Using your Cost Estimate to Answer Budget Questions

Melissa Cyrulik

Joint ISPA/SCEA Conference

June 2007

TECOLOTE RESEARCH, INC.

Introduction

- **We can use the budget and estimate together to answer three key questions:**

  - Is the budget sufficient for my program? Do I have years with budget shortfalls?

  - If the budget changes how will it affect my program?

    - ➢ Will you be able to purchase more units or forced to lower unit quantities?

    - ➢ Will the schedule need to be revised?

    - ➢ Will the budget confidence level change?

  - Which estimate elements do I need to watch carefully to help me keep on budget?

- **This presentation demonstrates some modeling techniques used to answer these questions and proposes how to display the results to management.**

This presentation was presented at this years ACEIT User Conference for purposes of providing specific guidance on how to apply the techniques in ACE. In this version of the presentation the goal is to focus on the techniques and reports.

Bridging Engineering and Economics Since 1973

Topics

- **Foundational Items in the analysis: Budget Section Set Up**
  - Recommendations on how to set up the budget information to maximize budget analysis capabilities

- **Estimate and Budget Reports**
  - Reports that show the estimate and the budget together in one view for easy comparison

- **Budgetary "What if" Drills**
  - Reports that show the budget/estimate delta
  - What if drills and updating the budget/estimate reports

- **Understanding Estimate Drivers**
  - Reports that identify the top contributors to the WBS elements - these are the items to watch to keep on budget

> ACEIT was used to perform the analysis and generate the reports described in this presentation, however the concepts are tool independent.

TECOLOTE RESEARCH, INC.

The Scenario

- ## Example Estimate Specifics
  - Model includes only a procurement section
  - Joint program using Air Force and Army procurement appropriations
  - Uncertainty distributions applied to the model inputs and estimating methods
  - Uncertainty distributions are correlated

- ## Budget Requirements
  - The budget is to be managed at the procurement level 2 elements (AF and Army Manufacturing, Quality Control, SEPM, Program Office Costs)

- ## Example Estimate Requirements
  - Procurement level 2 elements should be at the 65% CL (Manufacturing, Quality Control, SEPM, Program Office Costs)

- ## ACEIT Example file (shipped with ACEIT) used to demonstrate the techniques
  - File name: 03 Enhancing the Production Estimate.aceit

Bridging Engineering and Economics Since 1973

TECOLOTE RESEARCH, INC.

Bridging Engineering and Economics

Since 1973

Foundational Items in the ACE Session:
Budget Section Set Up in ACE

Estimate Example

TECOLOTE RESEARCH, INC.

■ **Joint program with 3010 and 2031 appropriations**

	WBS/CES Description	Approp	Unique ID	Point Estimate	Phasing Method	Equation / Throughput	Fiscal Year	Units
77	'Estimate		'Estimate					
78	Total		Total$	$ 417,296.810 (26%) *				
79	Procurement		Proc$	$ 417,296.810 (26%) *				
80	Manufacturing (Air Force)		AF_Mfg$	$ 197,825.262 (25%) *				
81	Air Vehicle (AF)		AF_AV$	$ 165,261.290 (24%) *				
82	Basic Structure (AF)	3010		$ 85,709.612 (0+%) *	R	10000	2003	$K
83	Navigation/Guidance (AF)	3010		$ 15,871.523 (15%) *	F	StepVal(FYCVal(@AFBuyQty), @BBQL,		
84	Propulsion (AF)	3010		$ 63,680.155 (50%) *	F	PropUC$ * AFBuyQty		
85	Integration & Test (AF)	3010		$ 24,789.194 (42%) *	F	0.15 * AF_AV$		
86	Ground Station LRIP Support (AF)	3010		$ 556.431 (25%) *	F	NPeople * Pay$		
87	Transportation (AF)	3010	Trans$	$ 1,261.243 (17%) *	F	TransUC$ * FYCVal(@AFBuyQty,		
88	Initial Operational Test & Eval (AF)	3010		$ 3,179.604 (17%) *	F	3	2004	$M
89	Initial Spares & Repair Parts (AF)	3010		$ 2,777.501 (24%) *	F	FYTot(@AvgAF$) * NInitAFSpr		
90								
91	Manufacturing (Army)		Army_Mfg$	$ 101,216.057 (18%) *				
92	Air Vehicle (Army)		Army_AV$	$ 79,957.087 (24%) *				
93	Basic Structure (Army)	2031		$ 41,585.308 (0+%) *	R	[Shared Learning - StrShr]		
94	Navigation/Guidance (Army)	2031		$ 7,869.520 (15%) *	F	StepVal(FYCVal(@ArmyBuyQty), @BBQL,		
95	Propulsion (Army)	2031		$ 30,502.259 (50%) *	F	PropUC$ * ArmyBuyQty		
96	Air Vehicle Integration (Army)	2031		$ 11,993.563 (38%) *	F	0.15 * Army_AV$		
97	Transportable Ground Stations (Army)			$ 556.431 (16%) *				
98	Ground Station Hardware (Army)	2031	GSHW	$ 238.470 (17%) *	F	GSHWUC$ * ArmyGSQty		
99	Transportable Vehicle (Army)	2031	TV$	$ 206.674 (20%) *	F	TVUC$ * ArmyGSQty		
100	Vehicle Ruggedization (Army)	2031	VehRug	$ 41.335 (30%) *	F	VR% * TV$		
101	Integration & Test (Army)	2031		$ 69.951 (23%) *	F	IT% * (VehRug + GSHW)		
102	Transportation (Army)	2031		$ 604.125 (17%) *	F	TransUC$ * ArmyBuyQty		
103	Initial Operational Test & Eval (Army)	2031		$ 5,299.340 (13%) *	F	5	2004	$M
104	Initial Spares & Repair Parts (Army)	2031		$ 2,805.512 (24%) *	F	FYTot(@AvgArmy$) * NInitArmySpr		
105	Quality Control	3010		$ 5,863.495 (21%) *	F	FYCVal(@QC%, FYYR - Adj) * (AF_Mfg$ +		
106	SEPM	3010		$ 110,645.288 (37%) *	TC	0.37 * (FYTOT(@AF_Mfg$) +		
107	Program Office Costs	3010		$ 1,746.708 (17%) *	TY	[Cost Throughput]		$K

Bridging Engineering and Economics Since 1973

Identify the Estimate Corresponding to the Budget

TECOLOTE RESEARCH, INC.

- **Identify the estimate rows that correspond to the level of budget that you are managing**

- **In this example we are managing to the procurement level 2 costs which are captured with two separate appropriations**

- **Summarize the estimate by appropriation - There are two main ways to do this:**

  - If the estimate structure WBS permits, utilize existing or insert parent elements that map to the funds you are managing

  - Add a summary section that calculates the appropriate sum – example below with the SumIf function

WBS/CES Description	Approp	ApropType (!) Approp Type	Unique ID	Point Estimate	Phasing Method	Equation / Throughput
'Estimate Summary by Approp			*EstSum			
Estimate Total				$ 417,296.810 (26%) *		
Procurement Estimate			SummaryNoAppn$	$ 417,296.810 (26%) *		
3010 Estimate			Estimate3010	$ 316,080.753 (28%) *	F	SumIf(ApropType, 3010, @Total$)
2031 Estimate			Estimate2031	$ 101,216.057 (18%) *	F	SumIf(ApropType, 2031, @Total$)

Bridging Engineering and Economics Since 1973

Calculate a Budget Delta

Budget Delta

- Appropriation parents (rows 21 and 24) shows the delta by total and fiscal year
- Total delta parent row (row 19) shows the overall delta by total and fiscal year
- Estimate included in section with subtraction

		WBS/CES	Appn	ID	Point Estimate	Ph	Eq / Thruput
	12	'Budget Information		'Budget			
Budget	13	Total Budget			$ 411,234.784 *		
	14	Procurement Budget			$ 411,234.784 *		
	15	3010 Budget	3010	Budget3010	$ 305,904.925 *	TY	[Cost Throughput]
	16	2031 Budget	2031	Budget2031	$ 105,329.859 *	TY	[Cost Throughput]
	17						
	18	'Budget Delta					
Budget Delta	19	Total Delta			$ -6,062.026 *		
	20	Procurment Budget Delta			$ -6,062.026 *		
	21	3010 Budget Delta		BudgetDelta3010	$ -10,175.828 *		
	22	3010 Budget			$ 305,904.925 *	F	Budget3010
	23	3010 Estimate			$ -316,080.753 *	F	-Estimate3010
	24	2031 Budget Delta		BudgetDelta2031	$ 4,113.802 *		
	25	2031 Budget			$ 105,329.859 *	F	Budget2031
	26	2031 Estimate			$ -101,216.057 *	F	-Estimate2031
	27						
Estimate Summary	56	'Estimate Summary by Approp		*EstSum			
	57	Estimate Total			$ 417,296.810 (26%) *		
	58	Procurement Estimate		talSummaryAppn$	$ 417,296.810 (26%) *		
	59	3010 Estimate	3010		$ 316,080.753 (28%) *	F	SumIf(ApropType, 3010, @Total$)
	60	2031 Estimate	2031		$ 101,216.057 (18%) *	F	SumIf(ApropType, 2031, @Total$)

TECOLOTE RESEARCH, INC.

Calculate the Yearly Budget/Estimate Delta

■ **Objective: calculate the budget delta overall AND for each year - Isolating the delta each year allows you to create some analysis reports to understand what is causing the delta**

	WBS/CES Description	Approp	Unique ID	Point Estimate	Phasing Method	Equation / Throughput	Fiscal Year	Units	Start Date	Finish Date
18	'Budget Delta									
19	Total Delta			$ -6,062.026 *						
20	Procurment Budget Delta			$ -6,062.026 *						
21	3010 Budget Delta		BudgetDelta3010	$ -10,175.828 *						
22	3010 Budget			$ 305,904.925 *	F	Budget3010				
23	3010 Estimate			$ -316,080.753 *	F	-Estimate3010				
24	2031 Budget Delta		BudgetDelta2031	$ 4,113.802 *						
25	2031 Budget			$ 105,329.859 *	F	Budget2031				
26	2031 Estimate			$ -101,216.057 *	F	-Estimate2031				
27										
28	'Yearly Budget Deltas									
29	Last Year of Estimate			2007 *	C	FYCFirstYr(@Proc$)				
30	First Year of Estimate			2015 *	C	FYCLastYr(@Proc$)				
31										
32	Total 3010 Delta			$ -10,175.828 *						
33	Budget 3010 Delta FY 1			$ 677.508 *	F	BudgetDelta3010			FYCFirstYr(@Proc$)	aStartDate
34	Budget 3010 Delta FY 2			$ -3,074.144 *	F	BudgetDelta3010			FYCFirstYr(@Proc$)+1	aStartDate
35	Budget 3010 Delta FY 3			$ 1,493.689 *	F	BudgetDelta3010			FYCFirstYr(@Proc$)+2	aStartDate
36	Budget 3010 Delta FY 4			$ 1,143.590 *	F	BudgetDelta3010			FYCFirstYr(@Proc$)+3	aStartDate
37	Budget 3010 Delta FY 5			$ 2,293.726 *	F	BudgetDelta3010			FYCFirstYr(@Proc$)+4	aStartDate
38	Budget 3010 Delta FY 6			$ 8,248.166 *	F	BudgetDelta3010			FYCFirstYr(@Proc$)+5	aStartDate
39	Budget 3010 Delta FY 7			$ -29,942.394 *	F	BudgetDelta3010			FYCFirstYr(@Proc$)+6	aStartDate
40	Budget 3010 Delta FY 8			$ 8,926.907 *	F	BudgetDelta3010			FYCFirstYr(@Proc$)+7	aStartDate
41	Budget 3010 Delta FY 9			$ 57.123 *	F	BudgetDelta3010			FYCFirstYr(@Proc$)+8	aStartDate
42	Budget 3010 Delta FY 10			$ 0.000 *	F	BudgetDelta3010			FYCFirstYr(@Proc$)+9	aStartDate

■ **Use the features in your tool of choice to organize the yearly data to simplify suitable reporting**

Bridging Engineering and Economics Since 1973

Define Risk Allocation
to Calculate Delta Adjusted for Risk

- **The example session produces a risk adjusted result at any confidence level**

- **In order to calculate a time phased risk adjusted result we must define how we want to spread the risk dollars throughout the WBS**

  - **Defining the risk allocation level for the estimate to compare it to a budget requires deep understanding of the scenario you are working to emulate**
    - Different scenarios require different allocation specifications
    - For example, do you want to allocate from level 1, 2 or 3 of the WBS or a mixture of levels? In general, WBS level alone may not be sufficient

  - **In ACE, the recommended approach is to create a risk allocation level column**
    - Change a Category Column name to "Risk Allocation Level"
    - In the column mark the rows where you want to manage the program from

  - **In our scenario, the procurement level 2 costs should be at the 65% CL**
    - Mark the rows in the estimate WBS – AF Manufacturing, Army Manufacturing, Quality Control, SEPM, and Program Office Costs
    - See the example in back up

**TECOLOTE
RESEARCH, INC.**
Bridging Engineering and Economics
Since 1973

Estimate and Budget Reports

Is the budget sufficient for my program?
Do I have years with budget shortfalls?

Estimate Report with Budget Marker

TECOLOTE RESEARCH, INC.

- **Report for the Point Estimate at 65% CL with the Total Budget**

Sand Chart

Point Estimate at 65% CL
Third Level of Visibility for Estimate Total

Bridging Engineering and Economics Since 1973

TECOLOTE RESEARCH, INC.
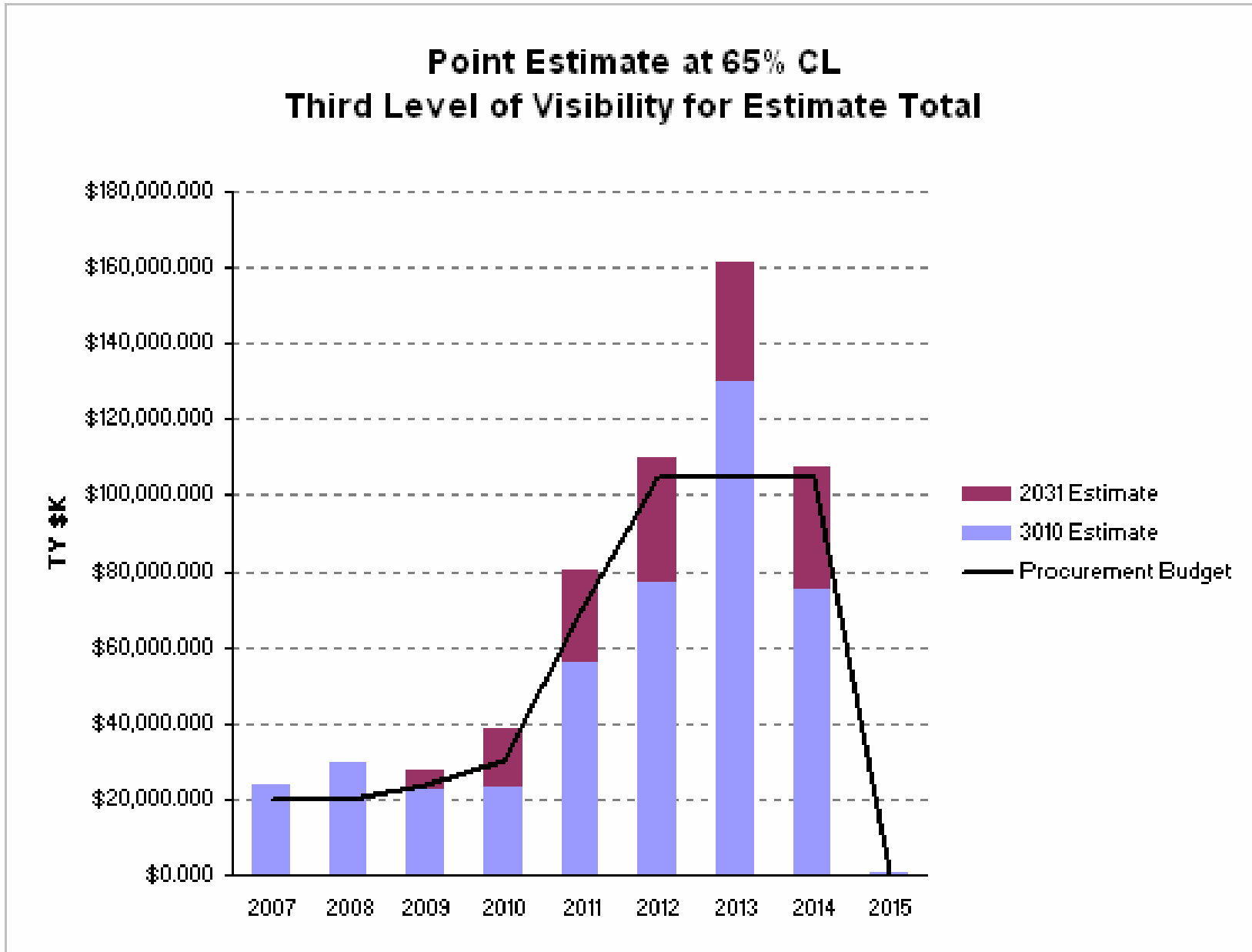
Budget Delta Yearly Results

- **Time Phased report of budget delta rows shows the yearly shortfalls in the program 65% CL estimate**

Time Phased Results for Point Estimate at 65% CL

Funding in TY $K										
WBS	Total	2007	2008	2009	2010	2011	2012	2013	2014	2015
"Budget Delta										
Total Delta	-$99,666.900	-$3,638.964	-$9,670.500	-$3,351.764	-$8,710.829	-$10,216.332	-$5,187.586	-$56,637.638	-$2,228.599	-$24.688
Procurment Budget Delta	-$99,666.900	-$3,638.964	-$9,670.500	-$3,351.764	-$8,710.829	-$10,216.332	-$5,187.586	-$56,637.638	-$2,228.599	-$24.688
3010 Budget Delta	-$82,109.672	-$3,638.964	-$9,670.500	-$2,605.109	-$3,032.593	-$6,137.946	-$1,970.981	-$54,540.195	-$523.714	$10.332
3010 Budget	$355,400.000	$20,000.000	$20,000.000	$20,000.000	$20,000.000	$50,000.000	$75,000.000	$75,000.000	$75,000.000	$400.000
3010 Estimate	-$437,509.672	-$23,638.964	-$29,670.500	-$22,605.109	-$23,032.593	-$56,137.946	-$76,970.981	-$129,540.195	-$75,523.714	-$389.668
2031 Budget Delta	-$17,557.228			-$746.655	-$5,678.236	-$4,078.386	-$3,216.604	-$2,097.443	-$1,704.885	-$35.020
2031 Budget	$124,200.000			$4,000.000	$10,000.000	$20,000.000	$30,000.000	$30,000.000	$30,000.000	$200.000
2031 Estimate	-$141,757.228			-$4,746.655	-$15,678.236	-$24,078.386	-$33,216.604	-$32,097.443	-$31,704.885	-$235.020

Bridging Engineering and Economics Since 1973

TECOLOTE RESEARCH, INC.

Bridging Engineering and Economics

Since 1973

Budgetary What if Drills

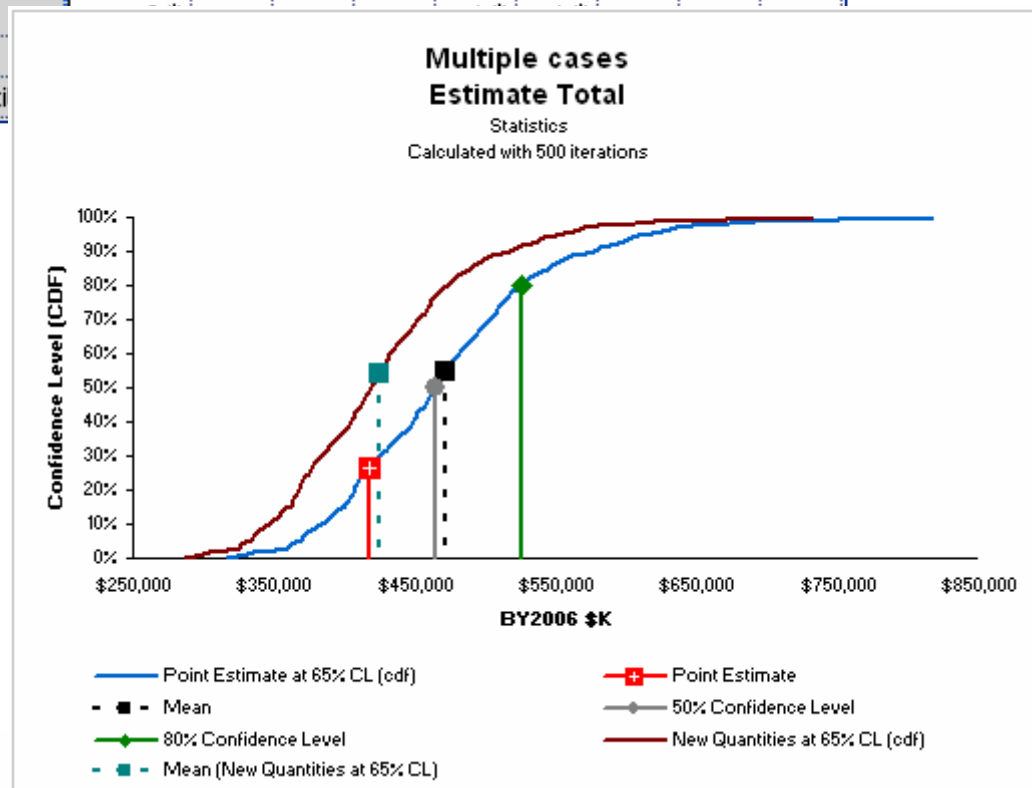## If the budget changes how will it affect my program?

TECOLOTE RESEARCH, INC.

Perform a What if Drill and View Estimate Impacts

- ■ **Create new What if case at the 65% uncertainty CL**

Cases
Lower Propulsion Cost Scen...
Point Estimate
Point Estimate at 65% CL (B...
New Quantities at 65% CL (B...

	WBS	Total	2006	2007	2008	2009	2010	2011	2012	2013
124	*Buy Quantities									
125	Total Air Vehicle Buy Quantity	156 *		1 *	1 *	2 *	2 *	20 *	40 *	65 *
126	Air Force Buy Quantities	99 *		1 *	1 *	1 *	1 *	10 *	20 *	45 *
127	Low Rate Initial Production	4 *		1 *	1 *	1 *	1 *			
128	Full Rate Production	95 *						10	20	45
129	Army Buy Quantities	57 *			1 *	1 *	10 *	20 *	20 *
130	Low Rate Initial Production									
131	Full Rate Production									
132	Army Transportable Ground Station Quanti									

- ■ **Compare Cases to examine the impacts**
  - ● Compare Time Phased Results
  - ● Compare S-Curves

Multiple cases
Estimate Total
Statistics
Calculated with 500 iterations

- Point Estimate at 65% CL (cdf)
- - ■ - Mean
- 80% Confidence Level
- - ■ - Mean (New Quantities at 65% CL)
- Point Estimate
- 50% Confidence Level
- New Quantities at 65% CL (cdf)

Delta Comparison

Costs in BY2006 $K	Total	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Point Estimate at 65% CL	$493,167.997		$21,579.189	$25,502.287	$24,023.022	$30,435.492	$70,205.093	$94,999.136	$137,030.187	$88,891.906	$501.686	
New Quantities at 65% CL	$443,856.212		$19,953.670	$23,864.639	$22,396.125	$28,771.111	$58,574.942	$93,788.951	$135,588.358	$60,606.255	$312.161	
Delta (Δ)	-$49,311.785		-$1,625.519	-$1,637.647	-$1,626.897	-$1,664.381	-$11,630.151	-$1,210.184	-$1,441.828	-$28,285.651	-$189.525	
Percent Δ	(10.00%)		(7.53%)	(6.42%)	(6.77%)	(5.47%)	(16.57%)	(1.27%)	(1.05%)	(31.82%)	(37.78%)	
Threshold	Medium		Medium	Medium	Medium	Medium	High	Low	Low	High	High	

TECOLOTE RESEARCH, INC.

Bridging Engineering and Economics

Since 1973

Understanding Estimate Drivers

Which estimate elements do I need to watch carefully to help me keep on budget?
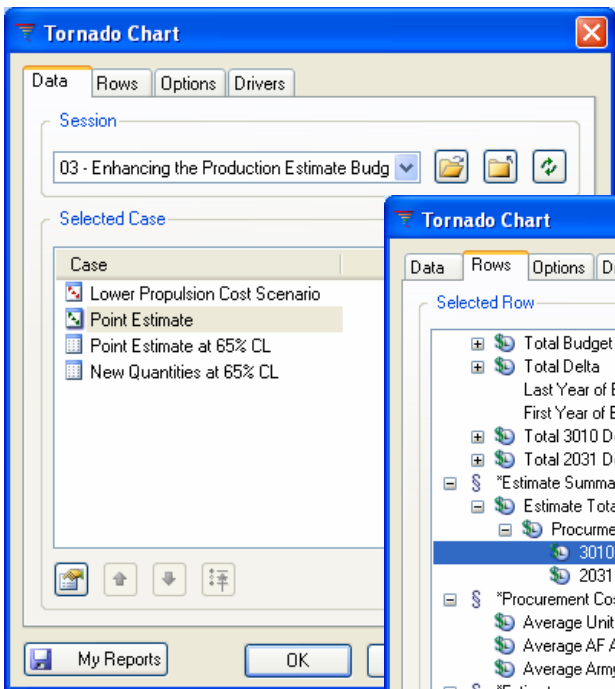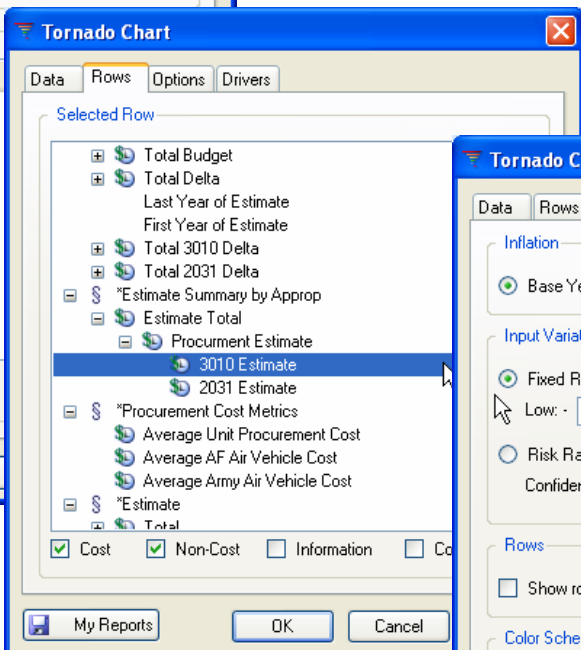
TECOLOTE RESEARCH, INC.

Understanding Estimate Drivers

- **Tornado and Spider reports display the impact of changing selected variables that drive the total result of a selected row**
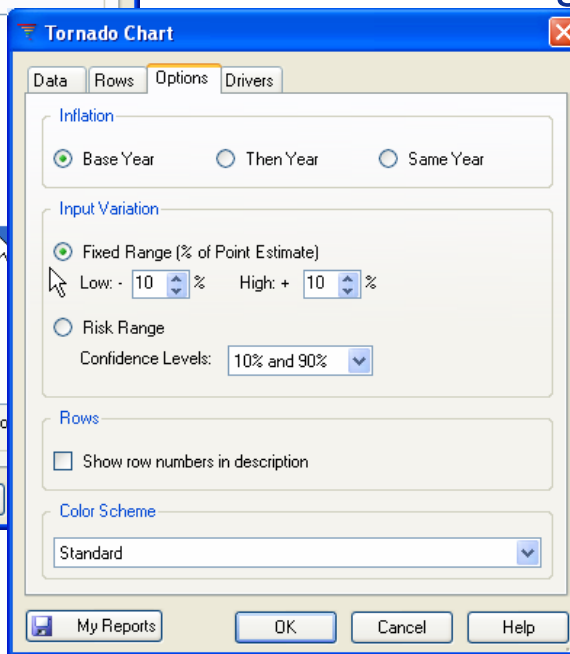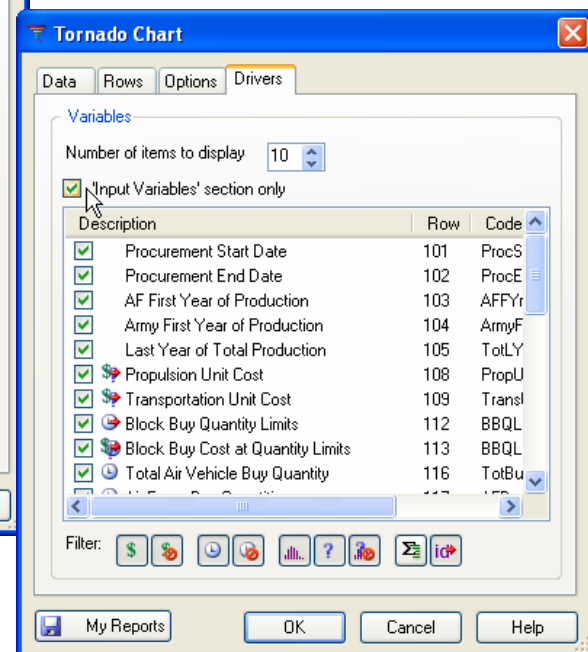
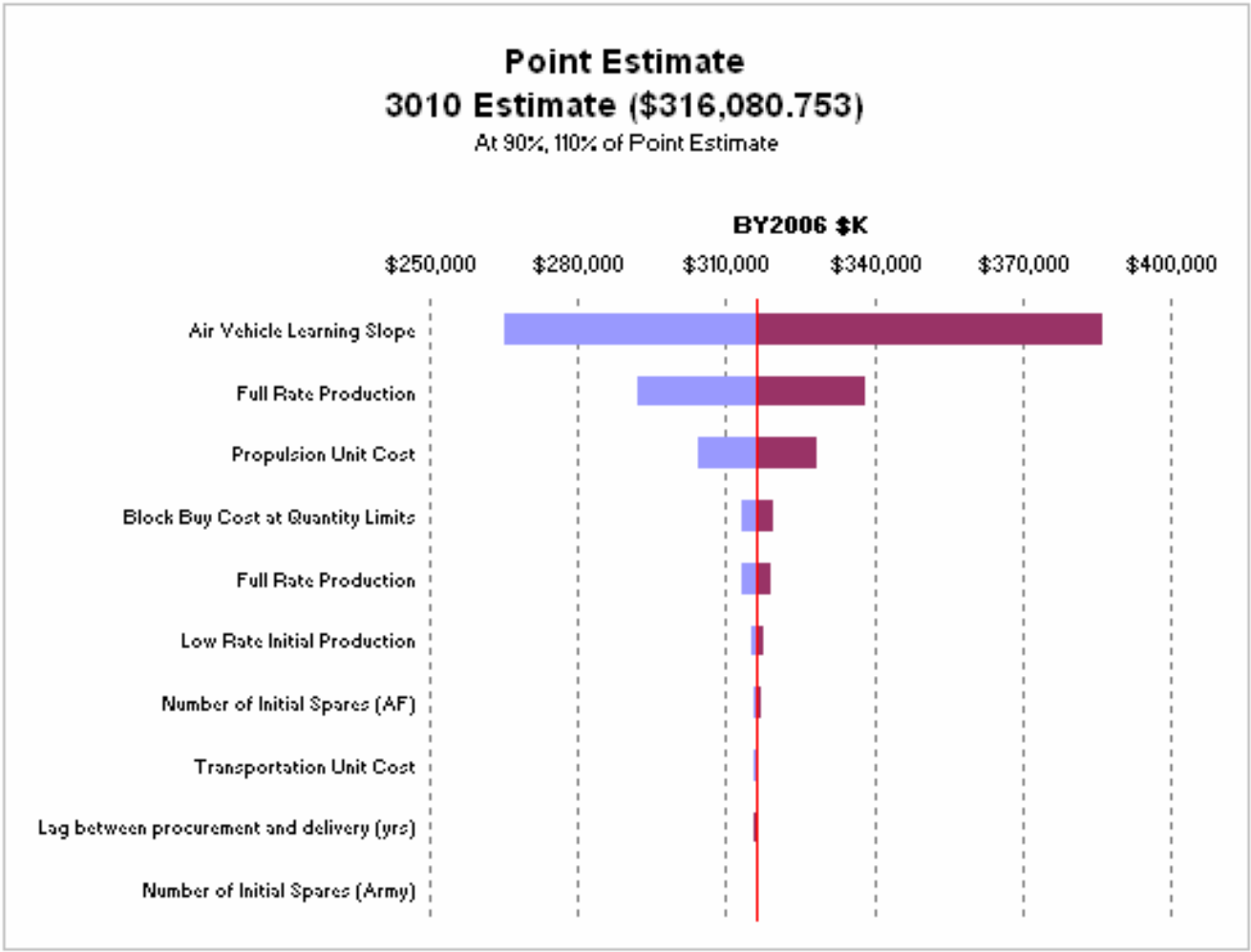1. Select the Point Estimate case

2. Select an appropriation summary

3. Select fixed range

4. Select the "Input Variables"

Bridging Engineering and Economics Since 1973

Reporting Estimate Drivers

TECOLOTE RESEARCH, INC.

Tornado Chart

Point Estimate
3010 Estimate ($316,080.753)
At 90%, 110% of Point Estimate

BY2006 $K

$250,000 $280,000 $310,000 $340,000 $370,000 $400,000

- Air Vehicle Learning Slope
- Full Rate Production
- Propulsion Unit Cost
- Block Buy Cost at Quantity Limits
- Full Rate Production
- Low Rate Initial Production
- Number of Initial Spares (AF)
- Transportation Unit Cost
- Lag between procurement and delivery (yrs)
- Number of Initial Spares (Army)

BaseYear ▼ Case

- **Tornado Chart**
  - Each variable is varied +/- 10% and the effect is measure on the target row
  - In our example the Learning Slope has the biggest effect on the 3010 estimate

Drivers & Results

Drivers (exluding Rollup)	Row	Target Row Results			Fixed Range Inputs		
		Delta	-10%	+10%	Point Estimate	-10%	+10%
Air Vehicle Learning Slope	140	$120,645.657	$265,124.506	$385,770.163	90	81	99
Full Rate Production	129	$45,799.094	$291,934.891	$337,733.984	115	104	127
Propulsion Unit Cost	118	$23,453.797	$304,353.854	$327,807.651	$535.127	$481.615	$588.640
Block Buy Cost at Quantity Limits	123	$5,870.747	$313,145.379	$319,016.126	$667.717	$600.945	$734.489

0807

Bridging Engineering and Economics Since 1973

18

TECOLOTE RESEARCH, INC.

Reporting Estimate Drivers

Spider Chart

Point Estimate
3010 Estimate ($316,080.753)
From 90% to 110% of Point Estimate

- Air Vehicle Learning Slope
- Full Rate Production
- Propulsion Unit Cost
- Block Buy Cost at Quantit
- Full Rate Production
- Low Rate Initial Productio
- Number of Initial Spares (
- Transportation Unit Cost
- Lag between procurement (yrs)
- Number of Initial Spares (

BaseYear   Case
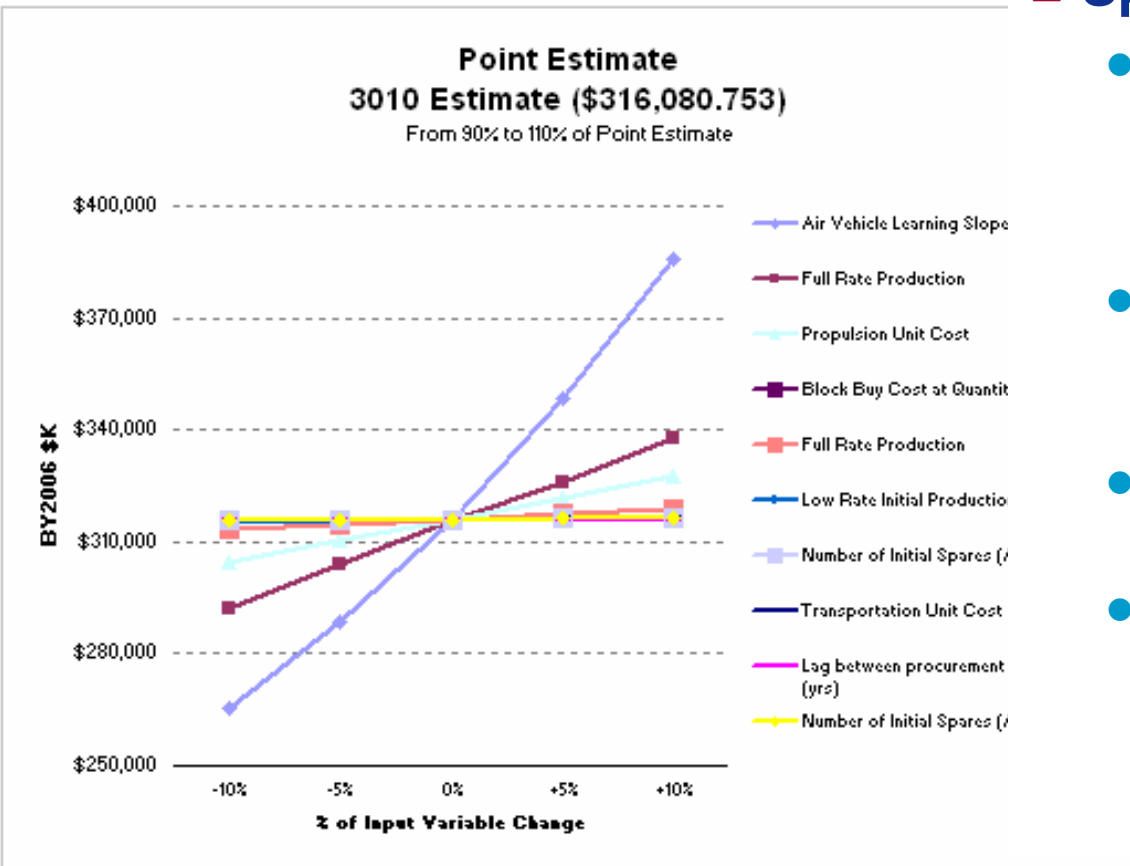
■ **Spider Chart**

- Similar to the Tornado chart, it plots results at user specified intervals between the end points to the plot driver sensitivity trend
- The line with the steepest slope corresponds to the input with the largest impact
- Useful to identify linear, non-linear, step and trend reversals of the variables
- In our example the AV learning slope has the steepest slope - Changes in this variable have the biggest effect on the 3010 estimate

Drivers & Results

Drivers (excluding Rollup)	Row	Target Row Results					Point Estimat	Fixed Range Inputs		
		Delta	-10%	-5%	0%	+5%	+10%		-10%	-5%	0%
Air Vehicle Learning Slope	140	$120,645.657	$265,124.506	$288,499.779	$316,080.753	$348,338.626	$385,770.163	90	81	86	90
Full Rate Production	129	$45,799.094	$291,934.891	$304,025.340	$316,080.753	$325,850.199	$337,733.984	115	104	109	115
Propulsion Unit Cost	118	$23,453.797	$304,353.854	$310,217.304	$316,080.753	$321,944.202	$327,807.651	$535.127	$481.615	$508.371	$535.127
Block Buy Cost at Quantity Limits	123	$5,870.747	$313,145.379	$314,613.066	$316,080.753	$317,548.440	$319,016.126	$667.717	$600.945	$634.331	$667.717

Bridging Engineering and Economics Since 1973

Do the Estimate Drivers Change Over the Fiscal Years?
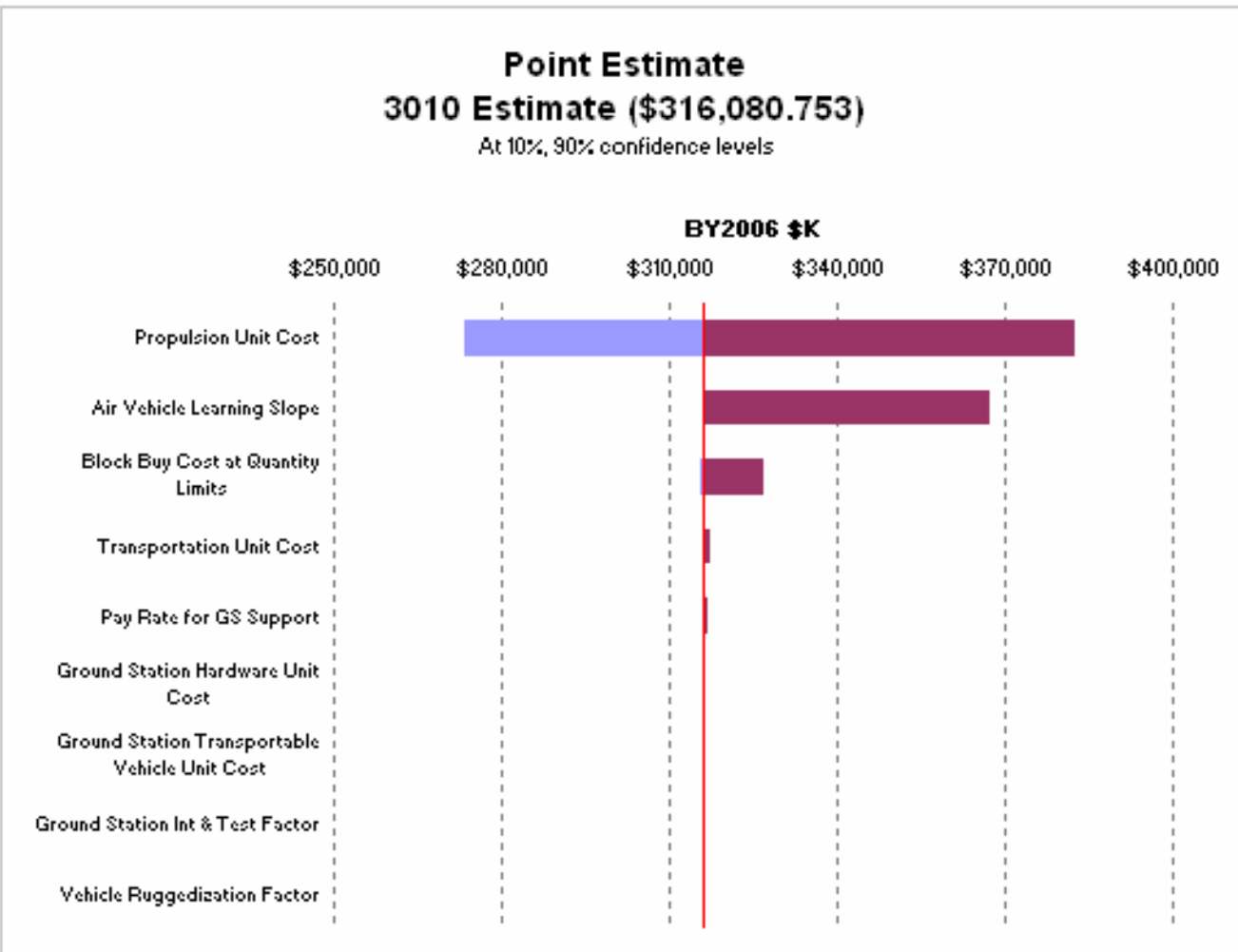
TECOLOTE RESEARCH, INC.

- **The yearly estimate drivers most likely will change as program activities commence and complete - The estimate driver in FY1 may not be the same in FY8 or FY9**

- **Run the Tornado or Spider chart on the yearly delta rows (rows 32 – 42, see slide 9) to see the yearly driver**

Point Estimate
Budget 3010 Delta FY 1 ($677.508)
At 90%, 110% of Point Estimate

Point Estimate
Budget 3010 Delta FY 8 ($8,926.907)
At 90%, 110% of Point Estimate

Point Estimate
Budget 3010 Delta FY 9 ($57.123)
At 90%, 110% of Point Estimate

Bridging Engineering and Economics Since 1973

TECOLOTE RESEARCH, INC.
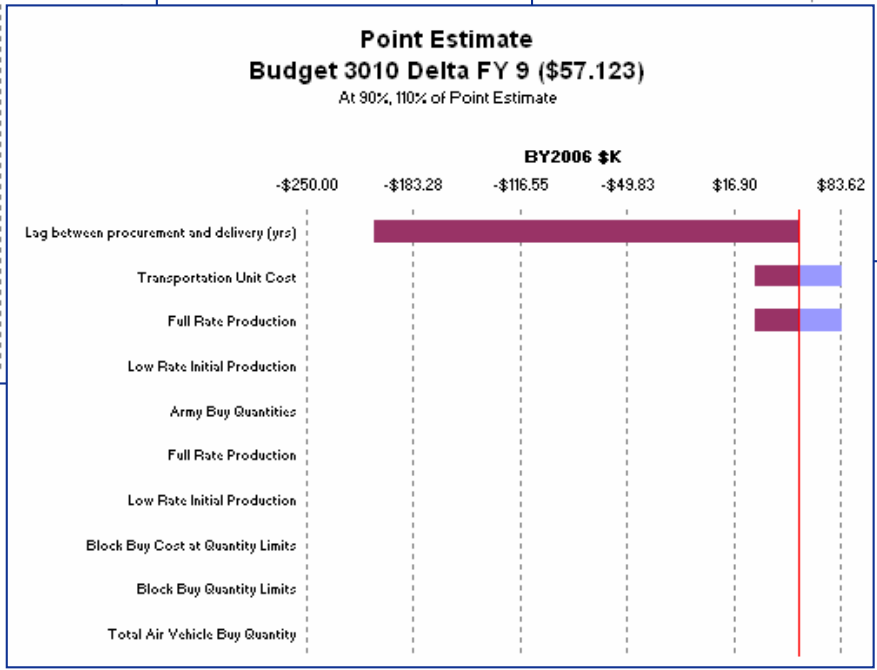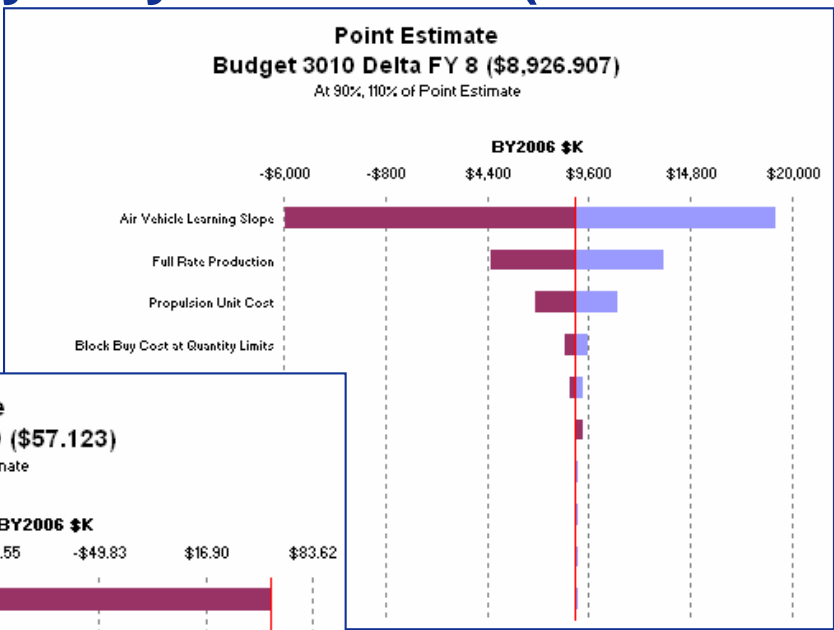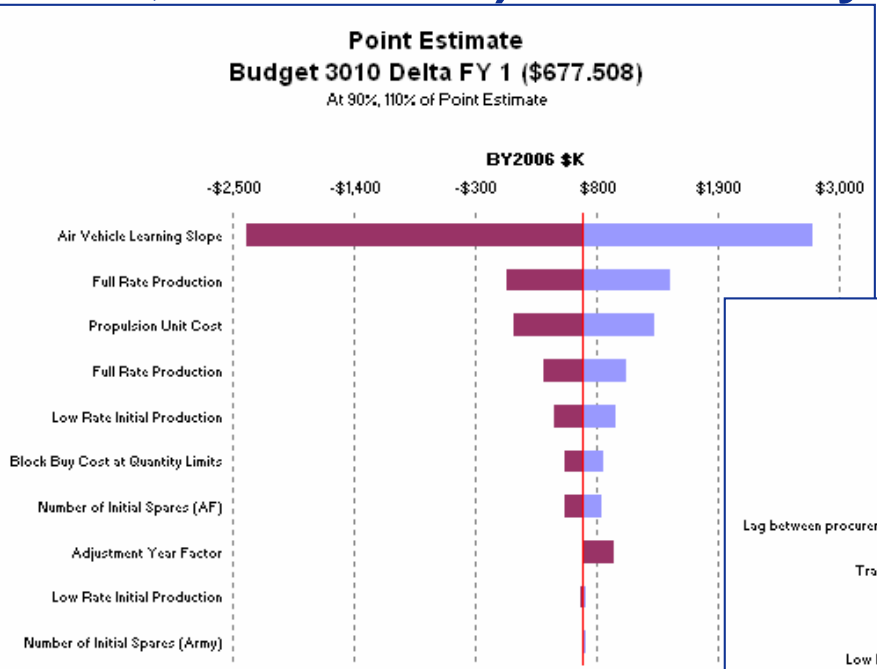
Understanding Uncertainty

Tornado Chart

Point Estimate
3010 Estimate ($316,080.753)
At 10%, 90% confidence levels

- **Tornado and Spider chart with risk range**

- **This report shows for all the uncertain elements that effect the target row (i.e. WBS Total) the 10/90 bounds of propulsion unit cost produce the greatest impact**

Drivers & Results

Drivers (exlcuding Rollup, Zero Uncertainty)	Row	Target Row Results			Risk Range Inputs		
		Delta	10%	90%	Point Estimate	10%	90%
Propulsion Unit Cost	118	$108,506.875	$273,683.984	$382,190.858	$535.127	$341.660	$836.804
Air Vehicle Learning Slope	140	$47,562.836	$319,529.444	$367,092.280	90	91	97
Block Buy Cost at Quantity Limits	123	$10,925.161	$315,624.864	$326,550.025	$667.717	$657.347	$905.864
Transportation Unit Cost	119	$764.460	$316,031.339	$316,795.799	$10.599	$10.334	$14.430

Bridging Engineering and Economics Since 1973

Summary

- **Working with budget and estimate information requires some set up**

  - Make sure you fully understand the scenario you are modeling and the uncertainty/risk requirements

  - Adding elements to the ACE session provides increased flexibility and analytical capability in POST

- **Understanding the difference between the Budget and the Estimate**

  - Is the budget sufficient for my program? Do I have years with budget shortfalls?

    - Generate POST Sand Charts with the Estimate and Budget line

    - Generate time Phased Reports for the Delta rows

  - If the budget changes how will it affect my program?

    - Quickly perform What if drills by creating new cases and updating the POST reports

  - Which estimate elements do I need to watch carefully to help me keep on budget?

    - Use the Tornado and Spider charts to determine estimate drivers for both the total and yearly results

Bridging Engineering and Economics Since 1973

TECOLOTE RESEARCH, INC.

Bridging Engineering and Economics
Since 1973

Back Up

Building the Estimate Summary using the SumIf Function

■ **The SumIf function requires a summary definition DEC (ApropType) to identify which rows to including in the sum**

	WBS/CES Description	Approp	ApropType (!) Approp Type	Unique ID	Point Estimate	Phasing Method	Equation / Throughput	Fiscal Year	Units
56	'Estimate Summary by Approp			*EstSum					
62	Estimate Total				$ 417,296.810 (26%) *				
63	Procurement Estimate			SummaryNoAppn$	$ 417,296.810 (26%) *				
64	3010 Estimate			Estimate3010	$ 316,080.753 (28%) *	F	SumIf(ApropType, 3010, @Total$)		
65	2031 Estimate			Estimate2031	$ 101,216.057 (18%) *	F	SumIf(ApropType, 2031, @Total$)		
76									
77	'Estimate			*Estimate					
78	Total			Total$	$ 417,296.810 (26%) *				
79	Procurement			Proc$	$ 417,296.810 (26%) *				
80	Manufacturing (Air Force)			AF_Mfg$	$ 197,825.262 (25%) *				
81	Air Vehicle (AF)			AF_AV$	$ 165,261.290 (24%) *				
82	Basic Structure (AF)	3010	3010		$ 85,709.612 (0+%) *	R	10000	2003	$K
83	Navigation/Guidance (AF)	3010	3010		$ 15,871.523 (15%) *	F	StepVal(FYCVal(@AFBuyQty), @BBQL,		
84	Propulsion (AF)	3010	3010		$ 63,680.155 (50%) *	F	PropUC$ * AFBuyQty		
85	Integration & Test (AF)	3010	3010		$ 24,789.194 (42%) *	F	0.15 * AF_AV$		
86	Ground Station LRIP Support (AF)	3010	3010		$ 556.431 (25%) *	F	NPeople * Pay$		
87	Transportation (AF)	3010	3010	Trans$	$ 1,261.243 (17%) *	F	TransUC$ * FYCVal(@AFBuyQty,		
88	Initial Operational Test & Eval (AF)	3010	3010		$ 3,179.604 (17%) *	F	3	2004	$M
89	Initial Spares & Repair Parts (AF)	3010	3010		$ 2,777.501 (24%) *	F	FYTot(@AvgAF$) * NInitAFSpr		
90									
91	Manufacturing (Army)			Army_Mfg$	$ 101,216.057 (18%) *				
92	Air Vehicle (Army)			Army_AV$	$ 79,957.087 (24%) *				
93	Basic Structure (Army)	2031	2031		$ 41,585.308 (0+%) *	R	[Shared Learning - StrShr]		
94	Navigation/Guidance (Army)	2031	2031		$ 7,869.520 (15%) *	F	StepVal(FYCVal(@ArmyBuyQty), @BBQL,		
95	Propulsion (Army)	2031	2031		$ 30,502.259 (50%) *	F	PropUC$ * ArmyBuyQty		
96	Air Vehicle Integration (Army)	2031	2031		$ 11,993.563 (38%) *	F	0.15 * Army_AV$		
97	Transportable Ground Stations (Army)				$ 556.431 (16%) *				
98	Ground Station Hardware (Army)	2031	2031	GSHW	$ 238.470 (17%) *	F	GSHWUC$ * ArmyGSQty		
99	Transportable Vehicle (Army)	2031	2031	TV$	$ 206.674 (20%) *	F	TVUC$ * ArmyGSQty		
100	Vehicle Ruggedization (Army)	2031	2031	VehRug	$ 41.335 (30%) *	F	VR% * TV$		
101	Integration & Test (Army)	2031	2031		$ 69.951 (23%) *	F	IT% * (VehRug + GSHW)		
102	Transportation (Army)	2031	2031		$ 604.125 (17%) *	F	TransUC$ * ArmyBuyQty		

Bridging Engineering and Economics Since 1973

Enter the Budget

TECOLOTE RESEARCH, INC.

■ Enter the budget

- Budget inputs are usually entered in Then Year (TY) dollars
- Give each budget managing row a unique ID
- If using appropriation level budgets include the ACE Appropriation on the row
- Add a section header to easily identify the budget section in report set up dialogs

	WBS/CES Description	Approp	ApropType (!) Approp Type	Unique ID	Point Estimate	Phasing Method	Equation / Throughput
12	'Budget Information			'Budget			
13	Total Budget				$ 411,234.784 *		
14	Procurement Budget				$ 411,234.784 *		
15	3010 Budget	3010		Budget3010	$ 305,904.925 *	TY	[Cost Throughput]
16	2031 Budget	2031		Budget2031	$ 105,329.859 *	TY	[Cost Throughput]

Bridging Engineering and Economics Since 1973

Session Includes Risk Distributions

- **The estimate includes uncertainty distributions to produce a result at a requested CL**

- **The risk inputs are on the estimate inputs and the estimating methods - These automatically ripple thru budget delta calculation rows without additional inputs**

ACE 7.1 - [03 - Enhancing the Production Estimate Budget Example.aceit - RI$K Basic (BY 2006$K)]

File Edit View Documentation Calc Cases Reports Tools Window Help

Arial   8   **B** *I* U

*Budget Informa   *Budget Information

	WBS/CES Description	Unique ID	Point Estimate	Equation / Throughput	Distribution Form	PE Position in Distribution	Spread	Skew	Low (% of PE)	High (% of PE)
77	'Estimate	'Estimate								
78	Total	Total$	296.810 (26%) *							
79	Procurement	Proc$	296.810 (26%) *							
80	Manufacturing (Air Force)	AF_Mfg$	325.262 (25%) *							
81	Air Vehicle (AF)	AF_AV$	261.290 (24%) *							
82	Basic Structure (AF)		709.612 (0+%) *	10000						
83	Navigation/Guidance (AF)		371.523 (15%) *	StepVal(FYCVal(@AFBuyQty), @BBQL,						
84	Propulsion (AF)		680.155 (50%) *	PropUC$ * AFBuyQty						
85	Integration & Test (AF)		789.194 (42%) *	0.15 * AF_AV$	Normal	Mean	High			
86	Ground Station LRIP Support (AF)		556.431 (25%) *	NPeople * Pay$						
87	Transportation (AF)	Trans$	261.243 (17%) *	TransUC$ * FYCVal(@AFBuyQty,						
88	Initial Operational Test & Eval (AF)		179.604 (17%) *	3	Triangular	Mode			85	175
89	Initial Spares & Repair Parts (AF)		777.501 (24%) *	FYTot(@AvgAF$) * NInitAFSpr						
90										
91	Manufacturing (Army)	Army_Mfg$	216.057 (18%) *							
92	Air Vehicle (Army)	Army_AV$	357.087 (24%) *							
93	Basic Structure (Army)		585.308 (0+%) *	[Shared Learning - StrShr]						
94	Navigation/Guidance (Army)		369.520 (15%) *	StepVal(FYCVal(@ArmyBuyQty),						

Ready

Bridging Engineering and Economics Since 1973

TECOLOTE RESEARCH, INC.

Risk Allocation in our Example

	WBS/CES Description	Approp	Unique ID	Point Estimate	Phasing Method	Equation / Throughput	Fiscal Year	Units	Risk Allocation Level
77	'Estimate		'Estimate						
78	Total		Total$	$ 417,296.810 (26%) *					
79	Procurement		Proc$	$ 417,296.810 (26%) *					
80	Manufacturing (Air Force)		AF_Mfg$	$ 197,825.262 (25%) *					x
81	Air Vehicle (AF)		AF_AV$	$ 165,261.290 (24%) *					
82	Basic Structure (AF)	3010		$ 85,709.612 (0+%) *	R	10000	2003	$K	
83	Navigation/Guidance (AF)	3010		$ 15,871.523 (15%) *	F	StepVal(FYCVal(@AFBuyQty), @BBQL,			
84	Propulsion (AF)	3010		$ 63,680.155 (50%) *	F	PropUC$ * AFBuyQty			
85	Integration & Test (AF)	3010		$ 24,789.194 (42%) *	F	0.15 * AF_AV$			
86	Ground Station LRIP Support (AF)	3010		$ 556.431 (25%) *	F	NPeople * Pay$			
87	Transportation (AF)	3010	Trans$	$ 1,261.243 (17%) *	F	TransUC$ * FYCVal(@AFBuyQty,			
88	Initial Operational Test & Eval (AF)	3010		$ 3,179.604 (17%) *	F	3	2004	$M	
89	Initial Spares & Repair Parts (AF)	3010		$ 2,777.501 (24%) *	F	FYTot(@AvgAF$) * NInitAFSpr			
90									
91	Manufacturing (Army)		Army_Mfg$	$ 101,216.057 (18%) *					x
92	Air Vehicle (Army)		Army_AV$	$ 79,957.087 (24%) *					
93	Basic Structure (Army)	2031		$ 41,585.308 (0+%) *	R	[Shared Learning - StrShr]			
94	Navigation/Guidance (Army)	2031		$ 7,869.520 (15%) *	F	StepVal(FYCVal(@ArmyBuyQty), @BBQL,			
95	Propulsion (Army)	2031		$ 30,502.259 (50%) *	F	PropUC$ * ArmyBuyQty			
96	Air Vehicle Integration (Army)	2031		$ 11,993.563 (38%) *	F	0.15 * Army_AV$			
97	Transportable Ground Stations (Army)			$ 556.431 (16%) *					
98	Ground Station Hardware (Army)	2031	GSHW	$ 238.470 (17%) *	F	GSHWUC$ * ArmyGSQty			
99	Transportable Vehicle (Army)	2031	TV$	$ 206.674 (20%) *	F	TVUC$ * ArmyGSQty			
100	Vehicle Ruggedization (Army)	2031	VehRug	$ 41.335 (30%) *	F	VR% * TV$			
101	Integration & Test (Army)	2031		$ 69.951 (23%) *	F	IT% * (VehRug + GSHW)			
102	Transportation (Army)	2031		$ 604.125 (17%) *	F	TransUC$ * ArmyBuyQty			
103	Initial Operational Test & Eval (Army)	2031		$ 5,299.340 (13%) *	F	5	2004	$M	
104	Initial Spares & Repair Parts (Army)	2031		$ 2,805.512 (24%) *	F	FYTot(@AvgArmy$) * NInitArmySpr			
105	Quality Control	3010		$ 5,863.495 (21%) *	F	FYCVal(@QC%, FYYR - Adj) * (AF_Mfg$ +			x
106	SEPM	3010		$ 110,645.288 (37%) *	TC	0.37 * (FYTOT(@AF_Mfg$) +			x
107	Program Office Costs	3010		$ 1,746.708 (17%) *	TY	[Cost Throughput]		$K	x

Bridging Engineering and Economics Since 1973

Row Set Up for POST

- **To maximize the What if drill capabilities in POST set the budget and estimate input rows External Type to "INPUT"**

Bridging Engineering and Economics Since 1973

Creating a Risk Adjusted Case in POST

TECOLOTE RESEARCH, INC.

- **The reports that we create to compare with the budget should be risk adjusted results**

- **Create a copy of the Point Estimate Case**

- **Set the Case Properties to Calculate a risk adjusted result**

Bridging Engineering and Economics Since 1973

POST Risk Case Results

TECOLOTE RESEARCH, INC.

Inputs/Results Viewer - 03 - Enhancing the Production Estimate Budget Example.aceit

View   Mode   Edit   Calculate   Session   Cases   Help

Base Year Results ▼ | Phased by Case ▼ | 📊 Calculate 🗂 Add Case... | 📋 Reports... | ✂ Cut 📋 Copy 📋 Paste 🔍 Find... | 🔹🔹🔹🔹 | ❓ Help

Cases
- Lower Propulsion Cost Scen...
- Point Estimate
- Point Estimate at 65% CL (B...

	WBS	Total	2006	2007	2008	2009	2010	2011
1	** EXAMPLE FILE **							
2	*Configuration Functions							
3	* Base Year of Calculation	2006						
4	* Units of Calculation	Thousands						
5	* System Inflation Table for Calculatio	US Government Indice						
6	* Time of Calculation	11:07 AM						
7	* Date of Calculation	06 Jan 2008						
8	* Time ACE Session Last Saved	11:06 AM						
9	* Date ACE Session Last Saved	06 Jan 2008						
10	* Risk Iterations	500						
11								
12	*Budget Information							
13	Total Budget	$411,234.784		$18,980.904	$18,556.810	$21,783.612	$26,661.334	$60,980.090
14	Procurement Budget	$411,234.784		$18,980.904	$18,556.810	$21,783.612	$26,661.334	$60,980.090
15	3010 Budget	$305,904.925		$18,980.904	$18,556.810	$18,159.220	$17,785.746	$43,580.132
16	2031 Budget	$105,329.859				$3,624.392	$8,875.589	$17,399.958
17								
18	*Budget Delta							
19	Total Delta	-$85,823.574 (33%)		-$3,453.541	-$8,972.682	-$3,041.880	-$7,736.615	-$8,898.037
20	Procurment Budget Delta	-$85,823.574 (33%)		-$3,453.541	-$8,972.682	-$3,041.880	-$7,736.615	-$8,898.037
21	3010 Budget Delta	-$70,635.753 (33%)		-$3,453.541	-$8,972.682	-$2,365.338	-$2,696.846	-$5,349.850
22	3010 Budget	$305,904.925		$18,980.904	$18,556.810	$18,159.220	$17,785.746	$43,580.132
23	3010 Estimate	-$376,540.677 (33%)		-$22,434.445	-$27,529.492	-$20,524.558	-$20,482.592	-$48,929.983
24	2031 Budget Delta	-$15,187.821 (35%)				-$676.542	-$5,039.769	-$3,548.187
25	2031 Budget	$105,329.859				$3,624.392	$8,875.589	$17,399.958
26	2031 Estimate	-$120,517.681 (35%)				-$4,300.934	-$13,915.357	-$20,948.145
27								

■ **You must ignore the CL after the Budget Total numbers - They are meaningless in this context because we took a 65% Risk Adjusted Estimate and subtracted it from a Budget where there is no confidence level association - we hid these CLs in ACE**

Bridging Engineering and Economics Since 1973

Changes required for 65% CL at the Appropriation Level

- **If you want the Approp total levels at the 65% level changes need to be made within the ACE session**

  - The Risk Allocation markers are moved to the Estimate Summary by Approp

  - Appropriations need to be added to the summary section

	WBS/CES Description	Approp	Unique ID	Point Estimate	Phasing Method	Equation / Throughput	Fiscal Year	Units	Risk Allocation Level
56	'Estimate Summary by Approp		*EstSum						
57	Estimate Total			$ 417,296.810 (26%) *					
58	Procurment Estimate		otalSummaryAppn$	$ 417,296.810 (26%) *					
59	3010 Estimate	3010		$ 316,080.753 (28%) *	F	Sumlf(ApropType, 3010, @Total$)			X
60	2031 Estimate	2031		$ 101,216.057 (18%) *	F	Sumlf(ApropType, 2031, @Total$)			X
61									

- **The appropriation estimates are at the 65% level**

Inputs/Results Viewer - 03 - Enhancing the Production Estimate Budget Example.aceit

View   Mode   Edit   Calculate   Session   Cases   Help

Base Year Results   Phased by Case   Calculate   Add Case...   Reports...   Cut   Copy   Paste   Find...   Help

Cases		WBS	Total	2006	2007	2008	2009	2010	2011	2012
Lower Propulsion Cost Scen...	56	*Estimate Summary by Approp								
Point Estimate (BY2006$K)	57	Estimate Total	$493,167.997 (66%)		$21,579.189	$25,502.287	$24,023.022	$30,435.492	$70,205.093	$94,999.136
Point Estimate at 65% CL [B...	58	Procurment Estimate	$493,167.997 (66%)		$21,579.189	$25,502.287	$24,023.022	$30,435.492	$70,205.093	$94,999.136
New Quantities at 65% CL [B...	59	3010 Estimate	$372,650.317 (65%)		$21,579.189	$25,502.287	$19,648.192	$19,620.634	$48,675.512	$65,834.100
	60	2031 Estimate	$120,517.681 (65%)				$4,374.831	$10,814.858	$21,529.581	$29,165.036

- **The consequence of this approach is that you loose risk allocation within the detailed estimate**

Bridging Engineering and Economics Since 1973