USC/CSE MyCOSYSMO
"A COSYSMO Prototype"
Tutorial

8th Annual PSM Conference

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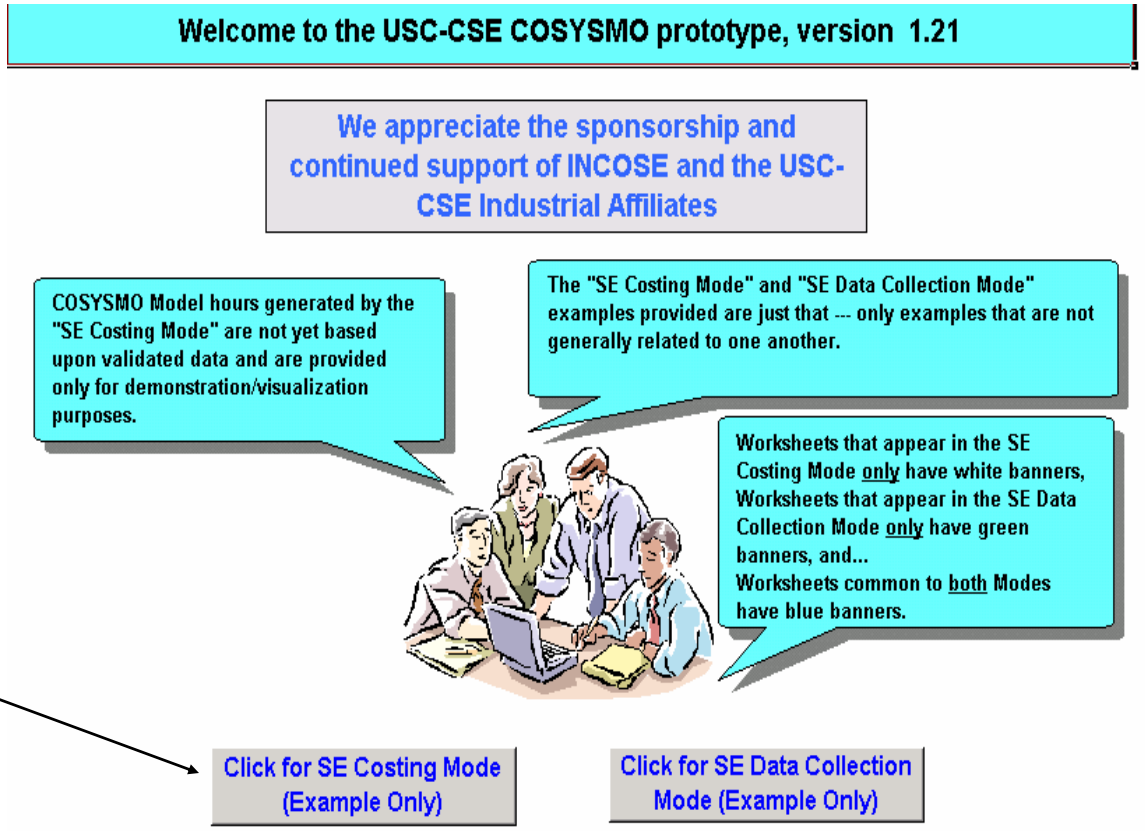
MyCOSYSMO Capabilities

- Jointly developed by USC/CSE and Raytheon
- Provides costing using local rates as well as effort
- Supports multiple levels of estimate formality/complexity
  - Budgetary estimate
  - Rough order of magnitude (ROM)
  - Proposal
- Embeds local systems engineering program performance data
  - Systems Engineering size and productivity
  - Environmental data
  - Local site salary grade profiles
- Provides for more consistent inputs and outputs, reduces variability
- Focus on risk, uncertainty
- Provides user friendly Interface and documentation
- Provides for local site expansion
  - Size drivers and effort multipliers
  - Site unique parameters
- Historical data collection mode

MyCOSYSMO: Getting Started

- Double-click on the MyCOSYSMO file
- Excel automatically opens to the Greetings worksheet (ws) after selecting "Enable Macros"
- We will only be addressing the SE Costing Mode (left button) in this tutorial, Single-click on this button to arrive at the TOC ws



MyCOSYSMO Table of Contents (TOC)

SE cost and schedule estimate example using COSYSMO version 1.21

Developing an SE Estimate...	Local Site SE Data Repository	Local Site COSYSMO Calibration	EIA-632 Scope / EIA-632 Phases	COSYSMO Table of Contents (TOC)	Version Release History	Cost Drivers vs. SE Activities	Acronyms / Relative Cost Tradeoff Curve Examples

WS	SE Costing Inputs and Outputs	Navigation	Errors?	WS	SE Sizing Artifacts Input	Navigation
1.	Executive Cost Summary	Go To		12a.	REQ (No. of System Requirements)	Go To
2	CWBS and Size Definitions	Go To		12b.	I/F (No. of Major Interfaces)	Go To
3.	Estimate Assumptions and Notes	Go To		12c.	ALG (No. of Critical Algorithms)	Go To
4.	Parameters I	Go To		12d.	SCN (No. of Operational Scenarios)	Go To
5.	Parameters II	Go To		12e.	SP1 (Spare 1)	Go To
6.	Staffing Table and Charts	Go To		12f.	SP2 (Spare 2)	Go To
7.	Labor Distribution	Go To		12g.	SP3 (Spare 3)	Go To
8a.	Application Factors	Go To				
8b.	Team + User Defined Factors	Go To				
9.	COSYSMO Model Computations	Go To				
10.	Model Hours and Staffing per Phase	Go To				
11.	Other Hours (Non-Model Sources of Effort)	Go To				

Grey buttons with blue fonts are macro links to other areas of MyCOSYSMO, return back to this worksheet by clicking on "TOC" button

Can input additional labor outside scope of COSYSMO Size Drivers

Table of Contents | 1. Executive Cost Summary | 2. WBS and Model Definition | 3. Project Assumptions | 4. Parameters I | 5. Parameters II | 6a. Sta

Some Reminders…

- **The TOC worksheet (ws) is "Home Base"**
  - **Single-click grey buttons with blue fonts to get to relevant worksheet(s)**
  - **Return back to the TOC by a single-click of the grey button labeled "TOC" in upper left hand corner of the other worksheets**
- **Generally, grey fields on a worksheet mean the user can input data or change the default, many fields are strongly typed with pull-down lists**
- **All worksheets are protected, but no password is needed to unprotect**
  - **If you unprotect a worksheet to expand or hide data, remember to re-protect it so you won't clobber formulas later!**
  - **Generally, I do not recommend using passwords for protection, if you should forget them, you are out of luck…trust me**

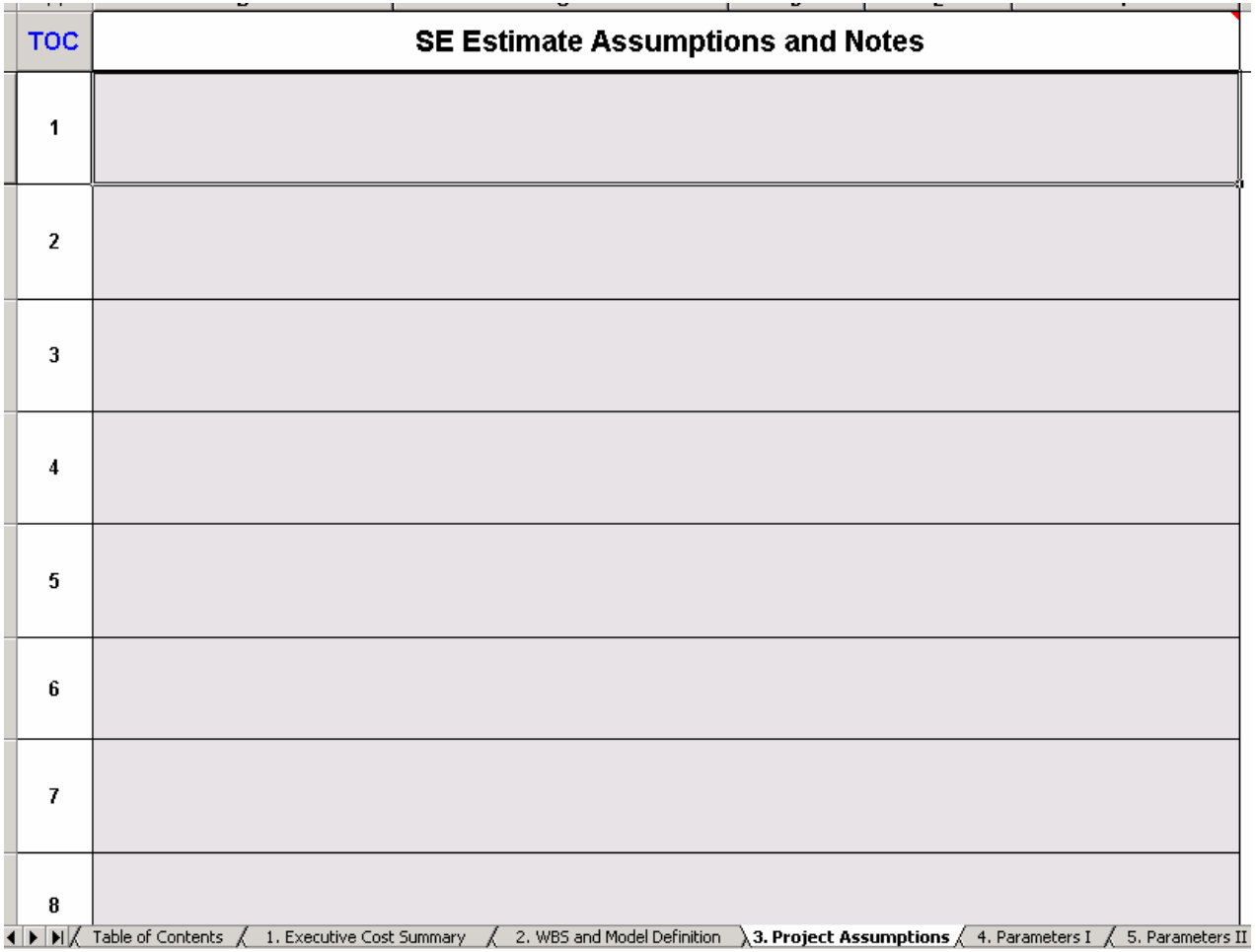
Click on “Developing an SE Estimate Button”…

TOC STEP	Develop SE effort/cost estimate - grey fields on worksheets(ws) are for user inputs
1	Click on ws 3. - Enter your SE Estimate Assumptions, Notes, and Requirement Sources
2a	Click on ws 4. - Update item 13 (Project Name), if you will use your local calibration effort constant to estimate, set item 10 (Use Local Calibration Effort Constant?) = Y, otherwise use the USC Calibration Factor (if available). For an effort estimate (no detailed costing/pricing) go to Step 4a, otherwise go to 2b.
2b	While still on ws 4, set item 14 (Detailed Pricing Inputs?) = Y, also set items 02 (Base Year for Rates), 04 (Mid Year for Rates), and 22 (Base Year for Staffing Chart). From you finance/pricing organziation obtain data to update the Salary Grade Rate Table (item 03) and the Approx. Yearly Rate Escalation (item 05).
3a	Click on ws 5. - Update Allocation Matrix for COSYSMO Activity vs. Phase (as needed.)
3b	Click on ws 7. - Update the Salary Grade vs. Activitities profiles table, and the Task Allocation used row (as needed.)
3c	Click on ws 2. - Enter the CWBS Task Identifiers and Descriptions.
3d	Click on ws 10-1 to 10-5. - Enter Task durations for each phase (MyCOSYSMO assumes a "flat-curve".)
4a	Click on ws 8a. - Rate the Application Factor Effort Multipliers. Provide comments.
4b	Click on ws 8b. - Rate the Team Factor Effort Multipliers. Provide comments.
5a	Click on ws 12a. to 12d. - Estimate the Systems Engineering Size, use each of the four SE size artifacts, as appropriate. Provide comments.
5b	Click on ws 11. - Enter any Other Sources of Effort (Hours) outside of current model scope and provide task activity durations, e.g., some of the SE-related "ilities" not covered by COSYSMO. Provide comments.
6	Review results: e.g., Click on ws 9, ws 6a and 6b, and ws 1
	Suggestion: Iterate Steps 1-5, and compare results (Step 6) to activity based, Delphi, % of software, or some other SE costing method. If you are not feeding your pricing system directly you are done. Otherwise, since most company pricing systems accept MS Excel worksheet based import files, a MyCOSYSMO export file can be built (fairly easily) using standard Excel functions and simple VB macros from the data on worksheets 4, 7, 10, and 11. Note: You may need to add a beta curve designation field per task duration (pricing system dependent) to spread the task hours.

Local SE Data Repository | A COSYSMO Calibration | Version Release Notes | EIA 632 Phases | COSYSMO Scope - EIA 632 | **Getting Started**

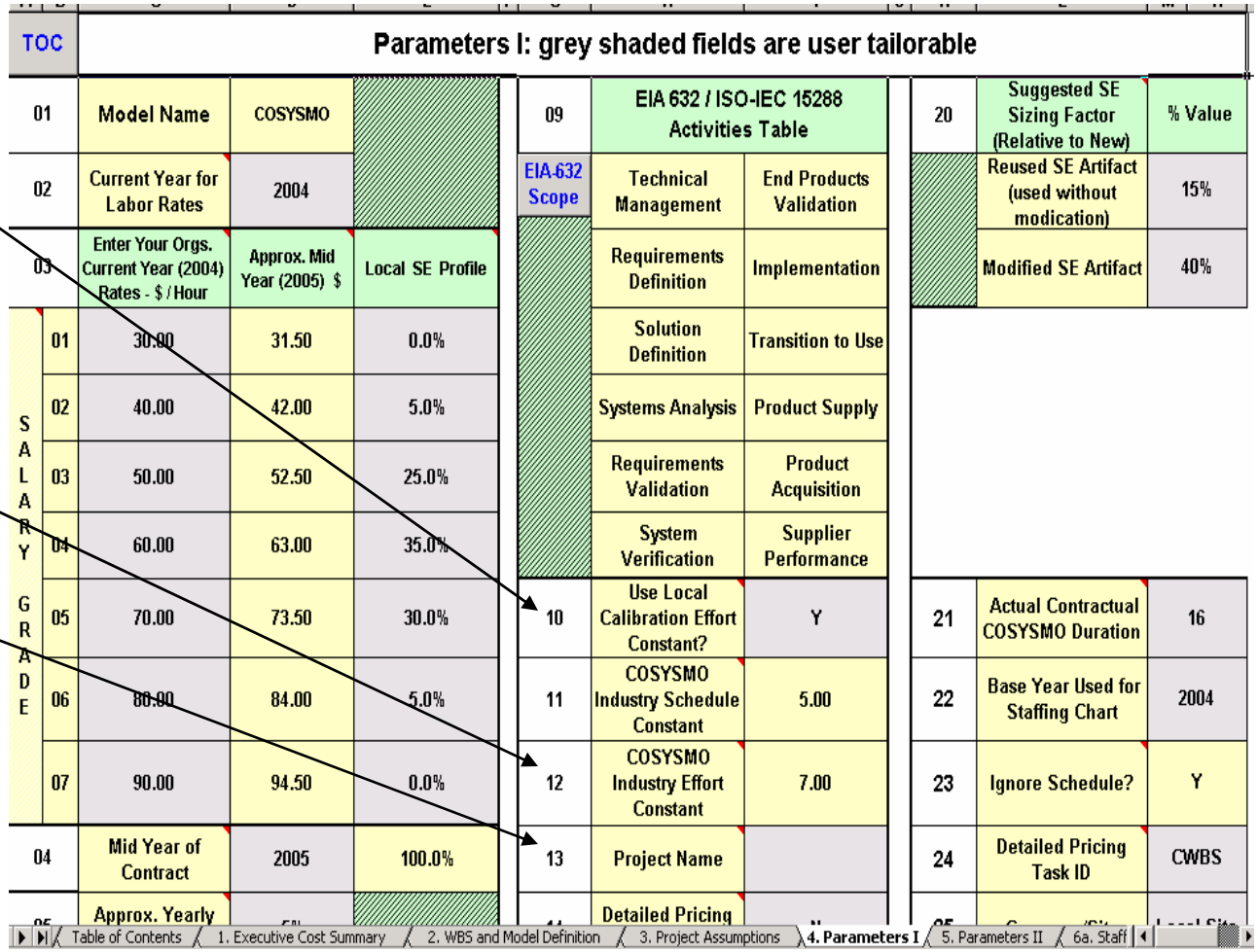
Step 1: ws 3, Enter Assumptions and Notes

- **Click on ws 3 from the TOC …**
- **Too often, estimate assumptions remain unstated, not written down by bidders, resulting in more risk than necessary**
- **10 entries are provided, user can expand as needed**



Step 2a: ws 4, Set Parameters

- **Click on ws 4 from the TOC …**
- **Use Local Calibration Factor?**
- **If Y, we use the local calibration constant computed from the "A COSYSMO Calibration" WS, otherwise use the (USC) Industry Effort Constant**
- **Enter Project Name**
- **For effort estimate only, skip to Step 4a. Otherwise, for detailed costing/pricing continue on to Step 2b (next chart)**

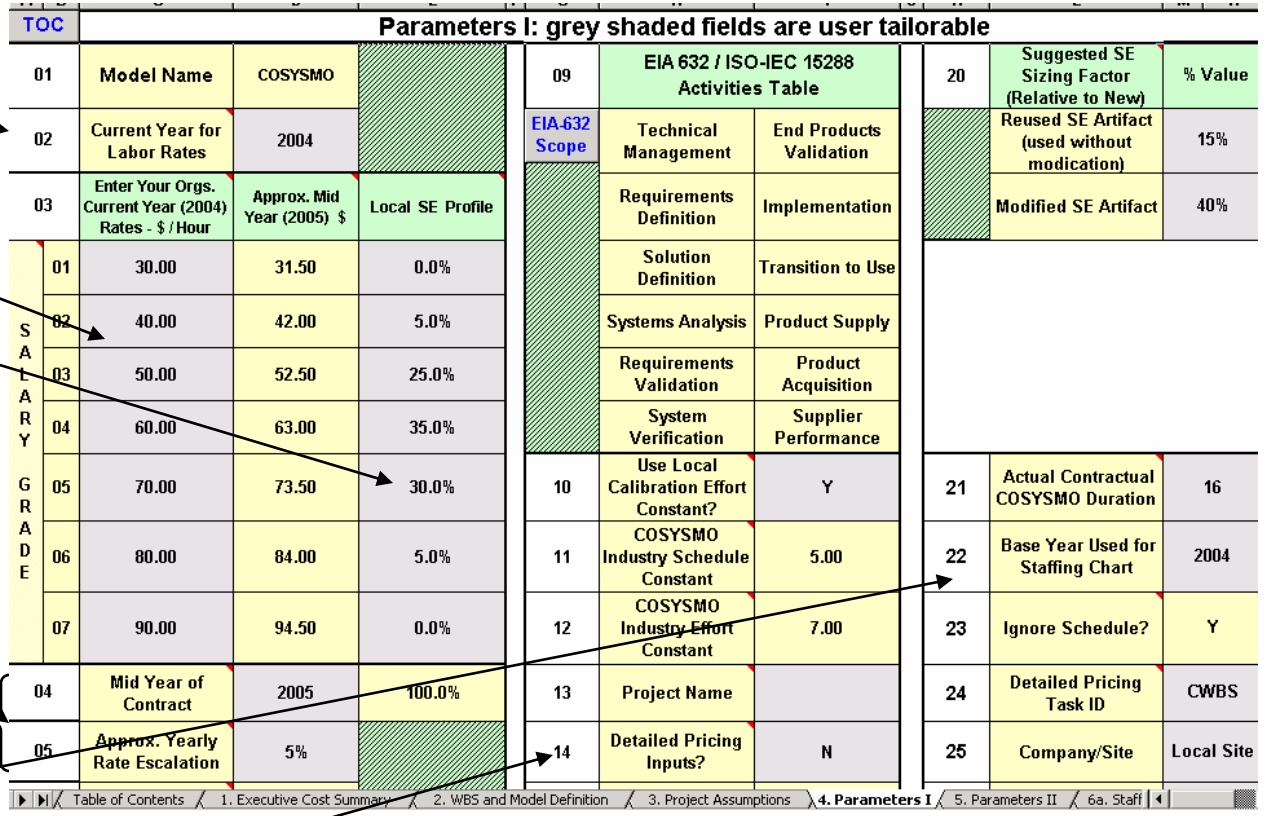


TOC	Parameters I: grey shaded fields are user tailorable								
01	Model Name	COSYSMO		09	EIA 632 / ISO-IEC 15288 Activities Table		20	Suggested SE Sizing Factor (Relative to New)	% Value
02	Current Year for Labor Rates	2004		EIA-632 Scope	Technical Management	End Products Validation		Reused SE Artifact (used without modication)	15%
03	Enter Your Orgs. Current Year (2004) Rates - $ / Hour	Approx. Mid Year (2005) $	Local SE Profile		Requirements Definition	Implementation		Modified SE Artifact	40%
SALARY GRADE 01	30.00	31.50	0.0%		Solution Definition	Transition to Use			
SALARY GRADE 02	40.00	42.00	5.0%		Systems Analysis	Product Supply			
SALARY GRADE 03	50.00	52.50	25.0%		Requirements Validation	Product Acquisition			
SALARY GRADE 04	60.00	63.00	35.0%		System Verification	Supplier Performance			
SALARY GRADE 05	70.00	73.50	30.0%	10	Use Local Calibration Effort Constant?	Y	21	Actual Contractual COSYSMO Duration	16
SALARY GRADE 06	80.00	84.00	5.0%	11	COSYSMO Industry Schedule Constant	5.00	22	Base Year Used for Staffing Chart	2004
SALARY GRADE 07	90.00	94.50	0.0%	12	COSYSMO Industry Effort Constant	7.00	23	Ignore Schedule?	Y
04	Mid Year of Contract	2005	100.0%	13	Project Name		24	Detailed Pricing Task ID	CWBS
05	Approx. Yearly				Detailed Pricing				

Table of Contents | 1. Executive Cost Summary | 2. WBS and Model Definition | 3. Project Assumptions | 4. Parameters I | 5. Parameters II | 6a. Staff

Step 2b: ws 4, Set Additional Parameters for Costing/Pricing

- **We are still on ws 4…**
- **Set item 02**
- **Set item 03 with Orgs. Salary Grade rates and local SE Profile**
- **Set items 04, 05**
- **Set item 22, (usually same as item 02)**
- **Set Item 14 (Detailed Pricing Inputs?) = Y**



TOC — Parameters I: grey shaded fields are user tailorable

01	Model Name	COSYSMO		09	EIA 632 / ISO-IEC 15288 Activities Table		20	Suggested SE Sizing Factor (Relative to New)	% Value
02	Current Year for Labor Rates	2004		EIA-632 Scope	Technical Management	End Products Validation		Reused SE Artifact (used without modication)	15%
03	Enter Your Orgs. Current Year (2004) Rates - $ / Hour	Approx. Mid Year (2005) $	Local SE Profile		Requirements Definition	Implementation		Modified SE Artifact	40%
SALARY GRADE 01	30.00	31.50	0.0%		Solution Definition	Transition to Use			
SALARY GRADE 02	40.00	42.00	5.0%		Systems Analysis	Product Supply			
SALARY GRADE 03	50.00	52.50	25.0%		Requirements Validation	Product Acquisition			
SALARY GRADE 04	60.00	63.00	35.0%		System Verification	Supplier Performance			
SALARY GRADE 05	70.00	73.50	30.0%	10	Use Local Calibration Effort Constant?	Y	21	Actual Contractual COSYSMO Duration	16
SALARY GRADE 06	80.00	84.00	5.0%	11	COSYSMO Industry Schedule Constant	5.00	22	Base Year Used for Staffing Chart	2004
SALARY GRADE 07	90.00	94.50	0.0%	12	COSYSMO Industry Effort Constant	7.00	23	Ignore Schedule?	Y
04	Mid Year of Contract	2005	100.0%	13	Project Name		24	Detailed Pricing Task ID	CWBS
05	Approx. Yearly Rate Escalation	5%		14	Detailed Pricing Inputs?	N	25	Company/Site	Local Site

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Step 3a: ws 5, Update Allocation Matrix for Pricing

- Click on ws 5…
- You may wish to click on button on this ws to access EIA 632 activity descriptions…
- Columns are Lifecycle phases
- Rows are EIA 632 activities
- Update the % of the EIA632 activities taking place throughout the lifecycle (as needed)

EIA-632 Scope

Allocation Matrix of EIA 632 \ ISO-IEC 15288 Activity by Phase

EIA 632 \ ISO-IEC 15288 Allocation - Clause No. (Requirements)	EIA 632 - Pre-System %	EIA 632 - Sys Definition %	EIA 632 - Subsystem Design %	EIA 632 - Detailed Design %	EIA 632 - Integration, Test, and Evaluation %	ISO-IEC 15288- Operations %	ISO-IEC 15288 - Maintenance or Support %	ISO-IEC 15288 - Retirement %	Totals	Check Sum
Technical Management - 4.2 (4-13)	15%	20%	20%	20%	25%	0%	0%	0%	100%	
Requirements Definition - 4.3.1 (14-16)	35%	30%	20%	10%	5%	0%	0%	0%	100%	
Solution Definition - 4.3.2 (17-19)	25%	35%	30%	5%	5%	0%	0%	0%	100%	
Systems Analysis - 4.5.1 (22-24)	25%	40%	25%	5%	5%	0%	0%	0%	100%	
Requirements Validation - 4.5.2 (25-29)	10%	35%	30%	15%	10%	0%	0%	0%	100%	
System Verification - 4.5.3 (30-32)	10%	25%	20%	20%	25%	0%	0%	0%	100%	
End Products Validation - 4.5.4.1 (33)	20%	25%	20%	15%	20%	0%	0%	0%	100%	
Implementation - 4.4 (20)	5%	10%	25%	40%	20%	0%	0%	0%	100%	
Transition to Use - 4.4 (21)	5%	10%	25%	30%	30%	0%	0%	0%	100%	
Product Supply - 4.1.1 (1)	40%	30%	20%	10%	0%	0%	0%	0%	100%	
Product Acquisition - 4.1.2 (2)	40%	30%	20%	10%	0%	0%	0%	0%	100%	

Table of Contents | 1. Executive Cost Summary | 2. WBS and Model Definition | 3. Project Assumptions | 4. Parameters I | **5. Parameters II** | 6

Step 3b: ws 7, Labor Distribution for Pricing

- **Click on ws 7…**
- **As needed, update salary profiles table**
- **As needed, update task allocation to be used**
- **Compare resulting data to the current org. SE salary grade profile (from Step 2b) at bottom of the ws**

Profile Your Estimated Salary Grade/Labor Category Percentage Distribution by EIA 632 / ISO-IEC 15288 Activity

	SG	Technical Management	Requirements Definition	Solution Definition	Systems Analysis	Requirements Validation	System Verification	End Products Validation	Implementation	Transition to Use	Product Supply	Product Acquisition	Supplier Performance
	01	0%	0%	0%	0%	0%	0%	0%	10%	0%	0%	0%	10%
	02	0%	0%	0%	10%	10%	0%	15%	20%	0%	0%	0%	20%
	03	0%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
	04	30%	40%	40%	30%	40%	40%	30%	30%	40%	40%	40%	40%
	05	30%	30%	30%	30%	20%	30%	25%	10%	30%	30%	30%	0%
	06	30%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	07	10%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Other Hour Distribution (Hours are from the Other Hours Worksheet)

	SG	Technical Management	Requirements Definition	Solution Definition	Systems Analysis	Requirements Validation	System Verification	End Products Validation	Implementation	Transition to Use	Product Supply	Product Acquisition	Supplier Performance	Total
Total		0	0	0	0	1,000	0	0	0	0	551	625	800	2,976
	01	0	0	0	0	0	0	0	0	0	0	0	80	80
	02	0	0	0	0	100	0	0	0	0	0	0	160	260
	03	0	0	0	0	300	0	0	0	0	166	188	240	894
	04	0	0	0	0	400	0	0	0	0	221	250	320	1,191
	05	0	0	0	0	200	0	0	0	0	166	188	0	554
	06	0	0	0	0	0	0	0	0	0	0	0	0	0
	07	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		0	0	0	0	1,000	0	0	0	0	553	626	800	2,979

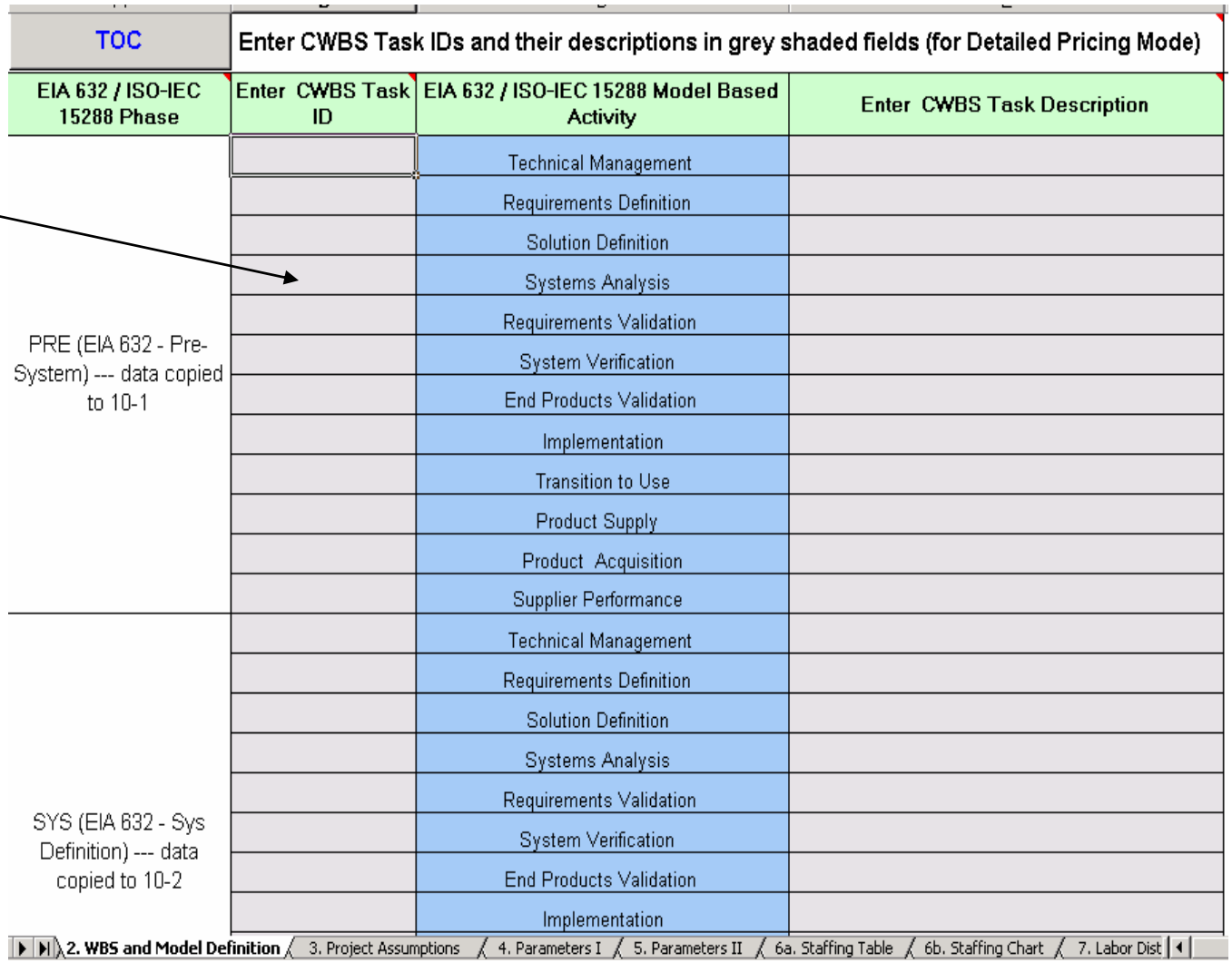
Model-Based Hour Distribution (Hours are from Model Computations Worksheet)

	SG	Technical Management	Requirements Definition	Solution Definition	Systems Analysis	Requirements Validation	System Verification	End Products Validation	Implementation	Transition to Use	Product Supply	Product Acquisition	Supplier Performance	Total
Suggested SE EIA 632 / ISO-IEC 15288		10-15%	12-16%	15-20%	12-15%	10-15%	10-15%	5-10%	5-10%	5-10%	1-2%	1-2%	1-2%	
Enter Task Allocation Used ==>		13.0%	14.0%	17.0%	14.0%	12.0%	13.0%					1.0%	1.0%	100.0%
Total		35,575	38,312	46,522	38,312	32,839	35,575					2,737	2,737	275,573

SG	Current Local SE Profile	This Estimate %	Variance (Typical vs. This Estimate)
01	0.0%	1.0%	-1.0%
02	5.0%	5.8%	-0.8%
03	25.0%	26.4%	-1.4%
04	35.0%	35.8%	-0.8%
05	30.0%	26.1%	3.9%
06	5.0%	3.6%	1.4%
07	0.0%	1.2%	-1.2%
	100.0%	100%	0%

Step 3c: ws 2 - Enter CWBS for Pricing

- **Click on ws 2…**
- **Government Compliant Pricing Systems require a Contract WBS ID (e.g., 2.2.2.3 or the alpha equivalent, BBBC)**



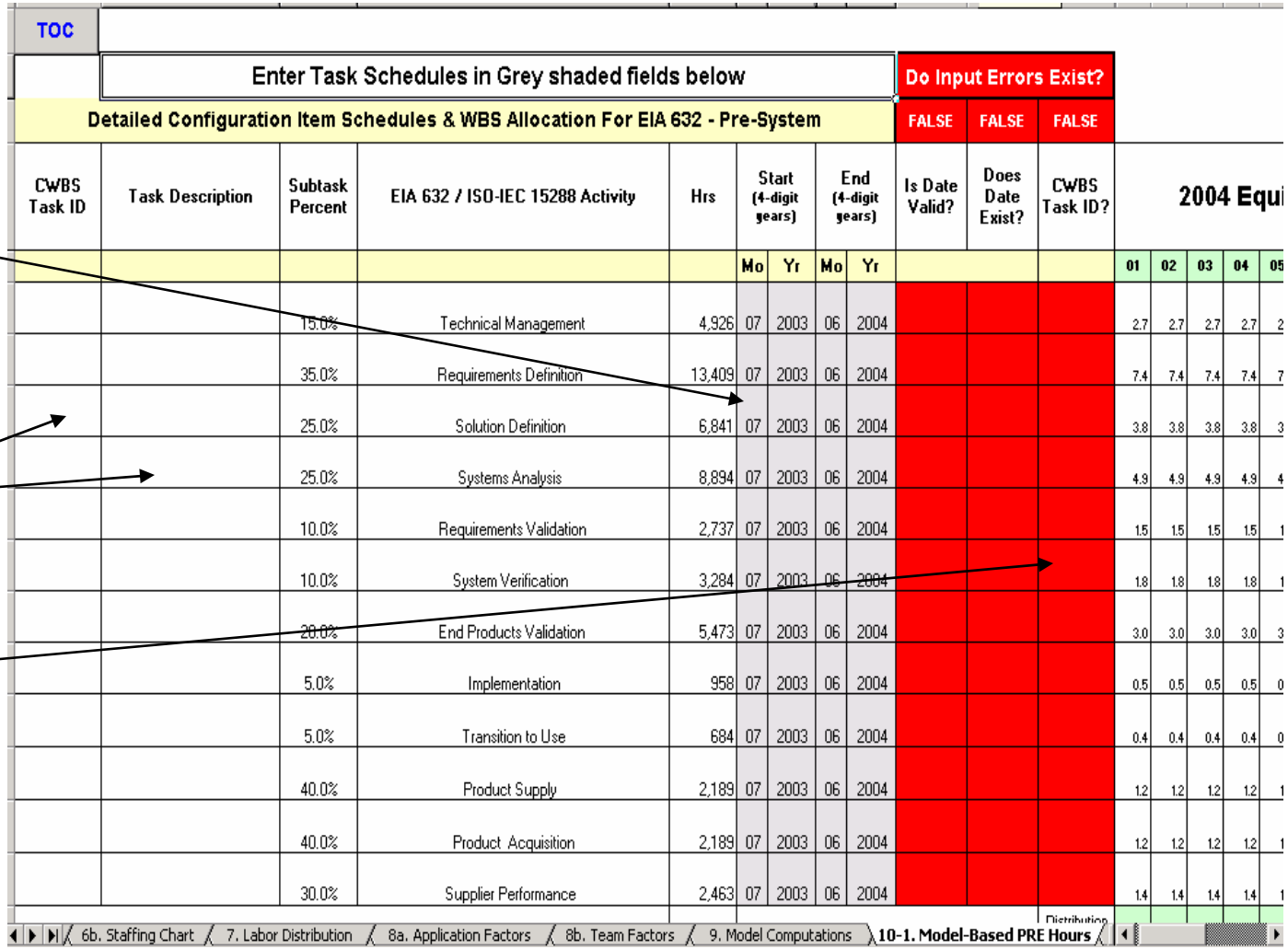
TOC	Enter CWBS Task IDs and their descriptions in grey shaded fields (for Detailed Pricing Mode)		
EIA 632 / ISO-IEC 15288 Phase	Enter CWBS Task ID	EIA 632 / ISO-IEC 15288 Model Based Activity	Enter CWBS Task Description
PRE (EIA 632 - Pre-System) --- data copied to 10-1		Technical Management	
		Requirements Definition	
		Solution Definition	
		Systems Analysis	
		Requirements Validation	
		System Verification	
		End Products Validation	
		Implementation	
		Transition to Use	
		Product Supply	
		Product Acquisition	
		Supplier Performance	
SYS (EIA 632 - Sys Definition) --- data copied to 10-2		Technical Management	
		Requirements Definition	
		Solution Definition	
		Systems Analysis	
		Requirements Validation	
		System Verification	
		End Products Validation	
		Implementation	

2. WBS and Model Definition | 3. Project Assumptions | 4. Parameters I | 5. Parameters II | 6a. Staffing Table | 6b. Staffing Chart | 7. Labor Dist

Step 3d: ws 10-1 to 10-5 – Set Task Durations for Pricing

Click on ws 10, then use scroll bar to advance from phase to phase

- **User enters task durations for each phase**
- **Linked from Step 3c inputs**
- **Various input error checks provided**



TOC

Enter Task Schedules in Grey shaded fields below

Do Input Errors Exist? FALSE FALSE FALSE

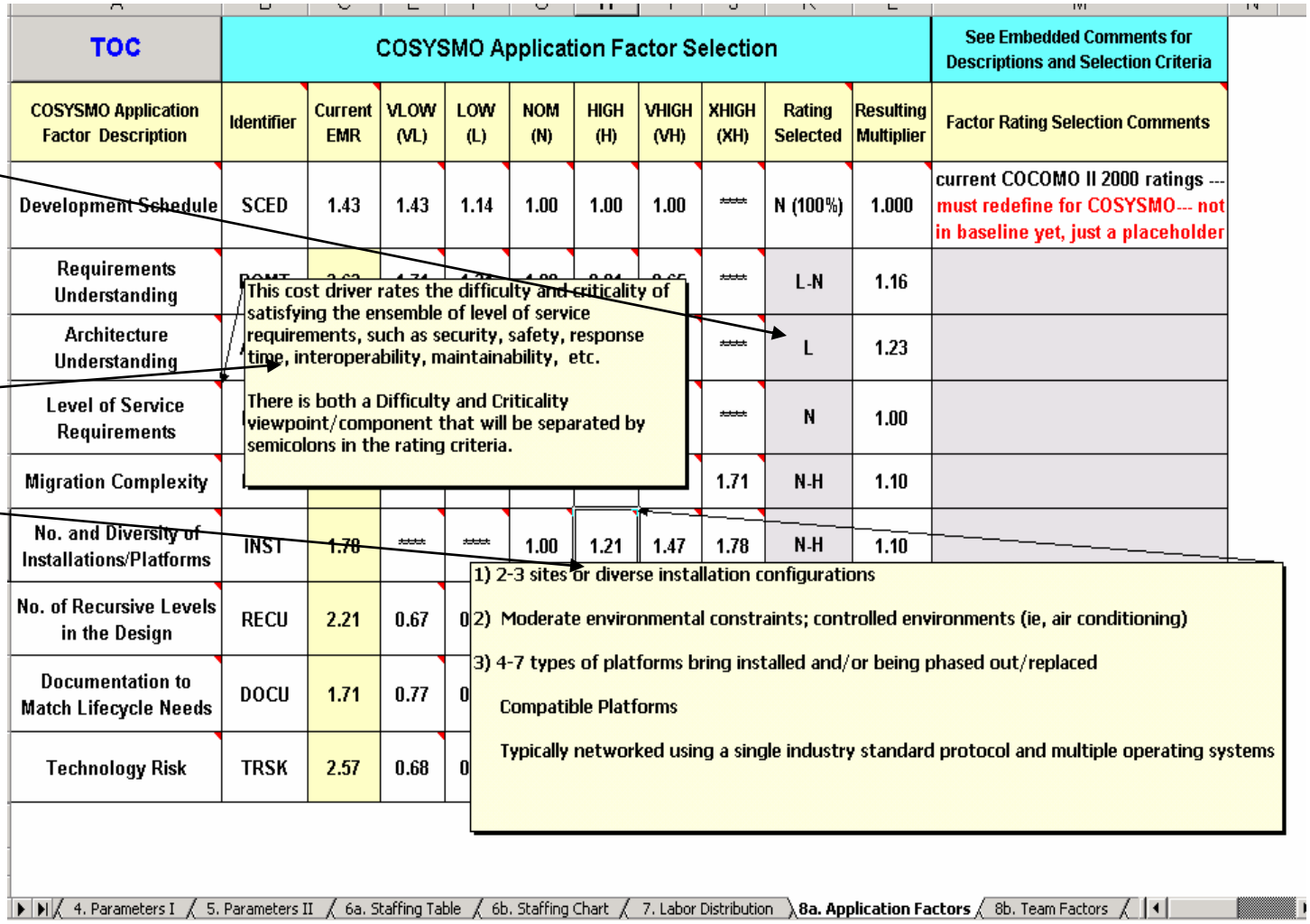
Detailed Configuration Item Schedules & WBS Allocation For EIA 632 - Pre-System

CWBS Task ID	Task Description	Subtask Percent	EIA 632 / ISO-IEC 15288 Activity	Hrs	Start (4-digit years) Mo	Start Yr	End (4-digit years) Mo	End Yr	Is Date Valid?	Does Date Exist?	CWBS Task ID?	2004 Equi 01	02	03	04	05
		15.0%	Technical Management	4,926	07	2003	06	2004				2.7	2.7	2.7	2.7	2
		35.0%	Requirements Definition	13,409	07	2003	06	2004				7.4	7.4	7.4	7.4	7
		25.0%	Solution Definition	6,841	07	2003	06	2004				3.8	3.8	3.8	3.8	3
		25.0%	Systems Analysis	8,894	07	2003	06	2004				4.9	4.9	4.9	4.9	4
		10.0%	Requirements Validation	2,737	07	2003	06	2004				1.5	1.5	1.5	1.5	1
		10.0%	System Verification	3,284	07	2003	06	2004				1.8	1.8	1.8	1.8	1
		20.0%	End Products Validation	5,473	07	2003	06	2004				3.0	3.0	3.0	3.0	3
		5.0%	Implementation	958	07	2003	06	2004				0.5	0.5	0.5	0.5	0
		5.0%	Transition to Use	684	07	2003	06	2004				0.4	0.4	0.4	0.4	0
		40.0%	Product Supply	2,189	07	2003	06	2004				1.2	1.2	1.2	1.2	1
		40.0%	Product Acquisition	2,189	07	2003	06	2004				1.2	1.2	1.2	1.2	1
		30.0%	Supplier Performance	2,463	07	2003	06	2004				1.4	1.4	1.4	1.4	1

6b. Staffing Chart | 7. Labor Distribution | 8a. Application Factors | 8b. Team Factors | 9. Model Computations | 10-1. Model-Based PRE Hours

Step 4a: ws 8a – Rate Application Factors

- **Click on ws 8a**
- **Rate Application Factors, Provide Comments**
- **Definition and Rating Criteria are provided as embedded notes**
- **Note: In the future, ws 8a, 8b rating scale values will be by "viewpoint", when applicable**



TOC	COSYSMO Application Factor Selection									See Embedded Comments for Descriptions and Selection Criteria
COSYSMO Application Factor Description	Identifier	Current EMR	VLOW (VL)	LOW (L)	NOM (N)	HIGH (H)	VHIGH (VH)	XHIGH (XH)	Rating Selected	Resulting Multiplier	Factor Rating Selection Comments
Development Schedule	SCED	1.43	1.43	1.14	1.00	1.00	1.00	****	N (100%)	1.000	current COCOMO II 2000 ratings --- must redefine for COSYSMO--- not in baseline yet, just a placeholder
Requirements Understanding								****	L-N	1.16	
Architecture Understanding								****	L	1.23	
Level of Service Requirements								****	N	1.00	
Migration Complexity								1.71	N-H	1.10	
No. and Diversity of Installations/Platforms	INST	1.78	****	****	1.00	1.21	1.47	1.78	N-H	1.10	
No. of Recursive Levels in the Design	RECU	2.21	0.67	0							
Documentation to Match Lifecycle Needs	DOCU	1.71	0.77	0							
Technology Risk	TRSK	2.57	0.68	0							

This cost driver rates the difficulty and criticality of satisfying the ensemble of level of service requirements, such as security, safety, response time, interoperability, maintainability, etc.

There is both a Difficulty and Criticality viewpoint/component that will be separated by semicolons in the rating criteria.

1) 2-3 sites or diverse installation configurations

2) Moderate environmental constraints; controlled environments (ie, air conditioning)

3) 4-7 types of platforms bring installed and/or being phased out/replaced

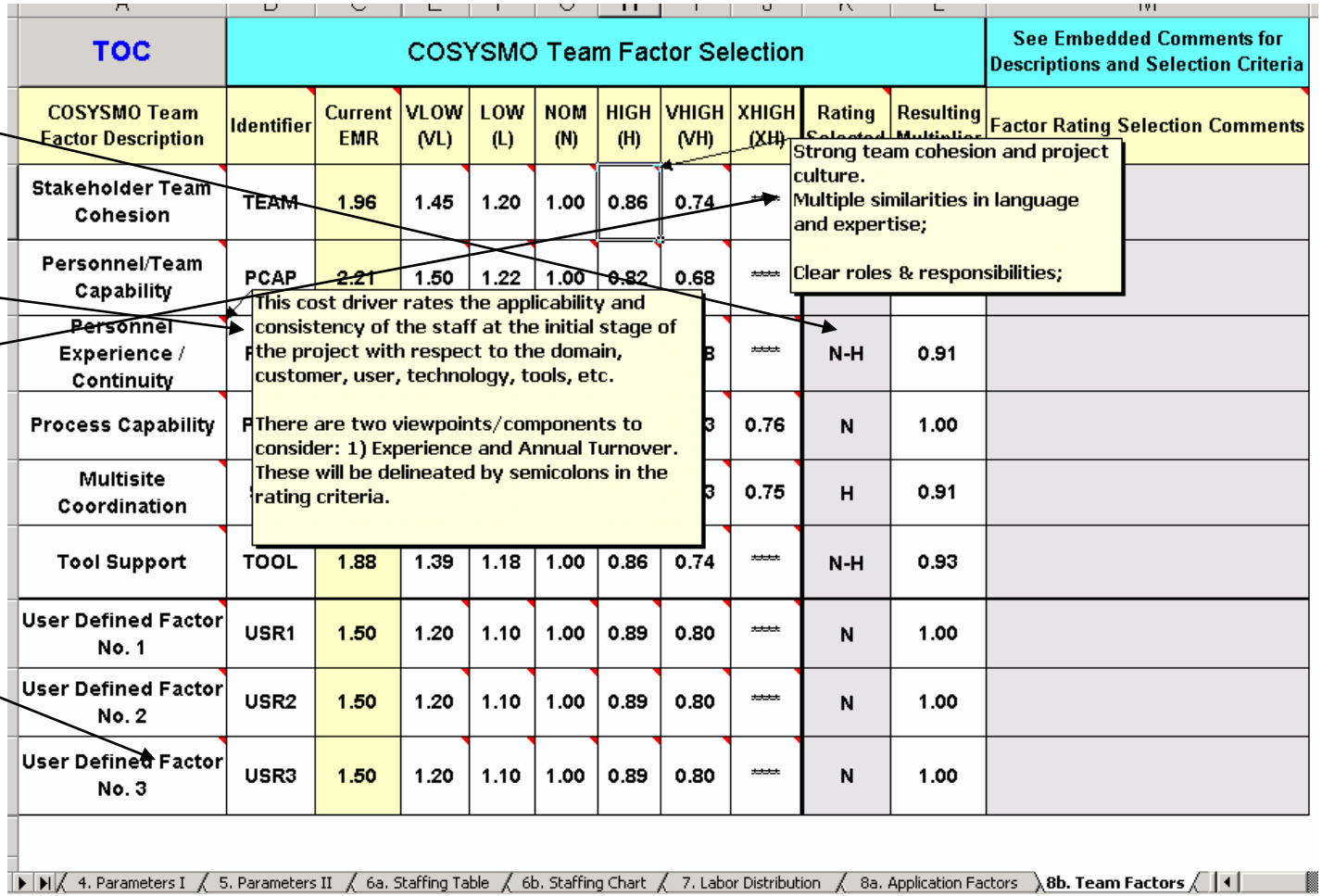
Compatible Platforms

Typically networked using a single industry standard protocol and multiple operating systems

4. Parameters I | 5. Parameters II | 6a. Staffing Table | 6b. Staffing Chart | 7. Labor Distribution | 8a. Application Factors | 8b. Team Factors

Step 4b: ws 8b – Rate Team Factors

- **Click on ws 8b**
- **Rate Team Factors, Provide Comments**
- **Definition and Rating Criteria are provided as embedded notes**
- **User Defined Factors for Growth or Local Site Care abouts, e.g. Info. Security**



TOC	COSYSMO Team Factor Selection									See Embedded Comments for Descriptions and Selection Criteria
COSYSMO Team Factor Description	Identifier	Current EMR	VLOW (VL)	LOW (L)	NOM (N)	HIGH (H)	VHIGH (VH)	XHIGH (XH)	Rating Selected	Resulting Multiplier	Factor Rating Selection Comments
Stakeholder Team Cohesion	TEAM	1.96	1.45	1.20	1.00	0.86	0.74	****			
Personnel/Team Capability	PCAP	2.21	1.50	1.22	1.00	0.82	0.68	****			
Personnel Experience / Continuity								****	N-H	0.91	
Process Capability							0.76		N	1.00	
Multisite Coordination								0.75	H	0.91	
Tool Support	TOOL	1.88	1.39	1.18	1.00	0.86	0.74	****	N-H	0.93	
User Defined Factor No. 1	USR1	1.50	1.20	1.10	1.00	0.89	0.80	****	N	1.00	
User Defined Factor No. 2	USR2	1.50	1.20	1.10	1.00	0.89	0.80	****	N	1.00	
User Defined Factor No. 3	USR3	1.50	1.20	1.10	1.00	0.89	0.80	****	N	1.00	

Strong team cohesion and project culture.
Multiple similarities in language and expertise;

Clear roles & responsibilities;

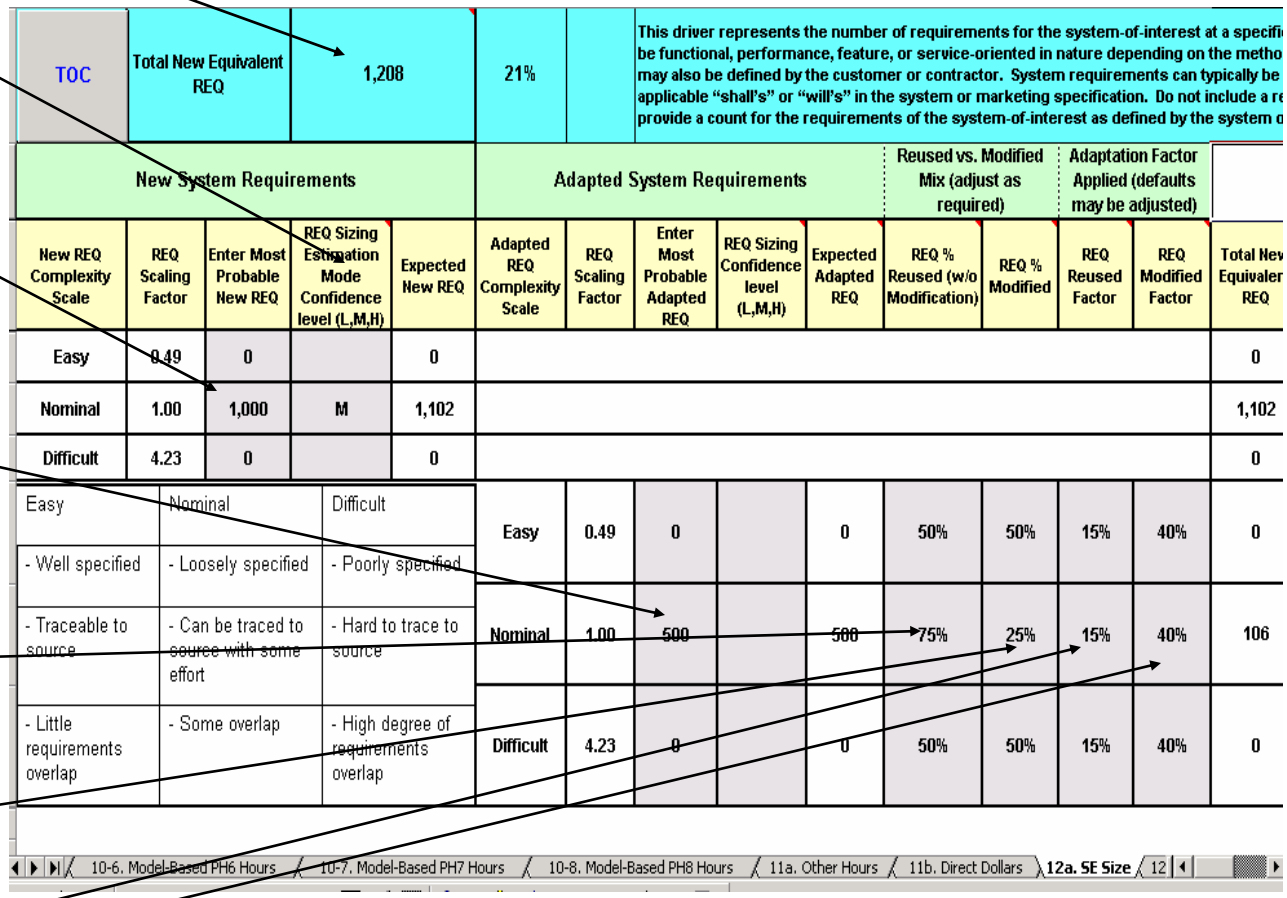
This cost driver rates the applicability and consistency of the staff at the initial stage of the project with respect to the domain, customer, user, technology, tools, etc.

There are two viewpoints/components to consider: 1) Experience and Annual Turnover. These will be delineated by semicolons in the rating criteria.

4. Parameters I | 5. Parameters II | 6a. Staffing Table | 6b. Staffing Chart | 7. Labor Distribution | 8a. Application Factors | 8b. Team Factors

Step 5a: Ws 12a. - Estimate Size (Requirements)

- **Total EREQ results…**
- **Confidence Levels (H,M,L) inject risk/growth**
- **1000 New, Nominal Requirements**
- **500 Nominal Requirements are being adapted from a heritage system**
- **75% will be reused without modification,**
- **25% will have some modifications**
- **Default adaptation factors may be overridden**



TOC	Total New Equivalent REQ	1,208	21%		This driver represents the number of requirements for the system-of-interest at a specifi be functional, performance, feature, or service-oriented in nature depending on the metho may also be defined by the customer or contractor. System requirements can typically be applicable "shall's" or "will's" in the system or marketing specification. Do not include a re provide a count for the requirements of the system-of-interest as defined by the system o

New System Requirements					Adapted System Requirements					Reused vs. Modified Mix (adjust as required)		Adaptation Factor Applied (defaults may be adjusted)		
New REQ Complexity Scale	REQ Scaling Factor	Enter Most Probable New REQ	REQ Sizing Estimation Mode Confidence level (L,M,H)	Expected New REQ	Adapted REQ Complexity Scale	REQ Scaling Factor	Enter Most Probable Adapted REQ	REQ Sizing Confidence level (L,M,H)	Expected Adapted REQ	REQ % Reused (w/o Modification)	REQ % Modified	REQ Reused Factor	REQ Modified Factor	Total New Equivalent REQ
Easy	0.49	0		0										0
Nominal	1.00	1,000	M	1,102										1,102
Difficult	4.23	0		0										0

Easy	Nominal	Difficult
- Well specified	- Loosely specified	- Poorly specified
- Traceable to source	- Can be traced to source with some effort	- Hard to trace to source
- Little requirements overlap	- Some overlap	- High degree of requirements overlap

Easy	0.49	0		0	50%	50%	15%	40%	0
Nominal	1.00	500		500	75%	25%	15%	40%	106
Difficult	4.23	0		0	50%	50%	15%	40%	0

10-6. Model-Based PH6 Hours | 10-7. Model-Based PH7 Hours | 10-8. Model-Based PH8 Hours | 11a. Other Hours | 11b. Direct Dollars | 12a. SE Size | 12

Step 5a: ws 12b - Estimate Size (Interfaces)

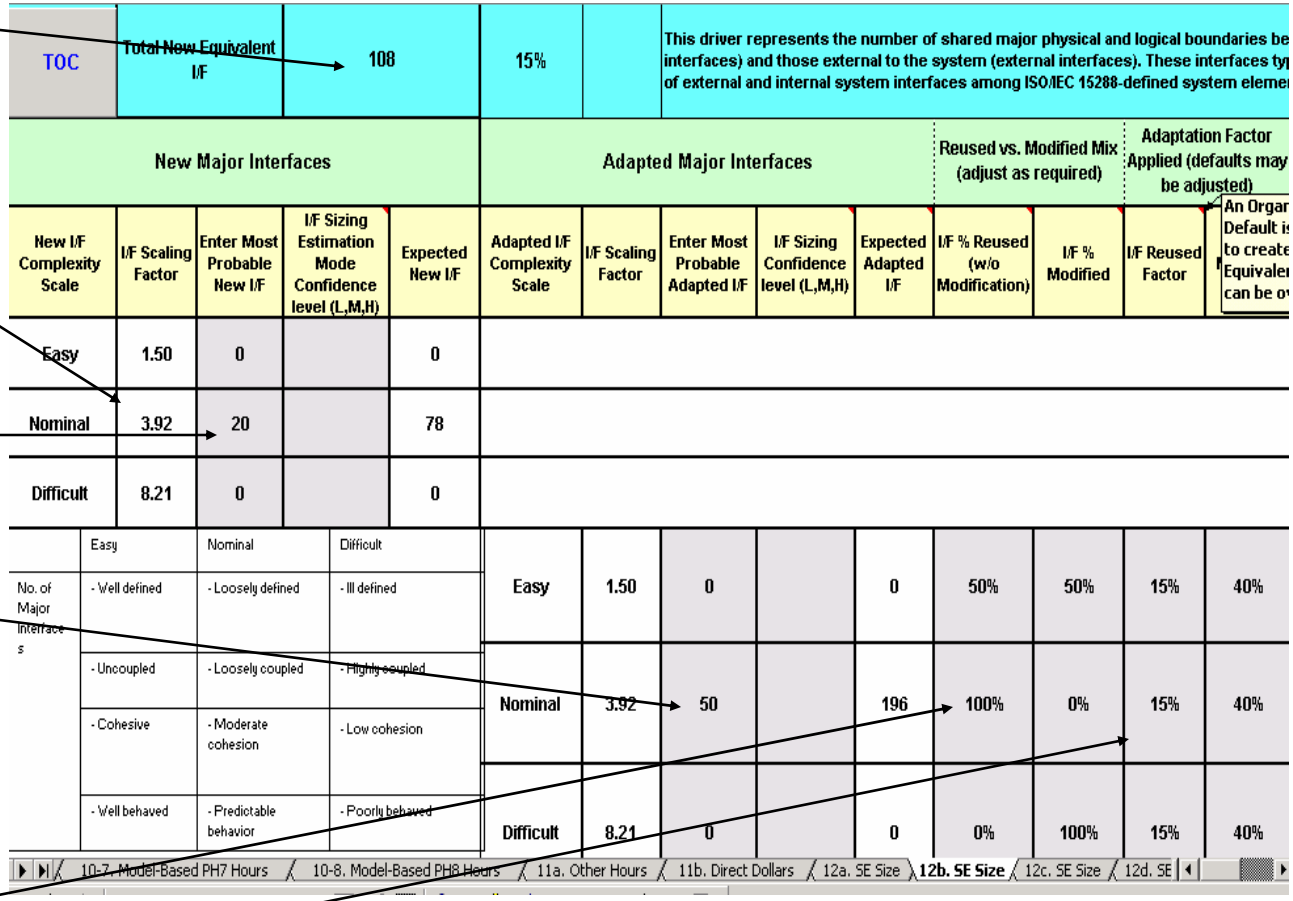
Total EREQ results…

One Nominal Interface is equivalent to 3.92 Nominal Requirements

20 New, Nominal Interfaces

50 Nominal Interfaces are being adapted from a heritage system

100% will be adapted without changes, with an adaptation factor of 15%



TOC	Total New Equivalent I/F	108	15%		This driver represents the number of shared major physical and logical boundaries be interfaces) and those external to the system (external interfaces). These interfaces ty of external and internal system interfaces among ISO/IEC 15288-defined system eleme

New Major Interfaces					Adapted Major Interfaces					Reused vs. Modified Mix (adjust as required)		Adaptation Factor Applied (defaults may be adjusted)	
New I/F Complexity Scale	I/F Scaling Factor	Enter Most Probable New I/F	I/F Sizing Estimation Mode Confidence level (L,M,H)	Expected New I/F	Adapted I/F Complexity Scale	I/F Scaling Factor	Enter Most Probable Adapted I/F	I/F Sizing Confidence level (L,M,H)	Expected Adapted I/F	I/F % Reused (w/o Modification)	I/F % Modified	I/F Reused Factor	An Organ Default is to create Equivale can be o
Easy	1.50	0		0									
Nominal	3.92	20		78									
Difficult	8.21	0		0									

	Easy	Nominal	Difficult
No. of Major Interfaces	- Well defined	- Loosely defined	- Ill defined
	- Uncoupled	- Loosely coupled	- Highly coupled
	- Cohesive	- Moderate cohesion	- Low cohesion
	- Well behaved	- Predictable behavior	- Poorly behaved

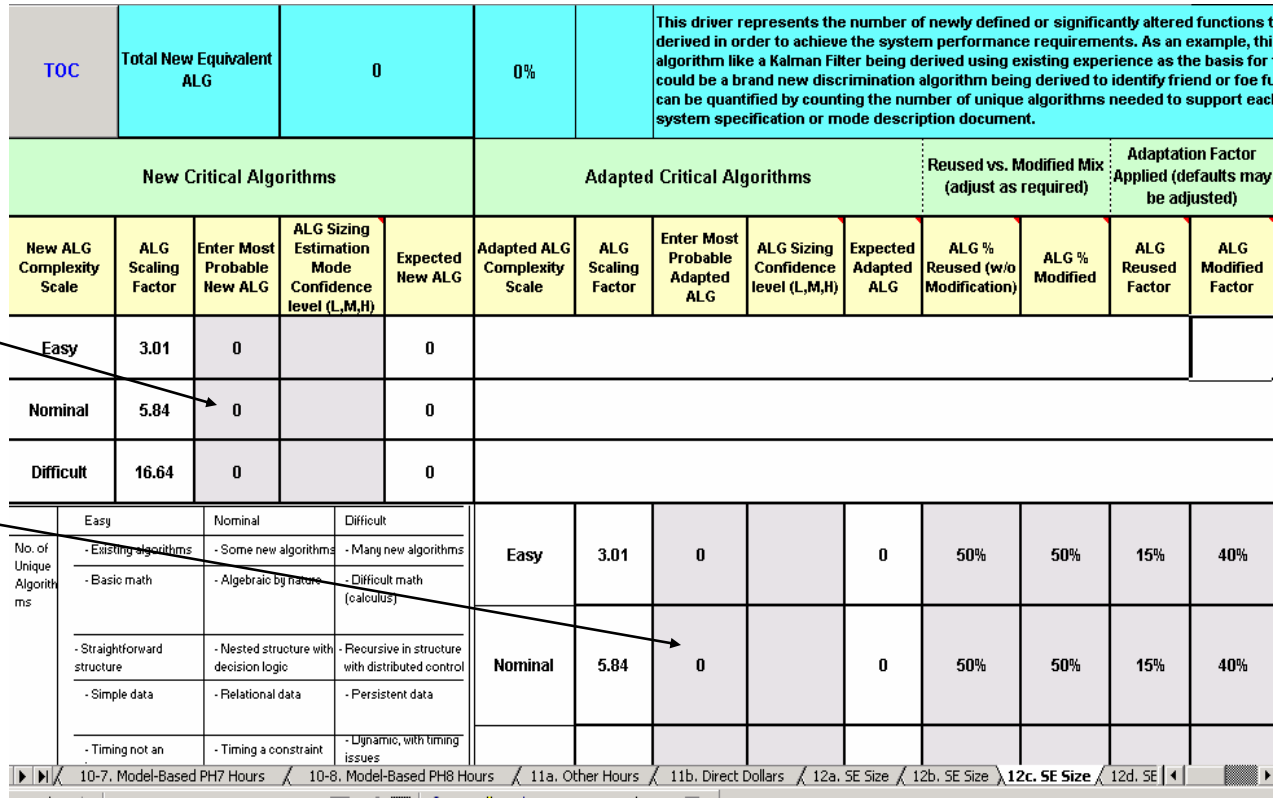
Easy	1.50	0		0	50%	50%	15%	40%
Nominal	3.92	50		196	100%	0%	15%	40%
Difficult	8.21	0		0	0%	100%	15%	40%

10-7. Model-Based PH7 Hours | 10-8. Model-Based PH8 Hours | 11a. Other Hours | 11b. Direct Dollars | 12a. SE Size | 12b. SE Size | 12c. SE Size | 12d. SE

Step 5a: ws 12c - Estimate Size (Critical Algorithms)

No New, Nominal Critical Algorithms identified

No Nominal Critical Algorithms are being adapted from a heritage system



TOC	Total New Equivalent ALG	0	0%		This driver represents the number of newly defined or significantly altered functions t derived in order to achieve the system performance requirements. As an example, thi algorithm like a Kalman Filter being derived using existing experience as the basis for could be a brand new discrimination algorithm being derived to identify friend or foe fu can be quantified by counting the number of unique algorithms needed to support eac system specification or mode description document.

New Critical Algorithms					Adapted Critical Algorithms					Reused vs. Modified Mix (adjust as required)		Adaptation Factor Applied (defaults may be adjusted)	
New ALG Complexity Scale	ALG Scaling Factor	Enter Most Probable New ALG	ALG Sizing Estimation Mode Confidence level (L,M,H)	Expected New ALG	Adapted ALG Complexity Scale	ALG Scaling Factor	Enter Most Probable Adapted ALG	ALG Sizing Confidence level (L,M,H)	Expected Adapted ALG	ALG % Reused (w/o Modification)	ALG % Modified	ALG Reused Factor	ALG Modified Factor
Easy	3.01	0		0									
Nominal	5.84	0		0									
Difficult	16.64	0		0									

	Easy	Nominal	Difficult
No. of Unique Algorithms	- Existing algorithms	- Some new algorithms	- Many new algorithms
	- Basic math	- Algebraic by nature	- Difficult math (calculus)
	- Straightforward structure	- Nested structure with decision logic	- Recursive in structure with distributed control
	- Simple data	- Relational data	- Persistent data
	- Timing not an	- Timing a constraint	- Dynamic, with timing issues

Easy	3.01	0		0	50%	50%	15%	40%
Nominal	5.84	0		0	50%	50%	15%	40%

10-7. Model-Based PH7 Hours | 10-8. Model-Based PH8 Hours | 11a. Other Hours | 11b. Direct Dollars | 12a. SE Size | 12b. SE Size | 12c. SE Size | 12d. SE

Step 5a: ws 12d - Estimate Size (Operational Scenarios)

Total EREQ results…

4 New, Easy Operational Scenarios

12 New, Nominal Operational Scenarios

6 New, Difficult Operational Scenarios

No Operational Scenarios will be adapted from a heritage program

TOC	Total New Equivalent SCN	659	0%		This driver represents the number of operational scenarios that a system must satisf scenarios that are developed to validate the system satisfies all of its requirements. quantified by counting the number of end-to-end tests used to validate the system fu calculated by counting the number of high-level use cases developed as part of the op

New Operational Scenarios					Adapted Operational Scenarios					Reused vs. Modified Mix (adjust as required)		Adaptation Factor Applied (defaults may be adjusted)	
New SCN Complexity Scale	SCN Scaling Factor	Enter Most Probable New SCN	SCN Sizing Estimation Mode Confidence level (L,M,H)	Expected New SCN	Adapted SCN Complexity Scale	SCN Scaling Factor	Enter Most Probable Adapted SCN	SCN Sizing Confidence level (L,M,H)	Expected Adapted SCN	SCN % Reused (w/o Modification)	SCN % Modified	SCN Reused Factor	SCN Modified Factor
Easy	10.31	4		41									
Nominal	24.58	12		295									
Difficult	53.85	6		323									

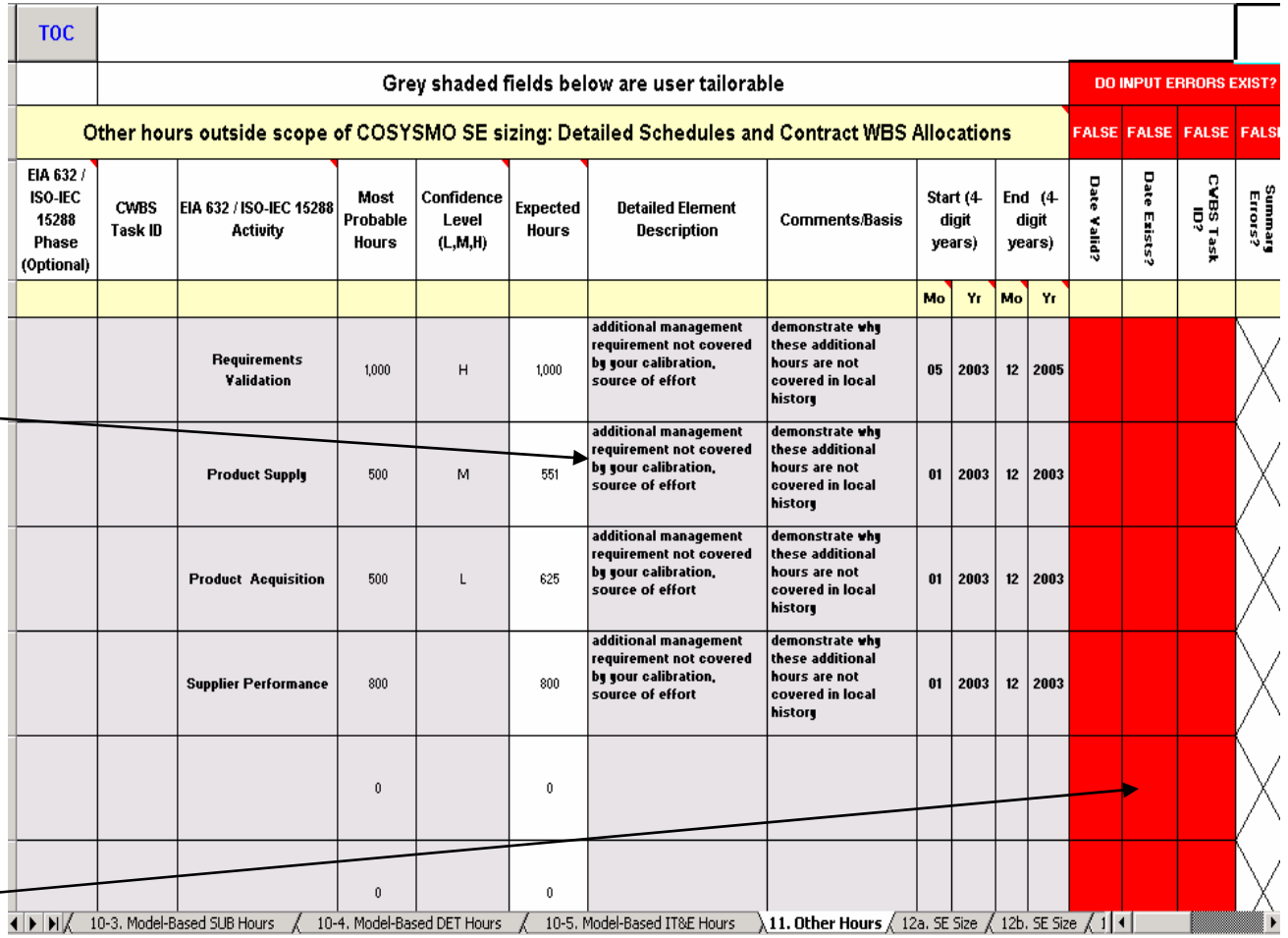
Easy	Nominal	Difficult
- Well defined	- Loosely defined	- Ill defined
- Loosely coupled	- Moderately coupled	- Tightly coupled or many dependencies/conflicting

Easy	10.31	0		0	50%	50%	15%	40%
Nominal	24.58	0		0	50%	50%	15%	40%

10-8. Model-Based PH8 Hours | 11a. Other Hours | 11b. Direct Dollars | 12a. SE Size | 12b. SE Size | 12c. SE Size | **12d. SE Size** | 12e. SE Size | 12f. SE Size

Step 5b: ws 11- Estimate Other Hours

- **Click on ws 11…**
- **Input Other "Sources of Effort" that are Non-COSYSMO based, i.e, not in the calibrated basis nor within the scope of the SE Sizing Inputs**
  - **Logistics functions**
  - **SE Admn. Support**
  - **etc.**
- **100 entries available…**
- **Various input error checks provided**



TOC

Grey shaded fields below are user tailorable

DO INPUT ERRORS EXIST?

Other hours outside scope of COSYSMO SE sizing: Detailed Schedules and Contract WBS Allocations

FALSE FALSE FALSE FALSE

EIA 632 / ISO-IEC 15288 Phase (Optional)	CWBS Task ID	EIA 632 / ISO-IEC 15288 Activity	Most Probable Hours	Confidence Level (L,M,H)	Expected Hours	Detailed Element Description	Comments/Basis	Start (4-digit years)		End (4-digit years)		Date Valid?	Date Exists?	CWBS Task ID?	Summary Errors?
								Mo	Yr	Mo	Yr				
		Requirements Validation	1,000	H	1,000	additional management requirement not covered by your calibration, source of effort	demonstrate why these additional hours are not covered in local history	05	2003	12	2005				
		Product Supply	500	M	551	additional management requirement not covered by your calibration, source of effort	demonstrate why these additional hours are not covered in local history	01	2003	12	2003				
		Product Acquisition	500	L	625	additional management requirement not covered by your calibration, source of effort	demonstrate why these additional hours are not covered in local history	01	2003	12	2003				
		Supplier Performance	800		800	additional management requirement not covered by your calibration, source of effort	demonstrate why these additional hours are not covered in local history	01	2003	12	2003				
			0		0										
			0		0										

10-3. Model-Based SUB Hours | 10-4. Model-Based DET Hours | 10-5. Model-Based IT&E Hours | 11. Other Hours | 12a. SE Size | 12b. SE Size

Step 6: ws 9 – Model Computation Results

- **Click on ws 9…**
- **Total COSYSMO Model PM and Hours**
- **Sum of all equivalent SE Sizing Inputs (EREQs)**
- **Effort Calibration Factor comes from Local Calibration (next Chart)**
- **Size and Cost Ranges based upon Confidence of inputs**

TOC	COSYSMO-Based Effort, Cost, and Schedule						
Total COSYSMO Effort (Person Months)	1,800	Total COSYSMO Effort (Hours)	273,657	Spare		Spare	
Computed COSYSMO Schedule Duration		Total Equivalent SE Size	11,729	Effort Calibration Factor	9.92	Effort Exponent (forced to 1.0)	1.00
Actual Contractural COSYSMO Schedule Duration		CO SYS MO		Schedule Calibration Factor	5.00	Schedule Exponent (forced to cube root)	0.33
Composite COSYSMO Effort Multiplier (EM)	1.548	Schedule Compression Percentage	100.0%	Composite COSYSMO Effort Multiplier (EM) Adjusted for Schedule	1.548	N	<= SCE Rating
2-Sigma SE Size	769	PERT Risk Analysis For Effort, Cost, and Schedule (Based on Lowest, Highest Size)					
Lowest SE Size (2-sigma) at the 95% Confidence Level	10,960	Lowest Hours (including lowest non-Model hours)	258,216	Lowest C/L (k$)	$16,150	Shortest Schedule Duration	
Highest SE Size (2-sigma) at the 95% Confidence Level	12,498	Highest Hours (including highest non-Model hours)	295,049	Highest C/L (k$)	$18,453	Longest Schedule Duration	

6a. Staffing Table | 6b. Staffing Chart | 7. Labor Distribution | 8a. Application Factors | 8b. Team Factors | 9. Model Computations | 10-1. Model

Step 6: A COSYSMO Calibration

Click on "Local Site COSYSMO Calibration"…

- **Local calibration factor used for model costing (previous chart)**
- **Pulled from SE Data Repository ws Projects**
- **Calibration Validation: compare to some commonly cited software criteria**

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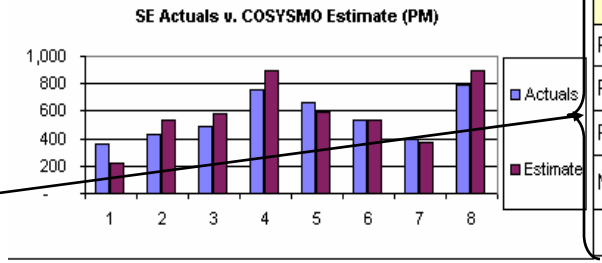
Sample COSYSMO Calibration for a Local Site (Notional)

Linear regression technique taken from "Software Estimation with COCOMO II", para. 4.6.1, currently assuming *E* = 1 and a nominal schedule *(NS)*

A: Computed, Local Calibration Factor **9.92**

Project Index	Project	Actual SE Effort In Hours	D: Actual SE Effort (PM)	Total SE Size (EREQ)	B: Scaled SE Size (EREQ/100)	SE Productivity (SE Hours per EREQ)	C: Geometric Product of All EMs	LOG D	LOG B	LOG C	COSYSMO Effort Estimate: PM $_{(NS)}$ = (A * B * C)	Magnitude of Relative Error (MRE)
1	Program A	55,000	362	2,000	20.0	27.5	1.09	2.56	1.30	0.04	216	0.40
3	Program C	65,000	428	4,500	45.0	14.4	1.20	2.63	1.65	0.08	535	0.25
4	Program D	75,000	493	5,000	50.0	15.0	1.18	2.69	1.70	0.07	585	0.19
6	Program F	115,000	757	9,000	90.0	12.8	1.00	2.88	1.95	0.00	892	0.18
2	Program B	100,000	658	7,500	75.0	13.3	0.80	2.82	1.88	-0.10	595	0.10
5	Program E	82,000	539	6,000	60.0	13.7	0.90	2.73	1.78	-0.05	535	0.01
7	Program G	60,000	395	5,000	50.0	12.0	0.75	2.60	1.70	-0.12	372	0.06
8	Program H	120,000	789	10,000	100.0	12.0	0.90	2.90	2.00	-0.05	892	0.13
Summary		672,000	4,421	49,000	490.0	13.5	1.0	21.81	13.96	-0.12	4,624	0.16



Industry software model calibration accuracy criteria		
PRED(.25) =	0.75	> 0.75
RMS	96.7	
RRMS =	0.17	< .25
MMRE =	0.16	< .25
R-Squared	0.99	

COSYSMO Effort Estimate Formula:

$$PM_{NS} = A \cdot (Size)^{E} \cdot \prod_{i=1}^{n} EM_i$$

12b. SE Size | 12c. SE Size | 12d. SE Size | 12e. SE Size | 12f. SE Size | 12g. SE Size | Local SE Data Repository | **A COSYSMO Calibration** | Version F

Step 6: - ws 6a, 6b – Resulting Staffing Data

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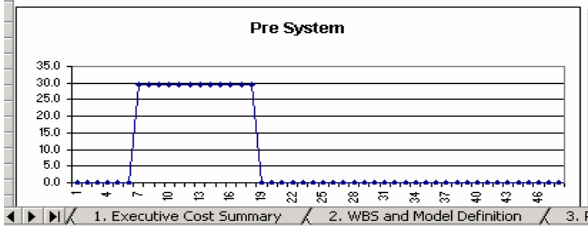
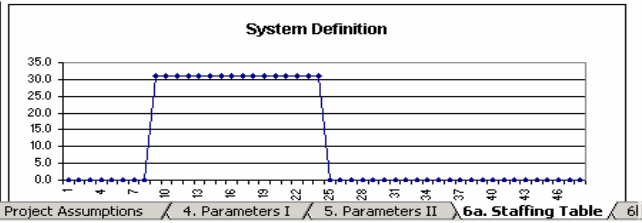
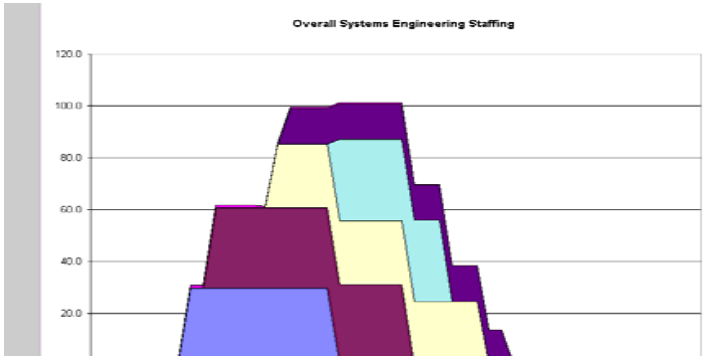
Systems Engineering Staffing

Type/Phase	2004 Equivalent Headcount												2005 Equivalent Headcount												2006 Equivalent Headcou								
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06	07	08	09
PRE	0.0	0.0	0.0	0.0	0.0	0.0	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	29.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SYS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	31.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	0.0	0.0	0.0
DET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	0.0	0.0	0.0	0.0	0.0	0.0
IT&E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	0.0
OPR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MNT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All Model Based	0.0	0.0	0.0	0.0	0.0	0.0	29.6	29.6	60.7	60.7	60.7	60.7	60.7	85.3	99.1	99.1	99.1	99.1	100.7	100.7	100.7	100.7	100.7	100.7	69.7	69.7	69.7	38.4	38.4	38.4	13.8	13.8	0.0
Other	0.9	0.9	0.9	0.9	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total SE Effort	0.9	0.9	0.9	0.9	1.2	1.2	30.8	30.8	61.9	61.9	61.9	61.9	61.2	85.9	99.6	99.6	99.6	99.6	101.3	101.3	101.3	101.3	101.3	101.3	69.7	69.7	69.7	38.4	38.4	38.4	13.8	13.8	0.0
Equivalent SE Heads per Calendar	315												1,153												352								
Approx. SE Cost (K$)	2,995												10,963												3,343								





1. Executive Cost Summary | 2. WBS and Model Definition | 3. Project Assumptions | 4. Parameters I | 5. Parameters II | **6a. Staffing Table** | 6l



Step 6: Ws 1 - Executive Cost Summary

- **Executive Cost Summary has data pulled from various worksheets (read only)**
- **The excerpt provided at right represents only a small part of the available data**

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System Engineering Cost Estimate ---

System Engineering Person-Months Estimated	1,820	System Engineering Hours Estimated	276,636	Total Normalized SE Size	11,729
SE Productivity (SE Hours per Normalized SE Size)	23.59	Average C/L$ / SE PM	$9,507	Total Estimated Cost-Line (K$)	$17,302

EIA 632 / ISO-IEC 15288 Activity	EIA 632 Clause No. (Reqs.)	Cost-Line (K$)
Technical Management	4.2 (4-13)	2,483
Requirements Definition	4.3.1 (14-16)	2,414
Solution Definition	4.3.2 (17-19)	1,724
Systems Analysis	4.5.1 (22-24)	2,167
Requirements Validation	4.5.2 (25-29)	1,698
System Verification	4.5.3 (30-32)	2,069
End Products Validation	4.5.4.1 (33)	1,623
Implementation	4.4 (20)	1,026
Transition to Use	4.4 (21)	862
Product Supply	4.1.1 (1)	380
Product Acquisition	4.1.2 (2)	384
Supplier Performance	4.1.2 (3)	473
Total K$ (Cost-Line)		$17,302

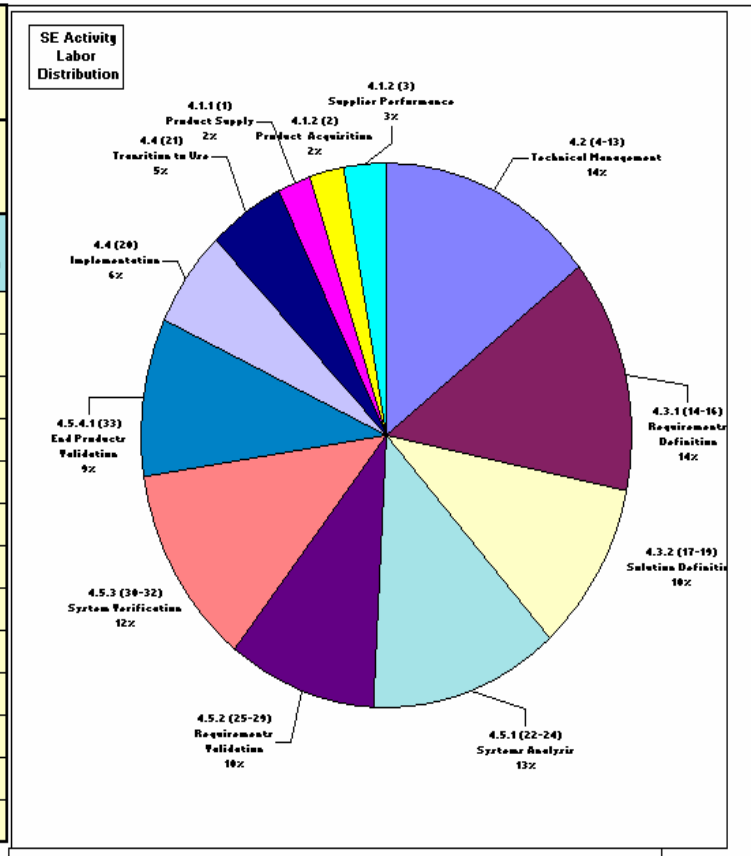
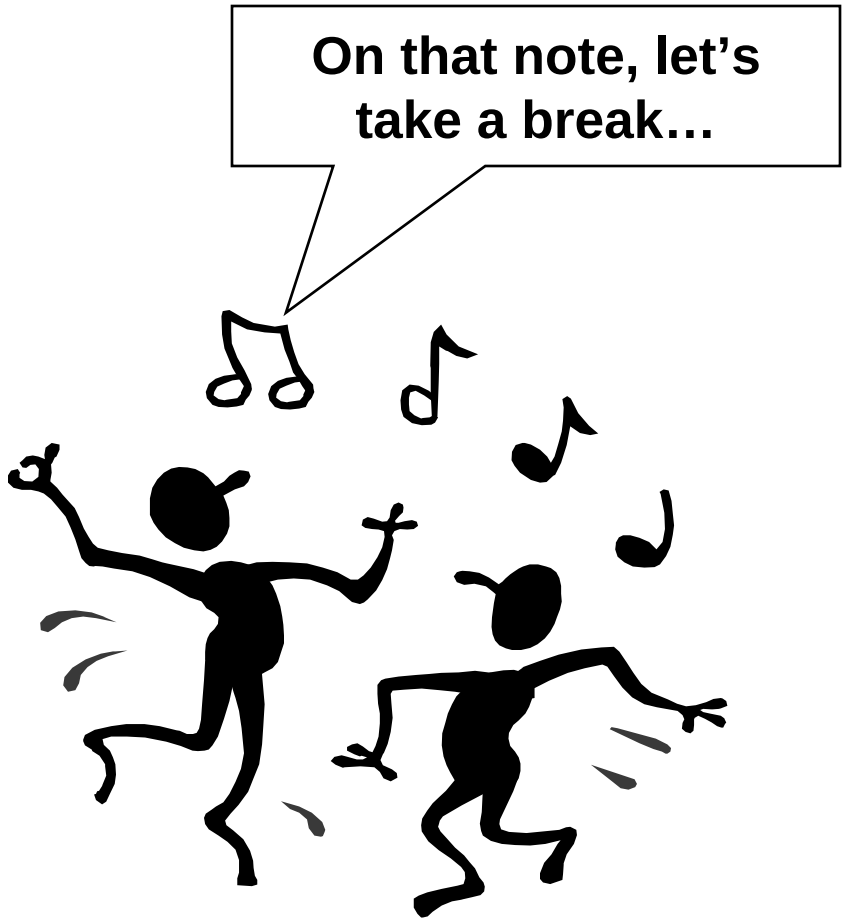


Table of Contents | 1. Executive Cost Summary | 2. WBS and Model Definition | 3. Project Assumptions | 4. Parameters I | 5. Parameters II | 6



Case Study I: Albatross Budgetary Estimate

- **You, as the Albatross SE lead, have just been asked to provide your program manager a budgetary estimate for a new, believed-to-be critical function to the current baseline**
  - **This new functionality would add some new, nearly-standalone, capability to your Albatross program, your best educated guess by looking at the emailed requirements provided by your customer is that it adds about 10% to the requirements baseline and two new interfaces, you guess we need at least one more Operational Scenario…**
  - **The customer also stated that they really need this capability to be integrated into the next delivery (5 months from now)**
  - **The PM absolutely has to have your SE cost estimate within the next two hours, as the customer representative needs a not-to-exceed (NTE) total cost soon after that!**
- **Information that may prove useful in your response**
  - **Albatross is well into system I&T, with somewhat higher than expected defects**
  - **Most of the baseline test procedures are nearing completion**
  - **This customer is known for indecisiveness in closing on requirements**
  - **The SE group has lost two experienced people in the past month to attrition**
  - **So far, the Albatross customer award fees have been excellent, with meeting of schedule commitments noted as a key strength**
  - **There is a final delivery already in the current baseline (10 months from now)**
- **What is your response to this scenario?**
  - **Take 10-15 minutes and work in groups of 3**
  - **Use "Case Study I: In-Class Discussion Questions" for Guidance**

Case Study I: In-Class Discussion Questions

- What are some of the risks?
- What additional questions could you ask of your PM?
- What additional questions could the PM (or the SE Lead) ask of the Customer Representative?
- What role could the Albatross PM play in this situation?
- Is providing only "a number" appropriate in this situation?
- How real is this scenario?
- What could be done to make this case study better?
- What additional assumptions did you make that can be captured by COSYSMO?

Case Study II: Goony Bird II ROM

- **You, as the Albatross SE Lead, have been asked to provide your management a Rough Order of Magnitude (ROM) cost for a building a ground system for *the same customer, but at a different site***
  - **At first glance, the new system appears to have objectives striking similar to your now operational Albatross system; however, there are two new data sources to be processed (call them Data Source X and Data Source Y)**
    - **The System has been dubbed in the Draft RFP (DRFP) as Goony Bird II (GB II)**
  - **Your Product Line VP needs your Not to Exceed ROM cost within three working days to support the decision making process**
- **Your assignment (should you decide to accept it) is to transform the MyCOSYSMO file (named Albatross.xls) that currently characterizes Albatross (in terms of actual size and complexity) into a MyCOSYSMO "Goony Bird II" file,*ie. use Albatross as a starting point.***
  - **Use the guidance/information on the next four charts to build a MyCOSYSMO file for in-class peer review**
  - **Take an hour and work in groups of 3 (designated subteams: Goony A, B, C,…)**
  - **Remember that documenting your assumptions is a good thing to do…**
  - **Answer as many questions on the "Case Study II: In-Class Discussions Questions" chart as you can**
- **Finally, we will discuss and critique each group's results**

Case Study II: Getting Started…

- Load Albatross.xls onto desktop
- Rename file as GB II.xls
- Open file and go to TOC
- From TOC, click on “Parms I” button and go to worksheet 4
  - Set Project Name: Item 13 = GB II
  - We will use our local calibration, so leave Item 10 = Y
  - As we are only doing an SE effort estimate in person months, leave Item 14 (Detailed Pricing Inputs?) = N

GB II: Effort Multiplier Similarities to Albatross

From TOC, Go To either Application (ws 8a) or Team Factor Selections (8b)

1. **The overall personnel/team capability will likely be about the same**
2. **We plan to use the same standard SE tool suite, most engineers have experience with it**
3. **The technologies associated with the new data sources appear to a similar level of maturity/risk as what we experienced on Albatross**
4. **The GB II deliverable documentation requirements appear to be about the same, it is still the same customer shop**

Note: You will already find information regarding Effort Multipliers – look for Sn, n= 1 to 4 in the "Factor Rating Selection Comments" column, consider leaving the GB II rating the same as Albatross, also use this column to document your assumptions

GB II: Effort Multiplier Differences from Albatross

From TOC, Go To either Application (ws 8a) or Team Factor Selections (8b)

1. **A lot of the application domain-experienced systems engineers have rolled off Albatross and are already committed elsewhere**
2. **There is a large user community at the new site GB II, we don't yet know what their expectations are…**
3. **The GB II DRFP appears to have more complex systems reliability requirements, while Albatross had virtually none**
4. **Our attrition rate has been climbing, maybe due to improvement in the economy**
5. **Our CMMI process capability is improving, plans are for Level 5 by late 2005**
6. **The Draft RFP has a number of Requirement TBD's/TBR's related to data sources X and Y performance**
7. **Unlike the multi-site developed Albatross, GB II will likely be all locally developed (and within the same building)**
8. **The two new data sources seem to imply two additional platforms that need to be handled**

Note: You will already find information regarding Effort Multipliers – look for Dn, D= 1 to 8 in the "Factor Rating Selection Comments" column, modify the rating for GB II as you see fit, also use this column to document your assumptions

GB II: Systems Engineering Sizing

From TOC, Go To SE Size (ws 12a, 12b, 12c, or 12d)

1. **We count about 200 new requirements mostly related to the new data sources, some may be more difficult than average…**
2. **There were 5,000 Albatross Source requirements, after quickly scanning the Draft RFP we estimate that maybe 80% of them can be adapted for GB II :**
   - **Assume that 25% of these 4000 will have to be modified and thus 75% of these 4000 can be reused "as is, w/o modification"**
3. **All of the 50 Interfaces can be reused "as is, w/o modification" from Albatross, we think we have at least 3 new ones for GB II**
4. **We know have 2 new Critical Algorithms (one supporting each data source), we think they may be quite challenging, but haven't been able to talk to algorithms people to verify this…**
5. **As for our 25 Albatross Operational Scenarios, we are concerned about the how much adaptation may be needed to satisfy the new site customers and users, a "risky business" indeed. Also, let's assume we have maybe 3-4 new ones for now…**

Note: In setting your Size Confidence Levels (default is High) consider the limited time you have to work this estimate

Case Study II: In-Class Discussion Questions

- How many SE person months did you estimate?
- What are some of the risks?
- What were some of the assumptions you made?
- How did you treat cost drivers for which you had little or no information?
- What additional assumptions did you make that can be captured by COSYSMO?
- Is providing only "a number" appropriate in this situation?
- How real is this scenario?
- What could be done to make this case study better?

Critique of Tutorial