simulation

More Critical Than Ever in a Challenging Environment

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October 2013
The Need for Modeling and Simulation

★ External Factors
  – Increasing Mission Complexity
    • Rapid What-if Scenarios
  – Declining Customer Budgets
  – Drive Toward FFP Contracts
  – Affordability
  – Long Range Planning Challenges

★ Internal Factors
  – Solution Credibility
  – Program Execution Risk
  – Affordability
  – Design to Cost
  – Dispersed Workforces
DOD Budget Outlook

Defense Budgets Past and Future (Base Budget)

Total -$1,079B

Ten-Yr Reductions (FY12-21)

<table>
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<tr>
<th>Budget</th>
<th>Total Cut In All Budgets</th>
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<td>PB14 with BCA</td>
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Modeling and Simulation Applications

★ Metric/Statistical Models
  – IT Services Optimizations
  – IT Transformations

★ Business Process Modeling
  – Manufacturing Line Process Flows (Discrete Event)

★ Sustainment System Affordability Models
  – Integrated Logistics Affordability Optimizations

★ Mission Performance Models
  – Global Communications Modeling
Rapid Modeling and Simulation Methodology

1. Define Model Structure Based on Enterprise
2. Validate the Model Against the As-Is Baseline
3. Right Size Staffing for the To-Be Baseline
4. Introduce Innovations to Improve Productivity or Increase Workload
5. Continuous Model Refinement Using Metrics

- The Approach is Not Trivial...But it is Repeatable
- It Requires Skilled Staff to Implement
- It Provides Cost Estimation Credibility...And Supports Ongoing Enterprise Analysis
Problem Complexity

★ Why not prototype?

– Prototypes can be very expensive and may not accurately simulate the system
– Access to the systems’ inputs and outputs may be difficult to achieve or be non-existent
– Limited Availability to conduct What-if Analyses

★ Customer Mission Complexity is Rapidly Increasing

– Assets that support these missions are growing more complex at an equal or faster rate

★ Degrees of Variation are too broad for traditional methods to work

★ Optimized is in the eye of the Beholder

– Customer priorities, contractual requirements, budgets

Discover Hidden Performance Optimizations Through M&S and Expert Analyses
Enterprise IT Workflow Case Study

★ Challenge

– Maintain or Exceed SLA performance while simultaneously increasing productivity and reducing cost

★ Approach

– Model Specific Enterprise Workflows
– Validate
– Apply Business Innovations
– Optimize on Customer Best Value

★ Result

– 58% Cost Takeout
Enterprise IT Workflow Case Study
Simulation Output Analysis – Help Desk

Baseline Scenario – Staffing Based on Standard Metrics

- 12 FTE Help Desk Agents – 100% Utilization
  - 5 Morning shift personnel
  - 4 Afternoon shift personnel
  - 2 Overnight/Weekend shift personnel
  - Understaffed

- 16 FTE Help Desk Agents – 80% Utilization
  - 8 Morning shift personnel
  - 6 Afternoon shift personnel
  - 2 Overnight/Weekend shift personnel
  - Optimally Staffed

Optimal Sizing – Based on 80% Utilization

- Median Call Answer Time: 1.1 Hour
- 90% Call Answer Time: 3.8 Hours
- Median Call Answer Time > 1 Hour
- Understaffed

- Median Call Answer Time: 42 Seconds
- 90% Call Answer Time: 7.6 Minutes
- Optimally Staffed

Optimal Sizing – Based on 80% Utilization
Simulation Output Analysis – Break-Fix

- **Baseline Scenario – Staffing Based on Standard Metrics**
  - 20 Morning shift personnel
  - 17 Afternoon shift personnel
  - 6 Overnight/Weekend shift personnel
  - 44 FTE Break-Fix Techs – 51% Utilization

- **Optimal Sizing – Based on 90% Utilization**
  - 11 Morning shift personnel
  - 11 Afternoon shift personnel
  - 3 Overnight/Weekend shift personnel
  - 24 FTE Break-Fix Techs – 90% Utilization

- **Equations**
  - Median Return to Service: 1 Hour
    - \[ \pi(50) = \frac{E[s]}{c(1 - \rho)} \ln \left( \frac{100C(c,u,\rho)}{100 - 50} \right) \]
  - 90% Return to Service: 1 Hour
    - \[ \pi(90) = \frac{E[s]}{c(1 - \rho)} \ln \left( \frac{100C(c,u,\rho)}{100 - 90} \right) \]
  - Median Return to Service: 3.2 Hours
    - Optimally Staffed
  - 90% Return to Service: 8.9 Hours

- **Overstaffed**
- **Optimally Staffed**
Innovation With Purpose

Design to Cost and Value Optimization

Innovations

Business Innovation 1
Business Innovation 2
Business Innovation 3
Business Innovation 4
Business Innovation 5
Business Innovation 6
Business Innovation 7
Manufacturing Process Optimization Case Study

★ Challenge

– Can LNG tanks be produced at the right price points, and delivered on the required schedule
– Where are the productivity bottlenecks that prevent meeting the business objectives

★ Approach

– Model the manufacturing line process detailing required resources, including human, capital, and facilities. Determine system throughput.
– Add a second processing line and update the models to include resource contention and evaluate impacts to throughput
– Develop an integrated labor/cost modeling tool for rapid ROM preparation

★ Result

– Rapid response to new orders
– Easily assess value to changes in the flow or adding additional capacity
Liquid Natural Gas Tank Manufacturing Model
Affordability Analysis Process Flow

- **Perform**: People, Programs, Products
- **Collect**: Logistics System Design – East, Engineering, Logistics System Design
- **Payload Operations**: Military Platform Ops
- **Analyze**: Programs, People, Products
- **Evaluate**: Dashboard (Graphs, Charts, Statistics)
## Architecture Performance Analysis Case Study

### Recent Proposal Past Performance

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<th>% Reduction In Total Support Costs (Including Warranty)</th>
<th>Total Recommended Cost Savings</th>
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### GCM Models Enterprise-Wide Comms

#### GCM updating MILSATCOM AoA since 2009: new scenarios, AEHF options, ACNs.

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#### No HALE ACNs

#### With 3 HALE ACNs in Theater

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Army Research Lab High-Performance Computing (ARL HPC) cluster runs high-fidelity netcentric communications models.

April ‘13 OSD and ARL determined that GCM would be the best way to flexibly and rapidly build large, relevant scenarios for their HPC-based communications modeling, including:

- Unit locations and movements
- Network topologies
- Network traffic

IS&GS working with OSD and ARL to enhance their comm modeling capability for XDR and Link-16 on the path toward a JALN Architecture Research Testbed (JART).
Modeling and Simulation Summary

- Models provide a degree of flexibility to model virtually any customer problem.
- Modeling first can save cost, burn down risk, and reduce schedule uncertainty.
- Modeling and Simulation can be applied in a multitude of ways to deliver real customer value.
- Traditional methods won’t address the degrees of variability or system uniqueness.
- Models provide customer’s and business with rapid “What-if” capability for Long Range Planning.