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Understanding Risk in the Budgeting Process from a Portfolio Point of View

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Disclaimer

The views expressed in this paper and in our remarks are our own and do not imply endorsement by the Office of the Director of National Intelligence or any other US Government agency

Agenda

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- **Approach**
- **Understanding Decisions – Problem Definition**
- **Understanding the Risk**
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- **Building a Model**
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Background

- **According to the National Security Act of 1947, Section 506A, Title 50 U.S.C.:**
  - "The Director of National Intelligence shall…prepare an independent cost estimate (ICE)…specify the amount required to be appropriated and obligated to develop, procure, and operate a major system in each fiscal year…" [1]
  - A major system acquisition is defined as "any significant program…with projected total development and procurement costs exceeding $500M" [2]
- **Intelligence Community Directive (ICD) 104 states that:**
  - "All National Intelligence Program (NIP) managers shall…budget major acquisition programs to an ICE endorsed by the DDNI.." [3]

- **Potential Impact:**
  - Programmatic trades among Major Systems Acquisitions (MSA) may be necessary due to limited resources
    - Agencies may not be able to budget to their programs' ICEs due to available funding
    - The conducting of MSA trades may occur at the MSA level without both a program and portfolio analysis

This paper outlines a technique to follow and details the potential outputs of a Monte Carlo based risk analysis to identify the risk at a portfolio level

Approach

Phase 1

- Understand how budget decisions are made to mitigate portfolio risk
- Determine a methodology for identifying and prioritizing uncertainty within MSAs, Agencies, and Portfolios
- Develop a model to incorporate this methodology with Monte Carlo simulation to capture portfolio risk

Phase 2

- Conduct and integrate research outlining statistical relationships among phasing, cost, and schedule in order to properly assess the cost penalties resulting from potential budget decisions

Phase 3

- Expand Model to include other Decision “types”
  - Schedule Decisions
  - Technology Insertion Decisions

Understanding Decisions - Problem Definition

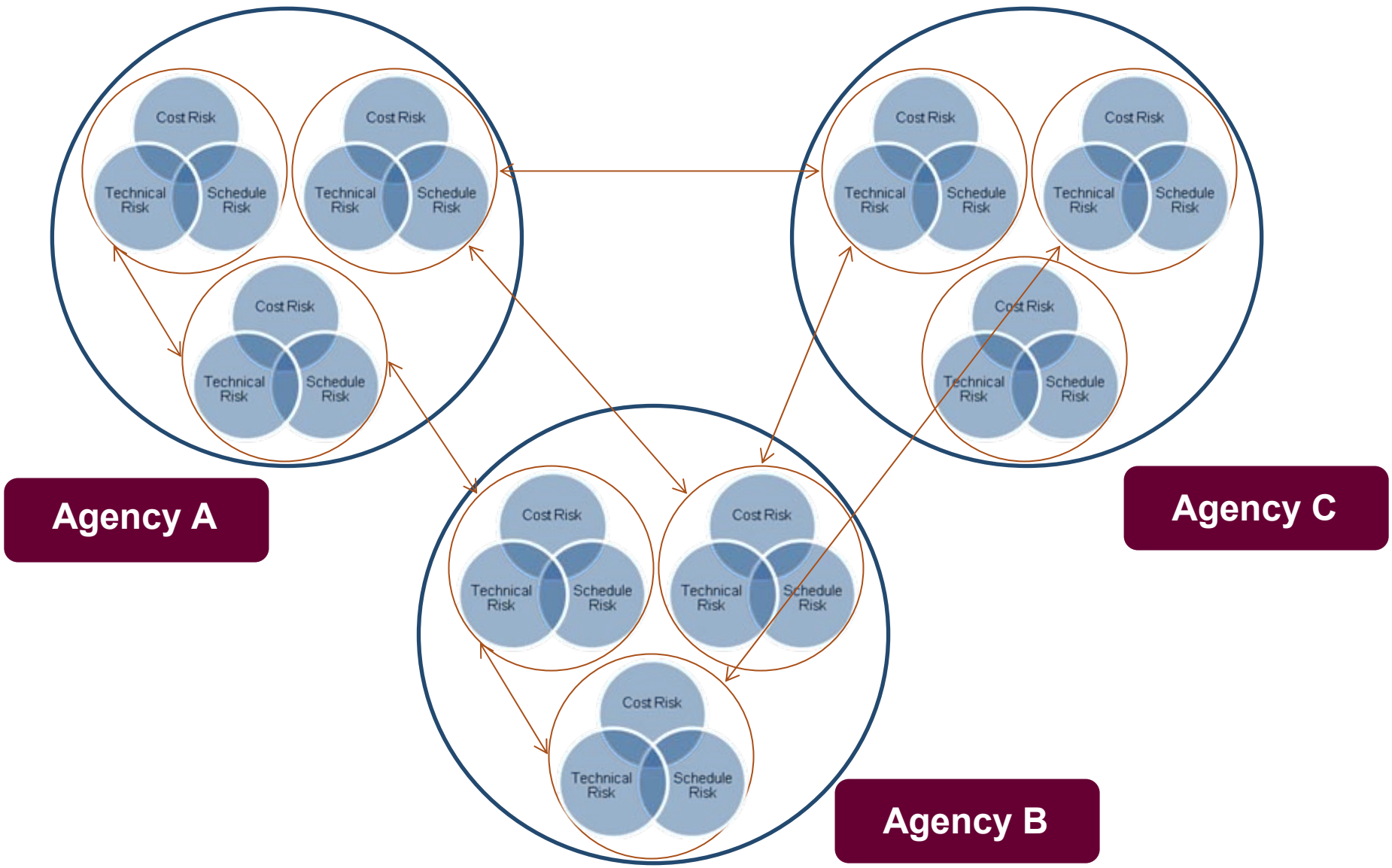
- **Due to financial limitations, not all MSAs may be funded to match an Independent Cost Estimate (ICE). This may result in one of three scenarios:**
  - A reallocation of funding from Non-MSA programs to meet the ICE;
  - Funding to the Agency Cost Position (ACP) with assumption of additional risk; or
  - The MSA suffers some reduction in capability or slip in schedule
- **Each scenario introduces some schedule or technical risk to an agency's program**
- **An agency must be aware of the potential risks not only to the program directly affected, but also the inherent risk produced indirectly to the agency's entire portfolio of programs**

Understanding the Risk

- **The assumption of risk is often not completely understood, especially when trying to bridge the gap among policy, implementation, and day-to-day execution of a program**

- **Since the NIP portfolio is a collection of Agency portfolios, understanding the risk impacts of potential trades among programs in terms of delivered capability is essential to the decision making process at the:**
  - Program Level
  - Agency Level
  - NIP Level

IC Wide Dependencies – NIP Portfolio



Building a Portfolio Risk Analysis Model (Phase 1)

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- **Model Objectives:**
  - Combine ICEs to create an Agency and/or NIP Portfolio S-Curve through the use of an MS Excel/VBA based tool and Monte Carlo simulation
    - **Compare the Budget to the Mean Estimate at the MSA and Portfolio level over varied time periods (Year-to-Year, FYDP, Acquisition)**
  - Identify potential risk within a portfolio resulting from the mean estimates and budget numbers, in terms of:
    - **Budget shortfalls/surpluses**
    - **Probability of meeting mission requirements**
    - **Estimate uncertainty**

- **Model Inputs:**
  - Develop Cost and Schedule estimates for each MSA
    - **Generate program level cost and schedule distributions**
  - Develop phasing profile that goes forward for budgeting for each MSA
  - Functional Correlation between cost and schedule within and among MSA's
  - Technical/Cost/Industrial Correlation (Phase 2)
  - Economic Escalation Ranges (Phase 2)

Discuss Assumptions

Building a Portfolio Risk Analysis Model – Continued (Phase 1)

Outputs (S-Curve - Combination of $, Percentile, and CoV)

- Mean – the expected value of the cost based on simulation inputs; used to prioritize relative risk
- Percentile – the probability that a given amount will be enough to accomplish the mission requirements
- CoV – quantifies the confidence in the mean cost
- Analyze results to develop Risk Assessment over various time periods at the MSA, Agency, and Portfolio level

Legend:

High Risk
Medium Risk
Low Risk
Potential Opportunity

Risk Assessment Matrix:

		CoV			
		Low (< 30%)	Mid-Low (30% - 45%)	Mid-High (46% - 60%)	High (> 60%)
Percentile	Low (< 40%)				
	Mid-Low (40% - 49%)				
	Mid-High (50% - 60%)				
	High (> 60%)				

Sample Results:

Baseline Scenario	2011 Mean	2012 Mean	2013 Mean	2014 Mean	2015 Mean	2016 Mean	2017 Mean	2018 Mean	2019 Mean	FYDP Mean	Acquisition Mean
Portfolio	294	419	167	24	228	337	217	79	12	1131	1776
X1	294	419	167	22	0					901	901
X2			0	2	228	337	217	79	12	230	875

Notional Scenario

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Scenario: A Portfolio has Programs X1 and X2 where:

- X1 and X2 have a Mean Cost and Schedule phased according to the table below:
- Correlation exists:
  - Between X1 cost and X1 schedule
  - Between X1 schedule and X2 schedule
  - Between X2 cost and X2 schedule

FYDP- FY11-FY15

Initial ICE	2011	2012	2013	2014	2015	2016	2017	2018	2019	FYDP	Total
X1	294	419	167	22	0	0	0	0	0	902	902
X2	0	0	0	2	228	337	217	79	12	230	875
ICE Portfolio	294	419	167	24	228	337	217	79	12	1132	1777

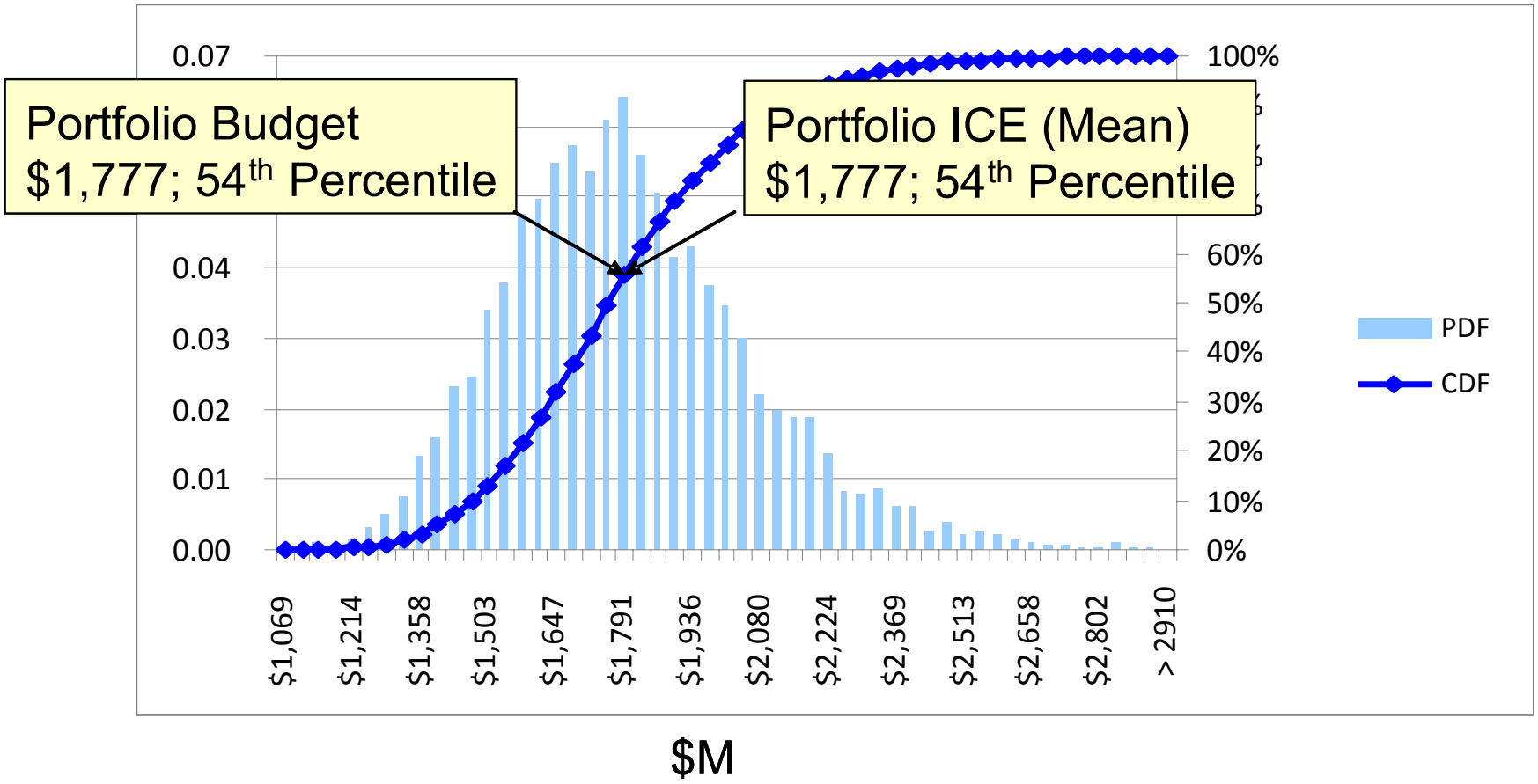
Budget constraints in FY11 and FY12 cause a “re-distributing” of the “X1” ICE amount over the FYDP and Acquisition Life Cycle

Decision

FYDP- FY11-FY15

BUDGET	2011	2012	2013	2014	2015	2016	2017	2018	2019	FYDP	Total
X1	250	375	233	44	0	0	0	0	0	902	902
X2	0	0	0	2	228	337	217	79	12	230	875
Budget Portfolio	250	375	233	46	228	337	217	79	12	1132	1777
Budget-ICE	-44	-44	66	22	0	0	0	0	0	0	0

Portfolio S-Curve (Total) – Based on aforementioned Notional Scenario



A comparison of the Portfolio ICE (mean) to the Portfolio Budget may or may not illustrate risk in the Portfolio

Annual S-Curves – Based on aforementioned Notional Scenario

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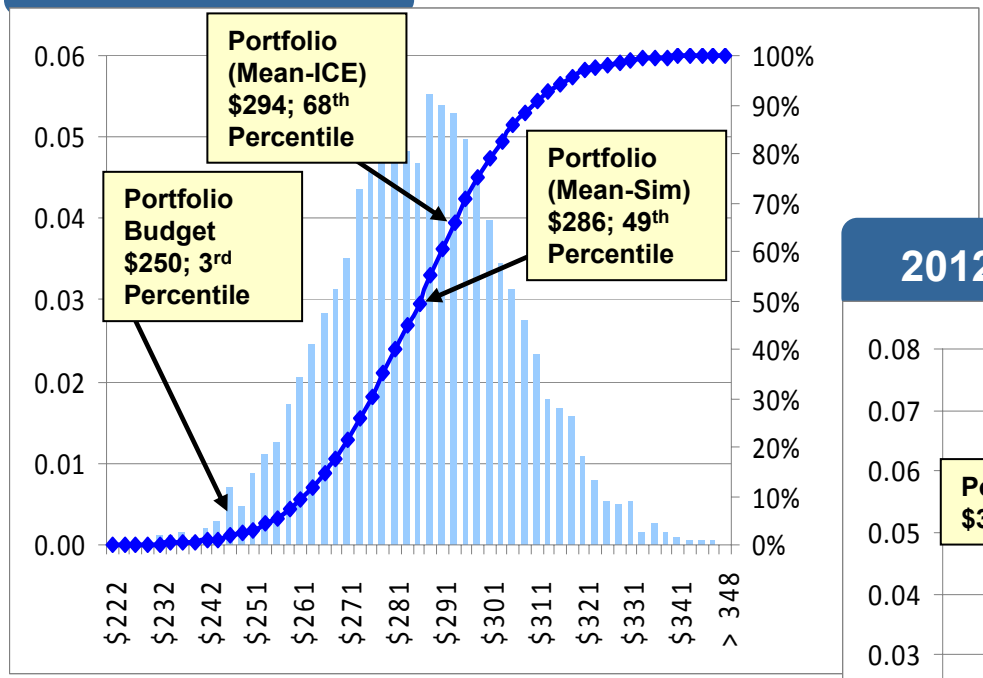
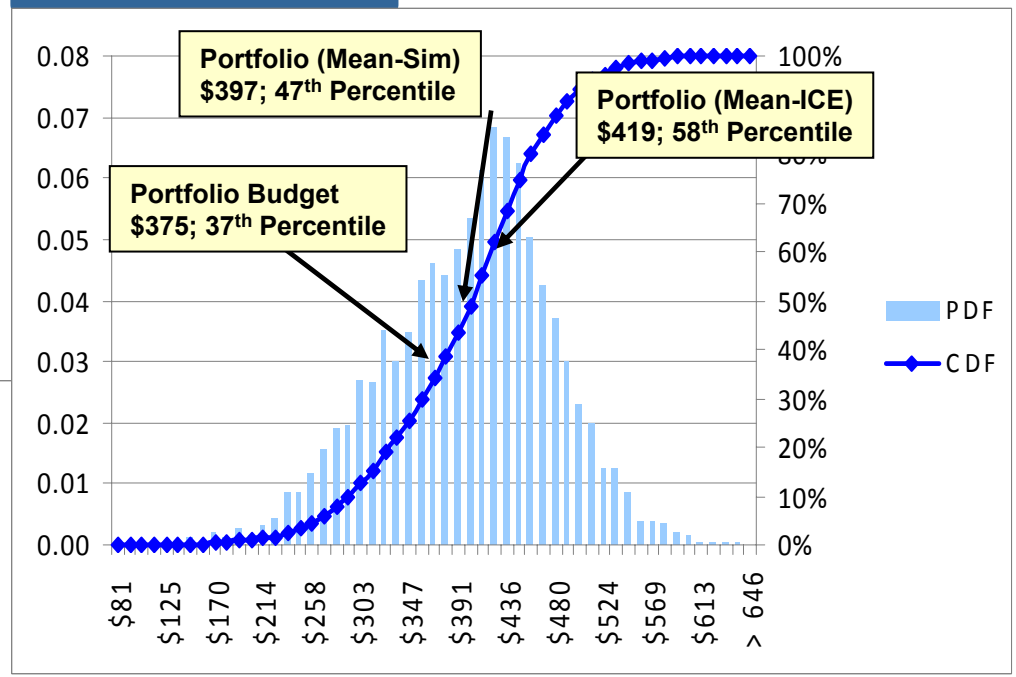
2011 S-Curve



Discussion Topics

- **Difference in Mean output of simulation vs. Mean Cost Estimate**
- **Difference in Percentiles of the "Mean"**
  - Portfolio vs. Annual, Simulation vs. ICE
- **MSA interdependencies**

2012 S-Curve



Based on the Budget constraints in FY11 and FY12, it is likely that there will be some type of programmatic impact (schedule/cost)

Results

- **Phase 1: Identify the Portfolio Risk based on Budget Decisions**

Annual Breakouts - Potential Issues

Large Δ in CoV's – due to correlation among cost, schedule, and phasing in simulated results
Explanation: Without a priori information, there is more confidence in Total Cost than Year-to-Year Cost

Portfolio Mean – No Issue

Baseline Scenario	2011			2012			2013			2014			2015			2016			2017			2018			2019			FYDP			Total Acq.		
	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV
Portfolio	294	68%	7%	419	58%	19%	167	48%	49%	24	20%	87%	228	52%	68%	337	84%	34%	217	51%	41%	79	48%	77%	12	47%	144%	1131	44%	18%	1776	52%	14%
X1	294	68%	7%	419	58%	19%	67	53%	55%	22	52%	122%	0	13%	267%													901	54%	25%	901	54%	26%
X2							0	84%	346%	2	52%	152%	228	52%	72%	337	84%	34%	217	51%	41%	79	48%	77%	12	47%	144%	230	52%	91%	875	51%	14%

Budget Scenario	2011			2012			2013			2014			2015			2016			2017			2018			2019			FYDP			Total Acq.		
	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV
Portfolio	250	3%	7%	375	37%	19%	233	69%	50%	45	33%	87%	228	52%	68%	337	84%	34%	217	51%	41%	79	48%	77%	12	47%	144%	1131	44%	18%	1776	54%	18%
X1	250	3%	7%	375	37%	19%	233	72%	55%	43	67%	123%	0	13%	259%													901	54%	25%	901	55%	26%
X2							0	88%	346%	2	52%	152%	228	52%	72%	337	84%	34%	217	51%	41%	79	48%	77%	12	47%	144%	230	52%	91%	875	50%	14%

Identify risks/opportunities in the budgeting process

- **Phases 2 and 3:**

Re-ICE Scenario	2011			2012			2013			2014			2015			2016			2017			2018			2019			FYDP			Total Acq.		
	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV	Mean	%	CoV
Portfolio	250	58%	10%	375	53%	22%	245	53%	42%	91	57%	87%	188	49%	71%	274	42%	29%	247	55%	37%	115	62%	62%	36	67%	72%	1149	44%	19%	1821	54%	19%
X1	250	58%	10%	375	53%	22%	245	54%	44%	60	59%	107%	12	72%	313%													942	54%	28%	941	54%	28%
X2							0	88%	413%	31	52%	189%	176	52%	74%	274	42%	29%	247	55%	37%	115	62%	62%	36	67%	72%	207	52%	98%	879	53%	27%

Change the ICE to reflect Budget constraints

Identify changing risks/opportunities in the budgeting process

Identify additional costs associated with Budget Constraints

$1,776 vs. $1,821

Assessing Additional Costs

- **Current Methodology:**
  - Phasing of Cost and Schedule estimates through statistically derived equations based on historical data
  - Impacts of affected programs assessed on a case-by-case basis, requiring
    - **Intimate knowledge of the program where the impact begins**
    - **Knowledge of cost, schedule, and or technical dependencies among programs in a portfolio**
  - Assessing impacts done through massive MS Excel drills given the potential decisions
    - **Time consuming and difficult to fully document**

The goal of Phases 2 and 3 is to extend the existing model to accommodate these methods

Model Demonstration

Conclusions

- **MSA portfolio risk analysis is particularly important given the implications of budget decisions**
  - Not just on the impacted program, but also it's associated dependencies
  - Methodology is adaptable to changing "decision environment" based on budget, schedule, technology insertions, etc…
- **S-curves can be both useful and misleading based on the perspective of the information presented**
  - Risk dashboard helps identify budget risk in conjunction with the S-curves
- **The tool created, though evolving, helps identify the budget risk associated with both the baseline cost estimate and potential budget decisions**

References

1. National Security Act of 1947, Section 506A, Title 50 U.S.C.: http://intelligence.senate.gov/nsaact1947.pdf
2. Intelligence Community Directive (ICD) 104: http://www.dni.gov/electronic_reading_room/ICD_104.pdf
3. Burgess, E., "Time Phasing Methods and Metrics," Presented at the 37th Annual DoD Cost Analysis Symposium, Williamsburg, VA, February 2004.
4. Smart, C., "The Portfolio Effect and The Free Lunch," Presented at the 2009 Joint ISPA-SCEA Conference, St. Louis, MO, June 2009.