CECOM's Tips for Creating More Efficient Estimates

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Purpose

- CECOM cost analysts utilize several sophisticated estimating methodologies in ACE to gain efficiencies. This presentation will address a few of those methodologies, and illustrate how they lead to more dynamic and powerful cost models

Agenda

- Linking quantity schedules for Procurement, Fielding, and Sustainment
- Using matrices to simplify manpower cost calculations
- Using the “IF” function with ACEIT cases to simplify estimates for CBAs, BCAs, etc.

Linking Quantity Schedules for Procurement, Fielding, and Sustainment

Linking Quantity Schedules

- The following statements are usually true about quantity schedules:
  - The **Fielding** (delivery) quantity schedule is the **Production** (buy) quantity schedule shifted out by some period of time (i.e. one year)
  - The **Sustainment** quantity schedule is the sum of the fielded quantities throughout the system life
  - It is more time consuming to maintain three quantity schedules in ACE than it is to build one

Linking Quantity Schedules

- Why is it advantageous to link schedules?
  - With unlinked schedules, quantity changes during what-if drills can result in significant rework for the analyst
  - If the quantity schedules are linked, the analyst is only required to change quantities in the Production (buy) quantity schedule, thus leading to more timely results
  - Fewer manual changes typically yield fewer errors

Linking Quantity Schedules

19	**PRODUCTION QUANTITY SCHEDULE**		ProdQty
20	Variant 1		ProdQtyVar1
21	Variant 2		ProdQtyVar2
22			
23	**System Production to Fielding Lag in Years**		lag
24			
25	**FIELDING QUANTITY SCHEDULE**		FieldQty
26	Variant 1		FieldQtyVar1
27	Variant 2		FieldQtyVar2
28			
29	**System Operational Life**		sys_life
30			
31	**SUSTAINMENT QUANTITY SCHEDULE (Cumulative)**		SustainQty
32	Variant 1		SustainQtyVar1
33	Variant 2		SustainQtyVar2

Linking Quantity Schedules

- **ACE functions required:**
  - *Fiscal Year Calculated Value* – ***FYCVal()***
    - This function returns the calculated yearly value (or sum of yearly calculated values if more than one FY is specified) for a specified row
  - *Fiscal Year Year* – ***FYYR***
    - This function returns as a value the fiscal year for each of the FY columns in your ACE session
  - *Operational Fielded Units* – ***OpFieldedUnits()***
    - This function determines a time-phased fielded units in use through the current year based on a buy schedule, fielding lag and life expectancy

- **User-created variables required:**
  - Lag from Production to Fielding (in years)
  - System Operational Life (in years)

Linking Quantity Schedules

	WBS/CES Description	Phasing Method	Approp	Lead /Lag	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
19	**PRODUCTION QUANTITY SCHEDULE**								
20	Variant 1	IS			10	20	30	40	50
21	Variant 2	IS			5	10	15	20	25

- Enter the Production quantity schedule in the Yearly Phasing Workscreen
  - This should be the only quantity schedule that needs to be entered manually

Linking Quantity Schedules

	WBS/CES Description	Unique ID	Point Estimate	Phasing Method	Equation / Throughput
18					
19	**PRODUCTION QUANTITY SCHEDULE**	ProdQty	225.000 *		
20	Variant 1	ProdQtyVar1	150.000 *	IS	[Input Throughput]
21	Variant 2	ProdQtyVar2	75.000 *	IS	[Input Throughput]
22					
23	**System Production to Fielding Lag in Years**	lag	1.000 *	C	1
24					
25	**FIELDING QUANTITY SCHEDULE**	FieldQty	225.000 *		
26	Variant 1	FieldQtyVar1	150.000 *	F	FYCVAL(@ProdQtyVar1, FYYR - lag)
27	Variant 2	FieldQtyVar2	75.000 *	F	FYCVAL(@ProdQtyVar2, FYYR - lag)

FYCVAL(@ProdQtyVar1, FYYR - lag)

- Use the FYCVal() and FYYR functions, and the created Lag variable to shift out the Production schedule
  - This produces the Fielding schedule

Linking Quantity Schedules

	WBS/CES Description	Unique ID	Point Estimate	Phasing Method	Equation / Throughput
25	**FIELDING QUANTITY SCHEDULE**	FieldQty	225.000 *		
26	Variant 1	FieldQtyVar1	150.000 *	F	FYCVAL(@ProdQtyVar1, FYYR - lag)
27	Variant 2	FieldQtyVar2	75.000 *	F	FYCVAL(@ProdQtyVar2, FYYR - lag)
28					
29	**System Operational Life**	sys_life		C	20
30					
31	**SUSTAINMENT QUANTITY SCHEDULE (Cumulative)**	SustainQty	4,500.000 *		
32	Variant 1	SustainQtyVar1	3,000.000 *	F	OpFieldedUnits(@FieldQtyVar1, Sys_Life)
33	Variant 2	SustainQtyVar2	1,500.000 *	F	OpFieldedUnits(@FieldQtyVar2, Sys_Life)

OpFieldedUnits(@FieldQtyVar1, Sys_Life)

- Use the OpFieldedUnits() function and the created System Life variable to make ACE produce the Sustainment schedule
  - The Sustainment schedule should begin in the same year as the fielding schedule

Linking Quantity Schedules

	Row	Cost Element	Approp	Total	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
1	19	PRODUCTION QUANTITY SCHEDULE		225.000	15.000	30.000	45.000	60.000	75.000			
2	20	Variant 1		150.000	10.000	20.000	30.000	40.000	50.000			
3	21	Variant 2		75.000	5.000	10.000	15.000	20.000	25.000			
4	22											
5	23	System Production to Fielding Lag in Years		1.000								
6	24											
7	25	FIELDING QUANTITY SCHEDULE		225.000		15.000	30.000	45.000	60.000	75.000		
8	26	Variant 1		150.000		10.000	20.000	30.000	40.000	50.000		
9	27	Variant 2		75.000		5.000	10.000	15.000	20.000	25.000		
10	28											
11	29	System Operational Life		20.								
12	30											
13	31	SUSTAINMENT QUANTITY SCHEDULE (Cumulative)		4,500.000		15.000	45.000	90.000	150.000	225.000	225.000	225.000
14	32	Variant 1		3,000.000		10.000	30.000	60.000	100.000	150.000	150.000	150.000
15	33	Variant 2		1,500.000		5.000	15.000	30.000	50.000	75.000	75.000	75.000

EQUAL

CUMULATIVE

- The totals for the Production and Fielding schedules should match
- The Sustainment schedule should be cumulative
  - Quantities should increase until a steady-state is reached, then begin to decrease until all systems have reached the end of their operational lives

Using Matrices to Simplify Manpower Cost Calculations

Using Matrices to Simplify Manpower Calculations

- There are several costs tied to the people (manpower) associated with any given program
  - Pay & Allowances (P&A), Permanent Change of Station (PCS), Temporary Duty (TDY), training, etc.
- It is simple to account for these costs in ACE, but it often requires entering methodology on many rows
- Again, fewer manual inputs yield fewer errors

Using Matrices to Simplify Manpower Calculations

	WBS/CES Description	Approp	Unique ID	Point Estimate
6	**MP DIRECT FUNDED ELEMENTS**	2010	MP$	$ 0.000 *
7	**CREW - Combat Engineers - MOS 12B**	2010	MPCREW$	$ 0.000 *
8	Pay and Allowances	2010		$ 0.000 *
9	PCS	2010		$ 0.000 *
10	Training	2010		$ 0.000 *

- **EXAMPLE:** Estimate P&A, PCS, and training costs for 10 Combat Engineers (MOS 12B) over multiple FYs

Using Matrices to Simplify Manpower Calculations

- **ACE Functions Required:**
  - *Matrix Column Total* **– *MATCOLTOT()***
    - This function performs a vector multiplication for a column by column calculation. It returns the dot product of a column vector with a column in another matrix

- **User-Created Variables Required:**
  - Number of rows in the matrix
  - Vector parent row
  - Matrix parent row

Using Matrices to Simplify Manpower Calculations

	WBS/CES Description	Approp	Unique ID	Point Estimate	Phasing Method	Equation / Throughput
60	**MOS COUNT					
61	CREW Count - VECTOR		Vector_CombEngE7	10.000 *		
62	12B Combat Engineer - E7			10.000 *	C	10
63						
64	**MOS RATES					
65	CREW Rates - MATRIX		Matrix_CombEngE7	0.000 *		
66	12B Combat Engineer - E7				I	[Input Throughput]
67						
68	Number of Rows in Crew Matrix		Num_Rows	1.000 *	C	1

- Build the vector and matrix sections for the manpower to be estimated
  - Specify the vector constant and number of rows in the matrix
  - Note that unique IDs in those sections should be placed on the row preceding the actual data
  - With vectors and matrices, the rows addressed @vector or @matrix are just markers for the beginning of the vector or matrix

Using Matrices to Simplify Manpower Calculations

	WBS/CES Description	Phasing Method	Approp	Lead /Lag	FY 2012	FY 2013	FY 2014
60	**MOS COUNT						
61	CREW Count - VECTOR				Column 1	Column 2	Column 3
62	12B Combat Engineer - E7	C					
63							
64	**MOS RATES				P&A	PCS	MPA Training
65	CREW Rates - MATRIX						
66	12B Combat Engineer - E7	I			96.035	3.626	.916
67							
68	**Number of Rows in Crew Matrix**	C					

- Enter the rates for P&A, PCS, and training in the matrix via the Yearly Phasing Workscreen
  - Use the “I” phasing method, and place the values and phasing method on the child row beneath the marker row
  - Only matrix values are entered in the Yearly Phasing Workscreen since the vector and row counts are C-phased

Using Matrices to Simplify Manpower Calculations

	WBS/CES Description	Approp	Unique ID	Point Estimate	Phasing Method	Equation / Throughput
6	MP DIRECT FUNDED ELEMENTS	2010	MP$	$ 24,138.480 *		
7	CREW - Combat Engineers - MOS 12B	2010	MPCREW$	$ 24,138.480 *		
8	Pay and Allowances	2010		$ 23,048.400 *	F	MatColTot(Num_Rows, @Vector_CombEngE7,
9	PCS	2010		$ 870.240 *	F	MatColTot(Num_Rows, @Vector_CombEngE7,
10	Training	2010		$ 219.840 *	F	MatColTot(Num_Rows, @Vector_CombEngE7,

P&A = MatColTot(Num_Rows, @Vector_CombEngE7, @Matrix_CombEngE7, 1)

PCS = MatColTot(Num_Rows, @Vector_CombEngE7, @Matrix_CombEngE7, 2)

Tng = MatColTot(Num_Rows, @Vector_CombEngE7, @Matrix_CombEngE7, 3)

- In the CES, place the created variables into the MATCOLTOT function and specify the column for the manpower cost category desired
- Use the F-phasing method so that costs are applied in each FY
  - Use start and end dates where necessary

Using Matrices to Simplify Manpower Calculations

	Row	Cost Element	Approp	Total	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
1	7	CREW - Combat Engineers - MOS 12B	2010	$ 24,138.480		$ 1,005.770	$ 1,005.770	$ 1,005.770	$ 1,005.770	$ 1,005.770	$ 1,005.770	$ 1,005.770	$ 1,005.770
2	8	Pay and Allowances	2010	$ 23,048.400		$ 960.350	$ 960.350	$ 960.350	$ 960.350	$ 960.350	$ 960.350	$ 960.350	$ 960.350
3	9	PCS	2010	$ 870.240		$ 36.260	$ 36.260	$ 36.260	$ 36.260	$ 36.260	$ 36.260	$ 36.260	$ 36.260
4	10	Training	2010	$ 219.840		$ 9.160	$ 9.160	$ 9.160	$ 9.160	$ 9.160	$ 9.160	$ 9.160	$ 9.160

- Results are consistent with expectations (rates x number of people)
  - P&A rate (E7) = $96.03K * 10 Combat Engineers = **$960.35K**
  - PCS rate (E7) = $3.62K * 10 Combat Engineers = **$36.26K**
  - Training rate (E7) = $0.91K * 10 Combat Engineers = **$9.16K**

Using the “IF” Function with ACEIT Cases to Simplify Estimates for CBAs, BCAs, etc.

Using the “IF” Function with ACEIT Cases

- Cost modeling with flexibility in mind:
  - Fiscal reality and What-if scenarios
  - Business Case Analysis (BCA), Cost Benefit Analysis (CBA), and Analysis of Alternatives (AoA) all represent different forms of What-If analyses

Using the “IF” Function with ACEIT Cases

- Example will show how to utilize the IF function & FY functions in combination with ACEIT Cases to create multiple What-If scenarios and quickly calculate costs for all cases

- This approach allows for one single ACEIT model instead of multiple models

Using the “IF” Function with ACEIT Cases

- Ground Rules & Assumptions:
  - Joint requirement for system “X”
  - The Army has established contract for New Equipment Training (NET)
  - As long as the Army is buying system “X”, “sister” Services can leverage NET established by the Army. However, if the Army is not buying the system, “sister” Services will have to establish their own NET, which will increase the cost by 30% per NET, per system, and also cause a 12-month delay

Using the “IF” Function with ACEIT Cases

- **ACE functions required:**
  - If(Condition, Yes [, No])
    - In our example, the condition is “If the Army is buying the System ‘X’:”
      - If Yes, NET cost will be $500K
      - If No, the cost for the Services will be 30% higher and NET will be delay by 12 months
  - Fiscal Year Total – FYTot(@Var)
  - FYCSLIP (SlipMonths, @var)
  - ACEIT Cases

Using the “IF” Function with ACEIT Cases

	WBS/CES Description	Approp	Unique ID	Point Estimate	Phasing Method	Equation / Throughput	Fiscal Year	Units
40								
41	*INPUT VARIABLES		*IN_VAR					
42								
43	Unit Cost	2035	UC$	$ 1,200.000 *		1.2	2012	$M
44								
45	Production Schedule			940.000 *				
46	Army		BuyQty_ARMY	500.000 *	IS	[Input Throughput]		
47	Navy		BuyQty_NAVY	250.000 *	IS	[Input Throughput]		
48	USAF		BuyQty_USAF	150.000 *	IS	[Input Throughput]		
49	USMC		BuyQty_USMC	40.000 *	IS	[Input Throughput]		
50								
51	New Equipment Training (NET) per Fielded Unit	2035	NET_per_UNIT$	$ 500.000 *		500	2012	$K
52	NET cost increase if Army does not buy any unit		NET_INCREASE_FACTOR	0.300 *		.30		
53	NET cost with increase factor	2035	NET_W_IF$	$ 650.000 *		NET_per_UNIT$*(1+NET_INCREASE_FACTOR)		$K
54								

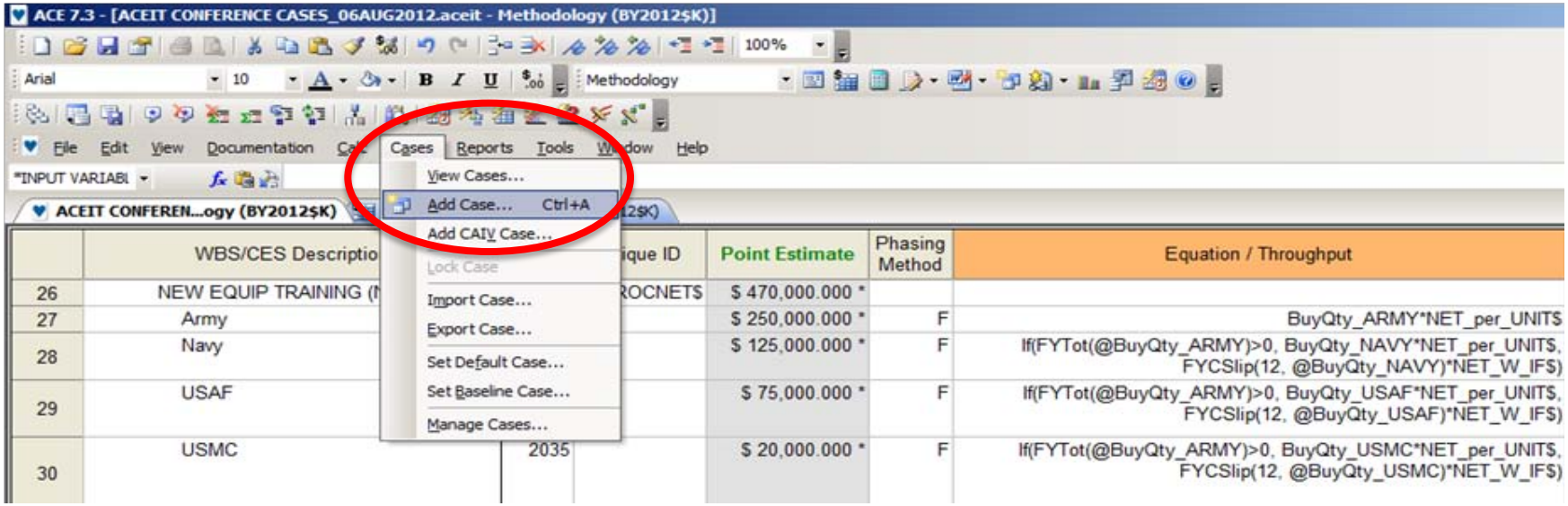
Using the "IF" Function with Multiple Cases

	WBS/CES Description	Approp	Unique ID	Point Estimate	Phasing Method	Equation / Throughput
26	NEW EQUIP TRAINING (NET)	2035	PROCNET$	$ 470,000.000 *		
27	Army	2035		$ 250,000.000 *	F	BuyQty_ARMY*NET_per_UNIT$
28	Navy	2035		$ 125,000.000 *	F	If(FYTot(@BuyQty_ARMY)>0, BuyQty_NAVY*NET_per_UNIT$, FYCSlip(12, @BuyQty_NAVY)*NET_W_IF$)
29	USAF	2035		$ 75,000.000 *	F	If(FYTot(@BuyQty_ARMY)>0, BuyQty_USAF*NET_per_UNIT$, FYCSlip(12, @BuyQty_USAF)*NET_W_IF$)
30	USMC	2035		$ 20,000.000 *	F	If(FYTot(@BuyQty_ARMY)>0, BuyQty_USMC*NET_per_UNIT$, FYCSlip(12, @BuyQty_USMC)*NET_W_IF$)

Army =
BuyQty_ARMY* NET_per_UNIT$

Navy = IF(FYTot(@BuyQty_Army)>0, BuyQty_NAVY*NET_per_UNIT$,FYCSLIP(12,@BuyQty_NAVY)*NET_IF$)

Using the “IF” Function with ACEIT Cases

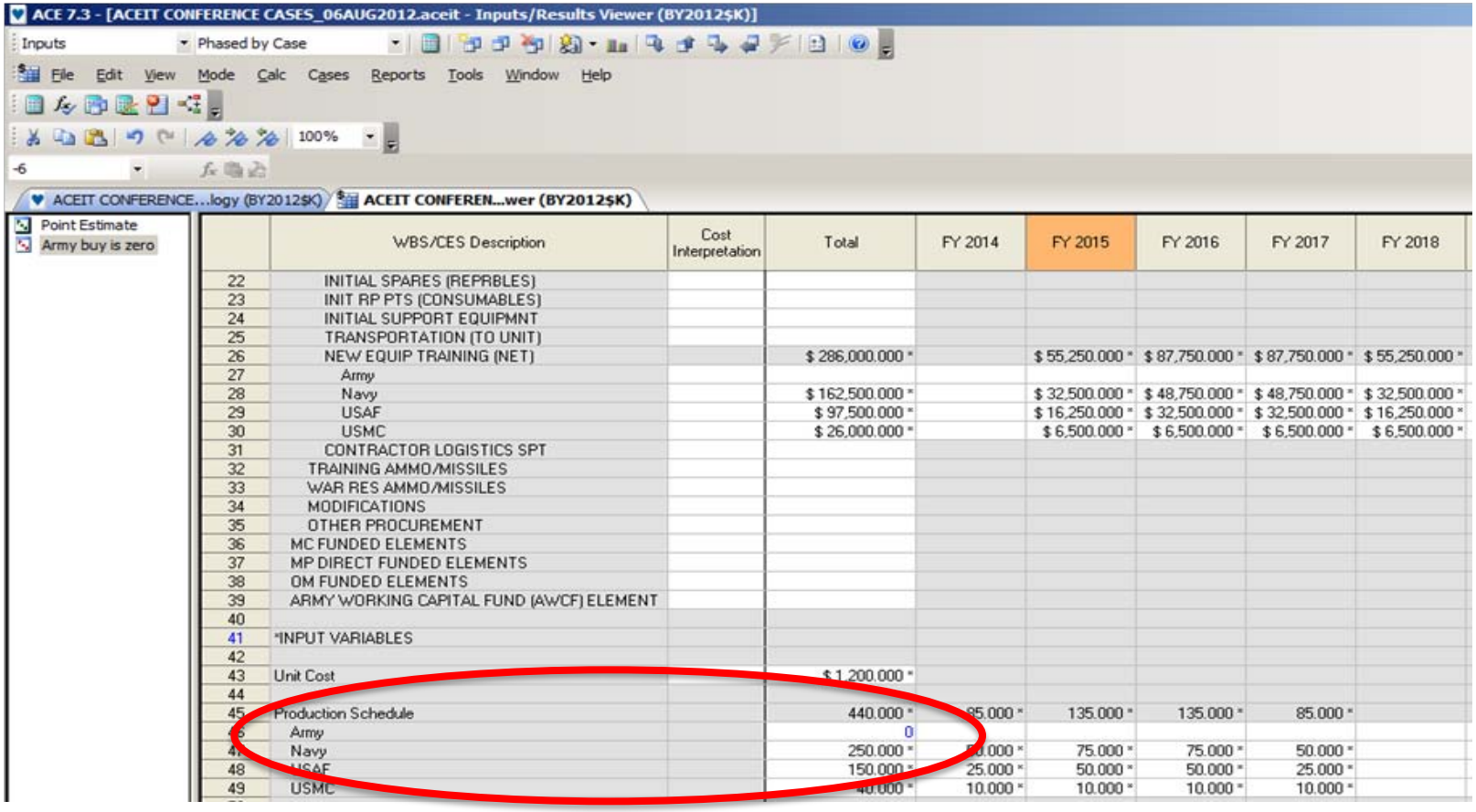


Next step – Add Case to your model

Using the “IF” Function with ACEIT Cases

- Enter new case name and description
  - In our example, we will create case “Army Buy is Zero”
- New screen will open and you will be able to see your Case
- Under Input Variables section, find Production Schedule and enter 0 for the Army

Using the "IF" Function with ACEIT Cases



	WBS/CES Description	Cost Interpretation	Total	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
22	INITIAL SPARES (REPRBLES)							
23	INIT RP PTS (CONSUMABLES)							
24	INITIAL SUPPORT EQUIPMNT							
25	TRANSPORTATION (TO UNIT)							
26	NEW EQUIP TRAINING (NET)		$ 286,000,000 *		$ 55,250,000 *	$ 87,750,000 *	$ 87,750,000 *	$ 55,250,000 *
27	Army							
28	Navy		$ 162,500,000 *		$ 32,500,000 *	$ 48,750,000 *	$ 48,750,000 *	$ 32,500,000 *
29	USAF		$ 97,500,000 *		$ 16,250,000 *	$ 32,500,000 *	$ 32,500,000 *	$ 16,250,000 *
30	USMC		$ 26,000,000 *		$ 6,500,000 *	$ 6,500,000 *	$ 6,500,000 *	$ 6,500,000 *
31	CONTRACTOR LOGISTICS SPT							
32	TRAINING AMMO/MISSILES							
33	WAR RES AMMO/MISSILES							
34	MODIFICATIONS							
35	OTHER PROCUREMENT							
36	MC FUNDED ELEMENTS							
37	MP DIRECT FUNDED ELEMENTS							
38	OM FUNDED ELEMENTS							
39	ARMY WORKING CAPITAL FUND (AWCF) ELEMENT							
40								
41	*INPUT VARIABLES							
42								
43	Unit Cost		$ 1,200,000 *					
44								
45	Production Schedule		440.000 *	85.000 *	135.000 *	135.000 *	85.000 *	
46	Army		0					
47	Navy		250.000 *	50.000 *	75.000 *	75.000 *	50.000 *	
48	USAF		150.000 *	25.000 *	50.000 *	50.000 *	25.000 *	
49	USMC		40.000 *	10.000 *	10.000 *	10.000 *	10.000 *	

Using the "IF" Function with ACEIT Cases

Point Estimate
Army buy is zero

	WBS/CES Description	Total	FY 2014	FY 2015	FY 2016	FY 2017
22	INITIAL SPARES (REPRBLES)					
23	INIT RP PTS (CONSUMABLES)					
24	INITIAL SUPPORT EQUIPMNT					
25	TRANSPORTATION (TO UNIT)					
26	NEW EQUIP TRAINING (NET)	$ 470,000.000	$ 92,500.000	$ 142,500.000	$ 142,500.000	$ 92,500.000
27	Army	$ 250,000.000	$ 50,000.000	$ 75,000.000	$ 75,000.000	$ 50,000.000
28	Navy	$ 125,000.000	$ 25,000.000	$ 37,500.000	$ 37,500.000	$ 25,000.000
29	USAF	$ 75,000.000	$ 12,500.000	$ 25,000.000	$ 25,000.000	$ 12,500.000
30	USMC	$ 20,000.000	$ 5,000.000	$ 5,000.000	$ 5,000.000	$ 5,000.000

Point Estimate
Army buy is zero

	WBS/CES Description	Total	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
22	INITIAL SPARES (REPRBLES)						
23	INIT RP PTS (CONSUMABLES)						
24	INITIAL SUPPORT EQUIPMNT						
25	TRANSPORTATION (TO UNIT)						
26	NEW EQUIP TRAINING (NET)	$ 286,000.000		$ 55,250.000	$ 87,750.000	$ 87,750.000	$ 55,250.000
27	Army						
28	Navy	$ 162,500.000		$ 32,500.000	$ 48,750.000	$ 48,750.000	$ 32,500.000
29	USAF	$ 97,500.000		$ 16,250.000	$ 32,500.000	$ 32,500.000	$ 16,250.000
30	USMC	$ 26,000.000		$ 6,500.000	$ 6,500.000	$ 6,500.000	$ 6,500.000

FY14 is $0

Results in BY$2012 (K)

Summary

- Topics Covered:
  - Linking quantity schedules for Procurement, Fielding, and Sustainment
  - Using matrices to simplify manpower cost calculations
  - Using the “IF” function with multiple cases to simplify estimates for CBAs, BCAs, etc.

- Applying these methodologies in ACE should result in more efficient and dynamic cost models

Questions

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