

# Air Force Institute of Technology

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## Predicting Over Target Baseline(OTB) Acquisition Contracts

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**U.S. AIR FORCE**



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*Educating the World's Best Air Force*



20% of Contracts Experience an OTB  
The average cost overrun for each contract experiencing an OTB  
is **\$321 Million** (BY09\$)





# What can we do about this?



- 1) Improve Control Mechanisms for acquisition programs
- 2) Improve Cost Estimates
- 3) Determine the Indicators for Cost Overruns before they occur



# Requirements for Earned Value Management

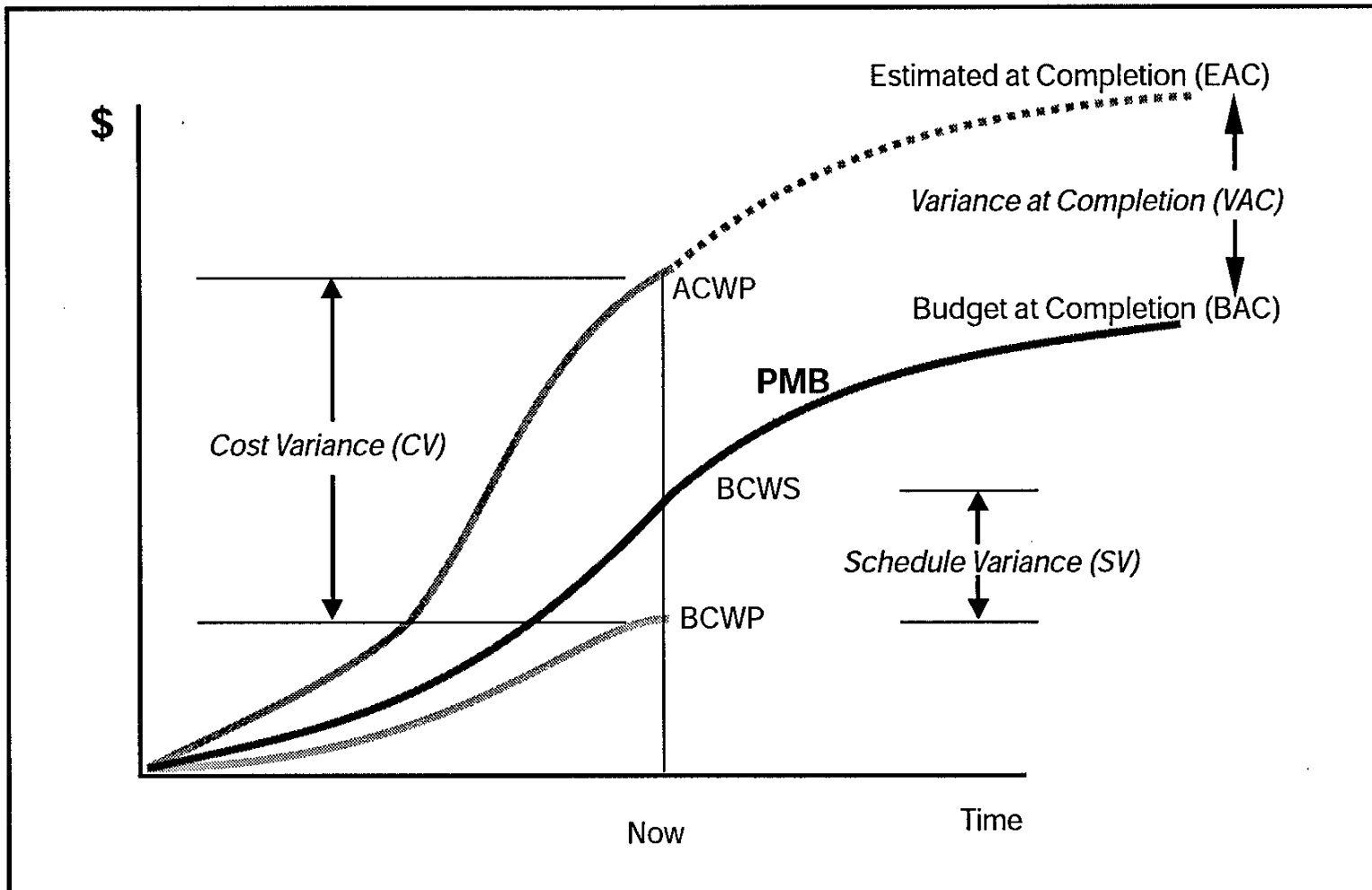


- FAR 34.2
- DFARS 234.2
- ANSI/EIA-748

Contracts	Thresholds	Reporting Requirements
Cost or Incentive Equal to Or Above Threshold	$\geq \$50M$	<u>Formal validation of contractor's EVM system</u> - Reporting - Contract Performance Report - Integrated Master Schedule - DCMA surveillance
Cost or Incentive Equal to Or Above Threshold	$< \$50M$ $\geq \$20M$	<u>Non Validated EVM system</u> - Reporting - Contract Performance Report (tailored) - Integrated Master Schedule (tailored) - DCMA surveillance
Cost or Incentive Less Than Threshold Plus All FFP	$< \$20M$	- EVM optional (risk-based decision) - Conduct cost-benefit analysis



# Earned Value Metrics



**Figure 2.**  
**Performance Measurement Baseline (With Technical Jargon)**



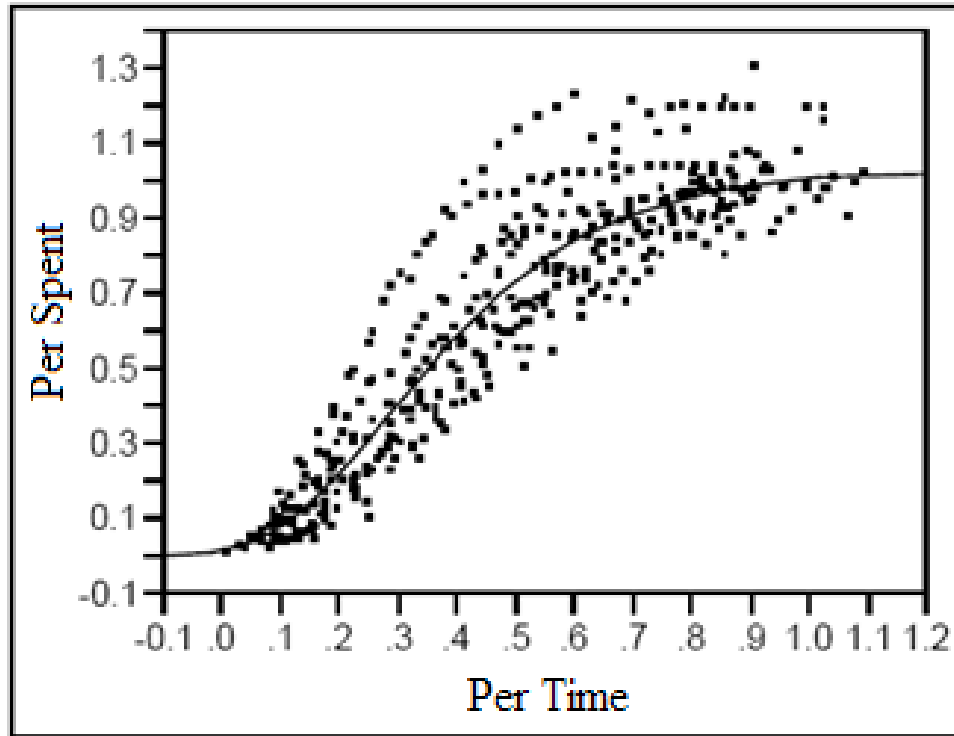
# Estimates at Completion (EAC)



- Dr. Christensen's review of EAC work
  - Indexed Based Approaches
  - Time Series Techniques
  - Performance Factors
  - Regression Approaches
- Subsequent Research
  - Multiple Regression
  - Use of Growth Curves



# Gompertz Growth Models



Development Growth Model (Trahan, 2009)

Gompertz Growth:	$GG(X) = \alpha(\exp(-\exp(\beta-\gamma*X)))$
EAC:	$EAC(X) = ACWP(X) + [ (GG(1) - GG(X))*BAC ]$



# Changes in the Performance Measurement Baseline



1. Authorized Contract Changes
  - Negotiated (Scope) Changes
  - Authorized Un-priced Work
2. Internal Re-planning
3. Inadequate Remaining Budget
  - **OTB Requirement**





# What is an OTB?



## Defense Acquisition University

“A Contract Budget Base that was formally reprogrammed to include additional **performance management budget** and which therefore exceeds the contract target cost”

## ANSI/EIA-748

“A recovery plan, a new baseline for management when the original objectives cannot be met and new goals are needed for management purposes”



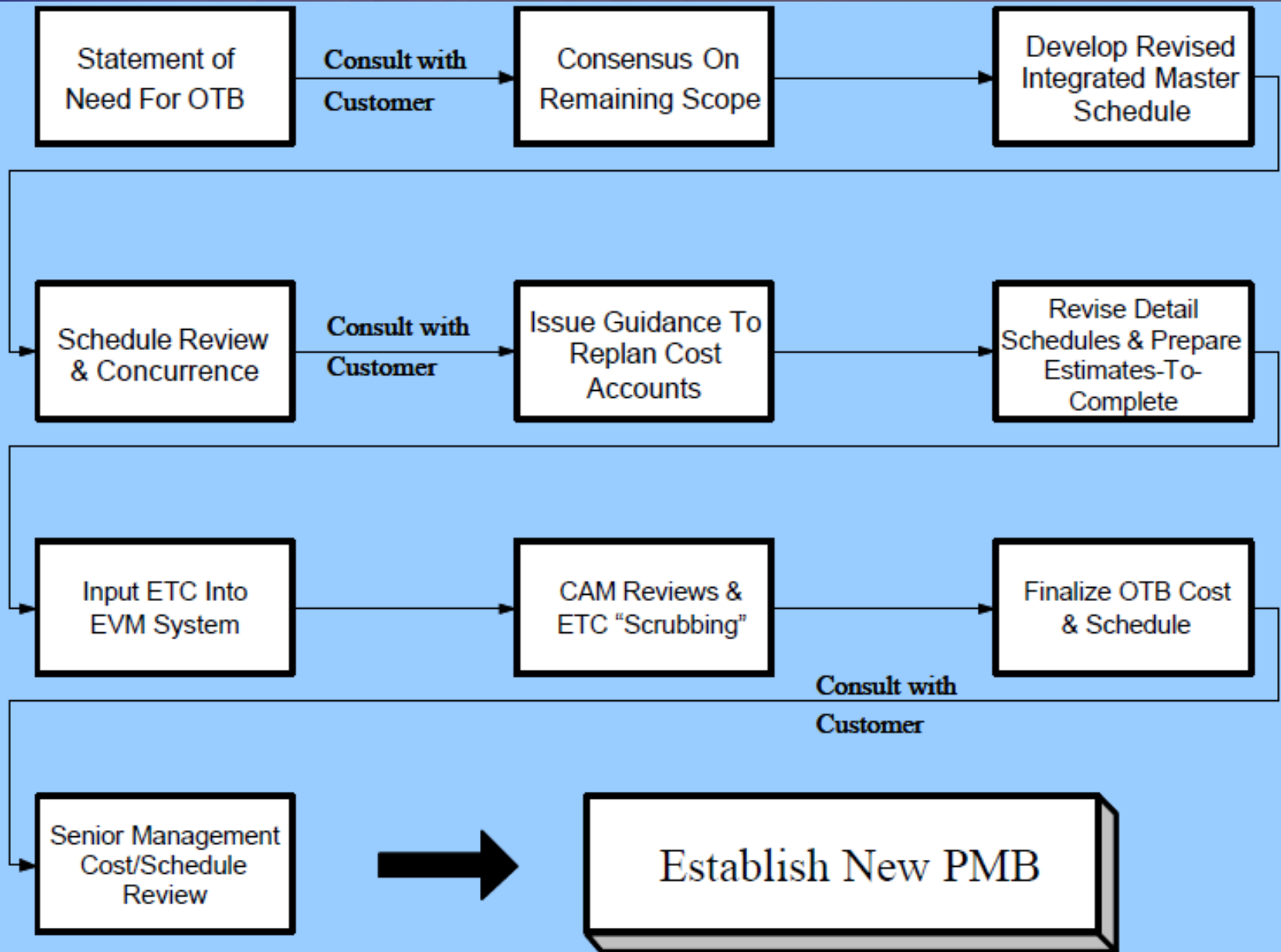
# Historical Reasons for OTBs



- Estimate at Completion (EAC) is less than actual costs for some elements
  - Existence of zero budget work packages
  - Cost and schedule variance explanations are no longer meaningful
  - Inability to effectively use the performance data
  - Unrealistic activity durations and relationship logic
  - Depletion or rapid use of management reserve
  - Lack of Confidence in contractor's EAC
- (Tiffany, 2004)

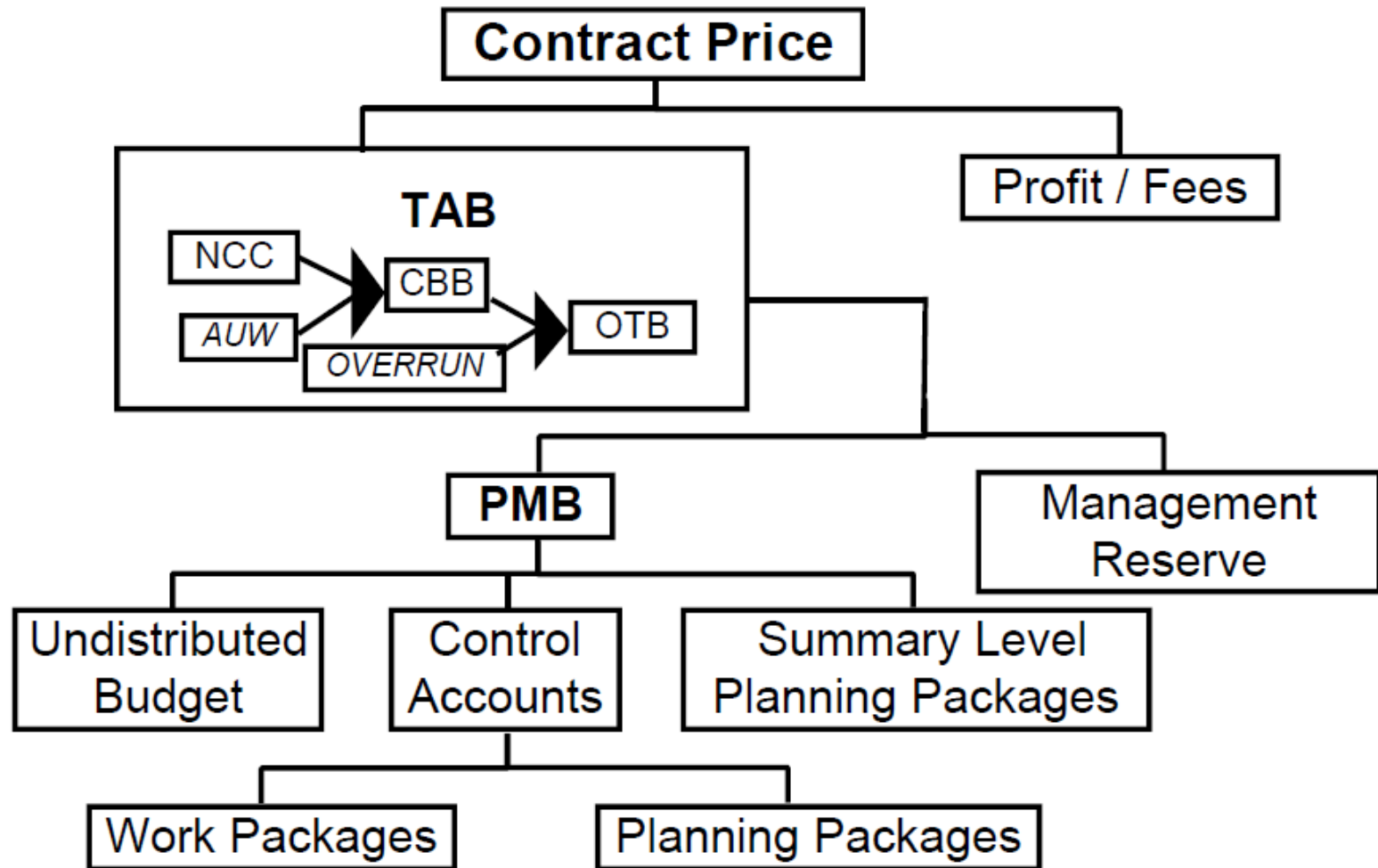


# OTB Process





# How do we identify an OTB?





# Why look at OTBs?



The capability to predict whether or not a contract will become an OTB contract provides:

- Ability to develop better Estimates at Completion using a Gompertz growth model
- Ability to predict OTB related cost overruns



# Two Step Model for OTBs



- 1) Logistic Regression- Identify contracts that are likely to become OTB  
(Capt Thickstun, 2010)
- 2) Gompertz Growth Model- Develop EACs for OTB contracts  
(Capt Trahan, 2009)



# The Logistic Regression Model



## Response Variable

- OTB (binary response)

## Potential Predictor Variables to Consider

- Cost Performance Indicators
- Schedule Performance Indicators
- EVM metrics
- Characteristics of the contract
- Development and Production Quantities
- Threshold Breaches (APB or Nunn-McCurdy)



# Logistic Regression Models Development (RDT&E) Contracts



Development (RDT&E) Contracts Coefficients and P values		
	5 Variable Model	6 Variable Model
Intercept	2.12134 (0.0001)	3.10318 (<.0001)
Air Force	1.74879 (<.0001)	1.40268 (<.0001)
Navy	1.68322 (<.0001)	1.61499 (<.0001)
Fighter	2.09911 (<.0001)	1.39849 (<.0001)
SPI*CPI	-4.98886 (<.0001)	-5.63935 (<.0001)
EAC (BY09\$)		0.00013 (<.0001)
% Complete		-0.98411 (<.0005)
APB Performance	-0.44962 (0.0051)	

## Indications of OTBs:

- Air Force contracts
- Navy Contracts
- Fighter Aircraft
- Low SPI\*CPI
- High EAC
- Low % Complete
- No APB Performance Breach





# Logistic Regression Models

## Production (Procurement) Contracts



<b>Production (Procurement) Contracts</b>		
<b>Coefficients and P values</b>		
	<b>5 Variable Model</b>	<b>7 Variable Model</b>
<b>Intercept</b>	-2.99823 ( $<.0001$ )	-2.45622 ( $<.0001$ )
<b>BCWS (BY09\$)</b>	.02918 ( $<.0001$ )	.03368 ( $<.0001$ )
<b>BCWP (BY09\$)</b>	-0.03472 ( $<.0001$ )	-0.03724 ( $<.0001$ )
<b>MR (BY09\$)</b>		0.01627 ( $<.0001$ )
<b>EAC (BY09\$)</b>	.00108 ( $<.0001$ )	
<b>% Complete</b>		-1.92580 ( $<.0001$ )
<b>% Change in Production Quantity</b>	0.00117 ( $<.0001$ )	0.00140 ( $<.0001$ )
<b>APB Schedule</b>	0.73515 (0.0010)	0.84723 (0.0002)
<b>APB Performance</b>		1.07029 ( $<.0001$ )

### Indications of OTBs:

- High amount of work scheduled (BCWS)
- Low amount of work performed (BCWP)
- High MR
- High EAC
- Low % Complete
- Large changes in production quantities
- APB Schedule breach has occurred
- APB Performance breach has occurred



# Logistic Regression Equation



$$\Pi(X) = \frac{e^{B_0 + B_1 X_1 + B_2 X_2 + \dots + B_n X_n}}{1 + e^{B_0 + B_1 X_1 + B_2 X_2 + \dots + B_n X_n}}$$

$\pi(x) = 0.75$  interpreted as a 75% chance of the contract becoming an OTB

To Predict OTBs, we use a cutoff of 0.5:

If  $0 \leq \pi(x) \leq 0.5$  then we predict that an OTB will not occur

If  $0.5 < \pi(x) \leq 1.0$  then we predict that an OTB will occur



# Validation Results



## RDT&E 5 Variables

### Outcome

Prediction	Actual	Frequency
0	0	592
1	1	27
0	1	112
1	0	30

## RDT&E 6 Variables

### Outcome

Prediction	Actual	Frequency
0	0	580
1	1	24
0	1	113
1	0	29

## Procurement 5 Variables

### Outcome

Prediction	Actual	Frequency
0	0	587
1	1	6
0	1	51
1	0	0

## Procurement 7 Variables

### Outcome

Prediction	Actual	Frequency
0	0	572
1	1	8
0	1	49
1	0	2



# Results



- Validation indicates inability to predict OTBs
  - Incorrect Predictions
  - Failing to Identify OTBs
- Additional Modeling Attempts
  - Restricting dataset by % Complete
  - Alternative method for identifying OTBs
  - Sensitivity to cutoff point
  - Examining trends for OTB contracts



# Conclusions



- Unable to predict OTBs or identify unique characteristics of OTBs
- OTBs are not required: performed at the contractor's discretion
- OTBs may be inherently random
  - Inability to validate predictor variables
  - Inability to find trends



# Final Thoughts



1. What is the benefit of using OTBs?
  - Improved contract performance?
  - Insight into cost overruns and contractor performance
2. Should we promote the use of OTBs?