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A GenCorp Company

Program Cost Risk Assessment Methodology

Given by: Bob Webster @ the Palisade Risk Conference-Las Vegas-4/5 Nov 2010

What's the Point?

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- Define the proper methodology to evaluate a program cost estimate
- Assess the probability of accomplishing the program for the cost estimated
- Set up the infrastructure to create the program Risk Mitigation planning

Why Do It?

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- Companies may unknowingly accept contracts that are nearly impossible to accomplish
- On fixed price programs, this results in the loss of profit and possibly company investment
- On cost plus programs, overruns cause problems with the customer's funding and possible program cancellations
- The Company is placed in a difficult position for obtaining new work

A Structured Methodology

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- Establish a baseline estimate
- Identify risk and opportunity events
- Evaluate the minimum, most likely, and maximum cost or savings and the probability of the event
- Create a spreadsheet with the data
- Run the model, create a histogram and an “S” curve
- Brainstorm Risk Mitigation Plan (after award?)

Flowchart of a Cost Risk Process

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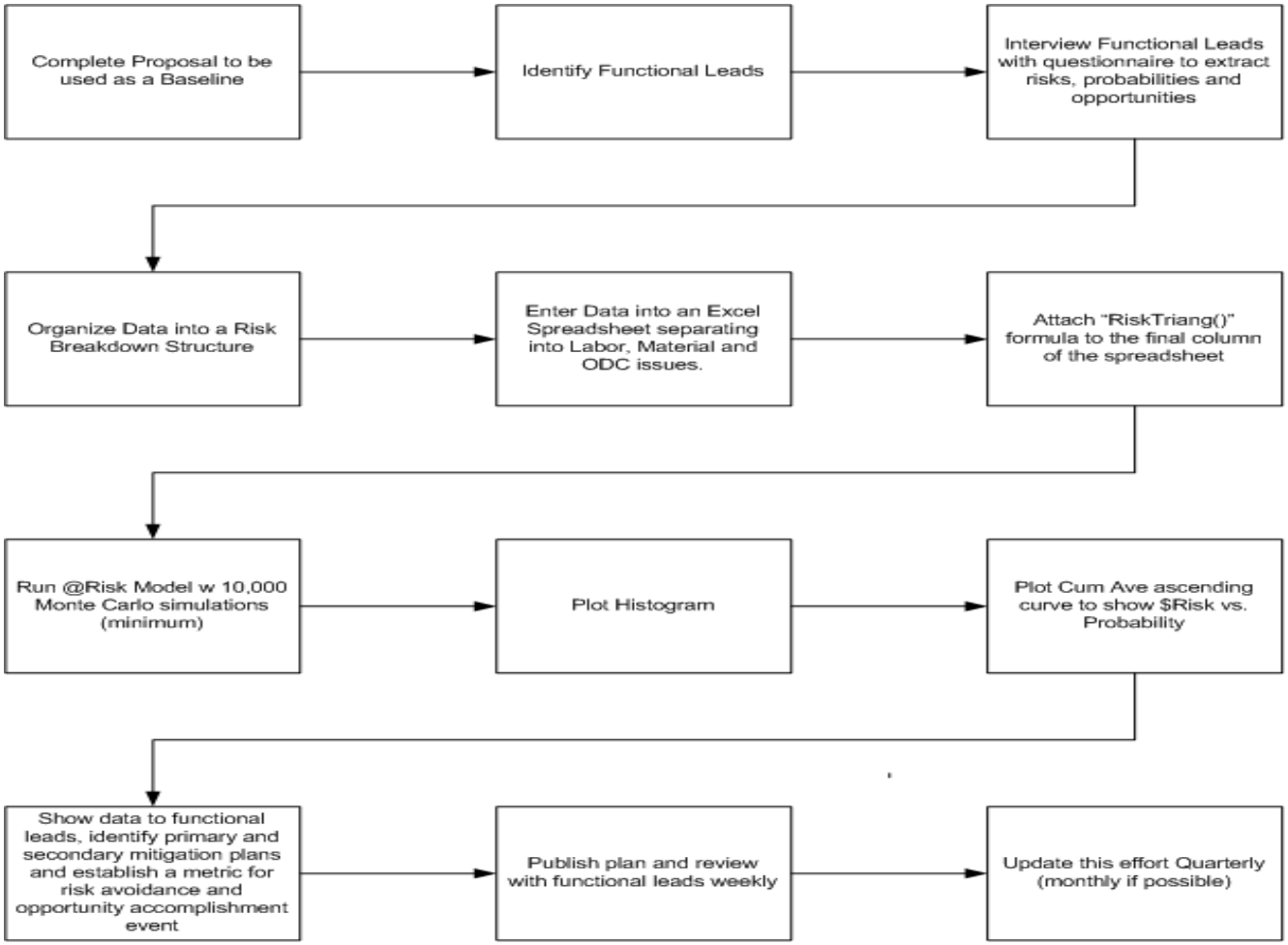

Types of Point Estimates

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- Parametric—usually based on an important performance or physical characteristic
- Analog (similar to previous history) with or without factors
- Engineering process standards
- Bottom up

Techniques Vary Depending on the Program Phase

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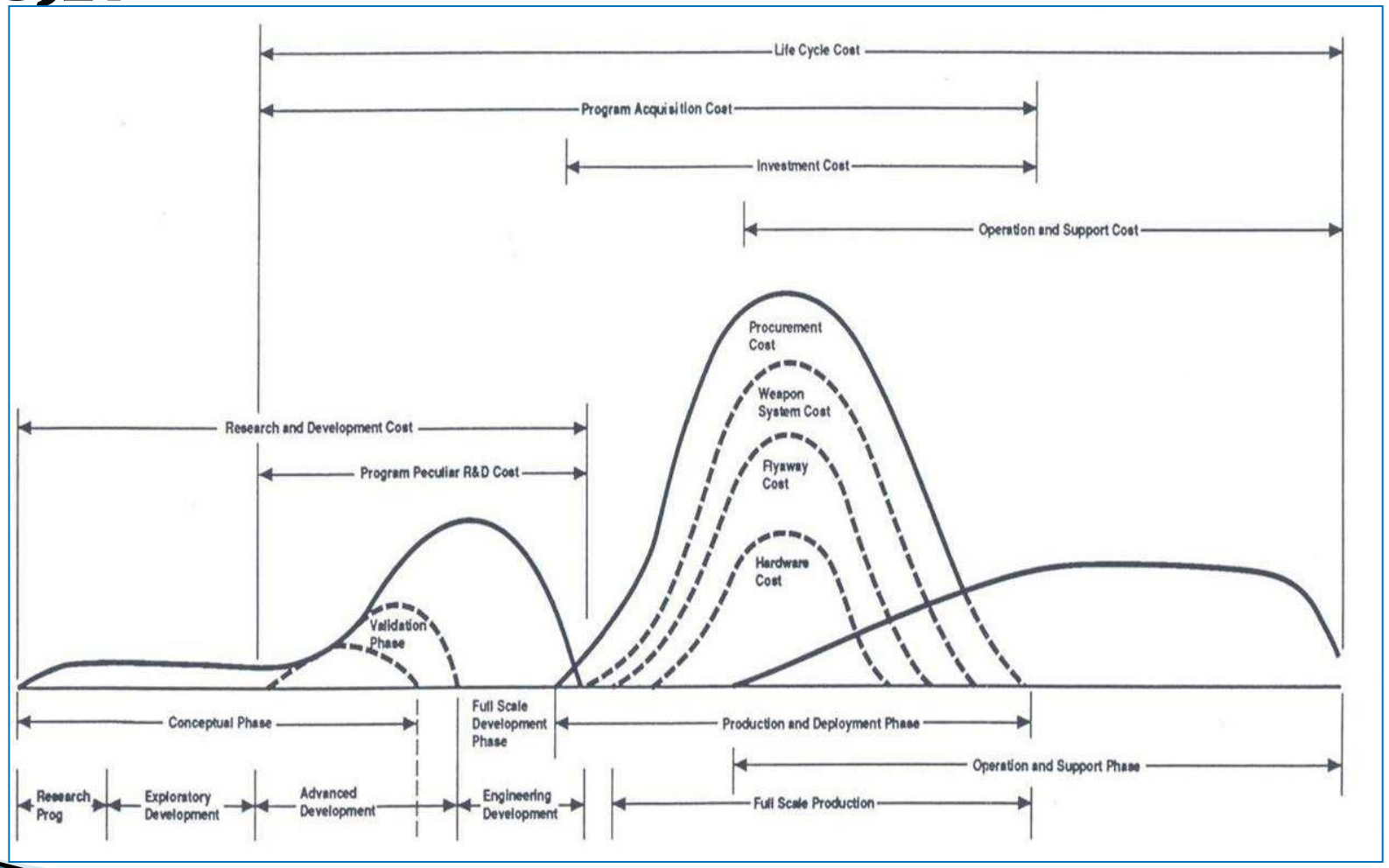

The Use of Statistical Software Is Not a Replacement for Estimating Rigor

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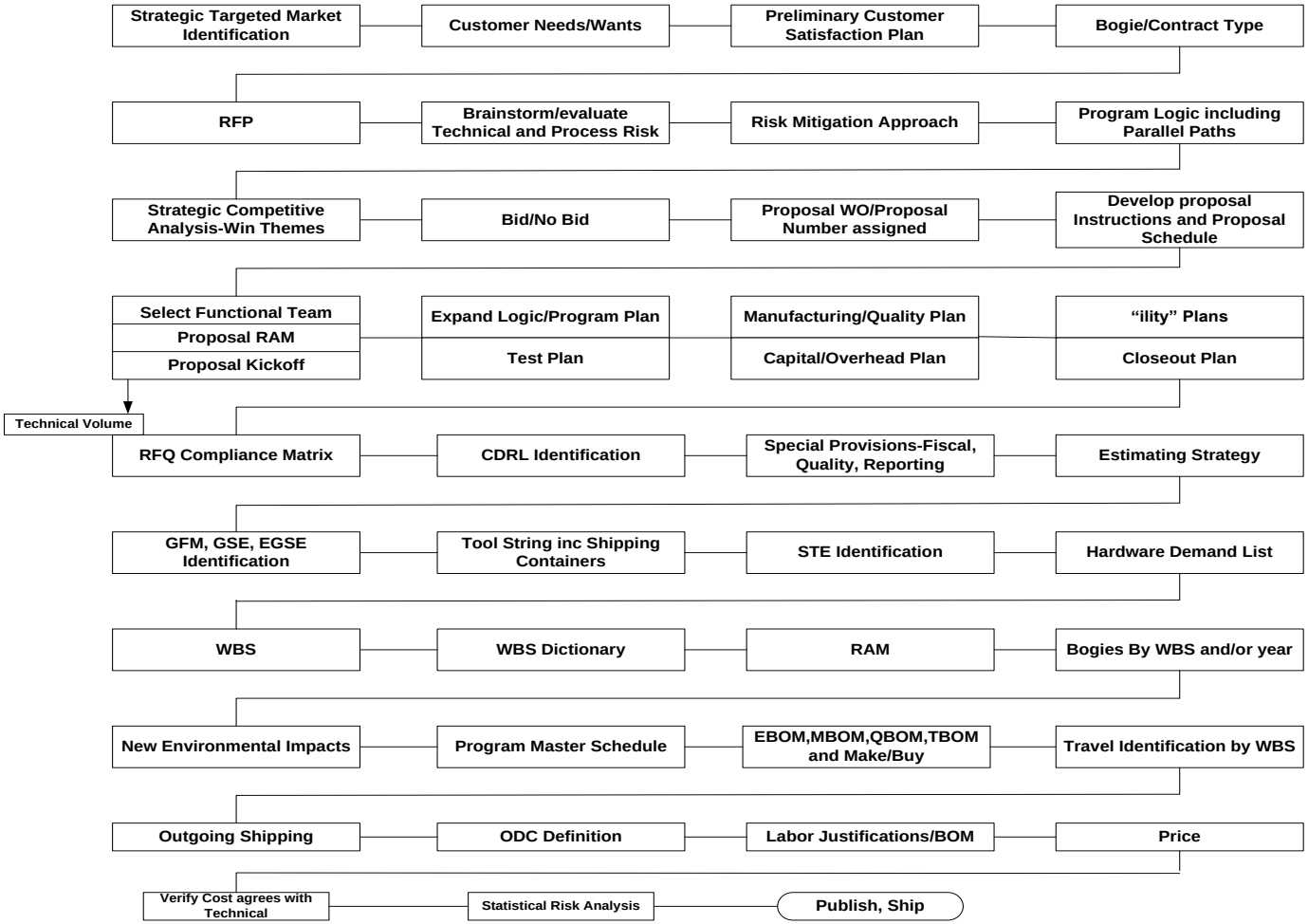

Pick the Program Leads for Functional Interviews

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- In my company, they are:
  - Engineering
  - Manufacturing
  - Tooling
  - Quality
  - Test
  - Facilities
  - Management groups are not interviewed—PM, Fiscal, Contracts

Use a Checklist for Consistency and a Data Record

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BASELINE PROPOSAL NUMBER _____
NAME OF PROPOSAL _____

1) WHAT GROUP DO YOU REPRESENT:

❒ ENGR ❒ MFG ❒ TOOLING ❒ QUALITY ❒ TEST ❒ FACILITIES

2) NAME: _____
3) DATE: _____
4) WHAT TASK ARE YOU RESPONSIBLE FOR? _____
_____
_____
5) HAS YOUR TEAM DONE THIS BEFORE? _____
6) HAS AEROJET DONE THIS BEFORE? _____

POSSIBLE RISK CATEGORIES: (AREAS TO THINK ABOUT WHEN CONSIDERING RISK)

Customer Requirements	Known + Fixed	⟷	Not Specified/Will change
Technical Maturity	Nothing New	⟷	Beyond State of Art
Complexity of Effort	Simple	⟷	Highly Complex w/Uncertainties
Risk Issue Interaction	Independent	⟷	Dependant on 3 or More Activities
Process Control	Documented Control	⟷	No Control Known
Demonstrated MFG Precision	Known + High	⟷	Unknown
Demonstrated Ability to Meet Reliability	EST	⟷	Not Feasible
Producibility	Established	⟷	Not Optimized
Resource Availability	Available	⟷	Some Not Available
Sub/Vendor Dependability	On Time + Budget	⟷	Last and Over Budget History
How Critical to Mission	Non-Essential	⟷	Show Stopper
Schedule	Previous Demo	⟷	Unknown
Cost Estimate	Historical Support	⟷	Unsubstantiated

7) RISKS: _____
_____
_____
_____
_____
_____
_____
_____

Interview and Gather Data

POSSIBLE OPPORTUNITIES: WHAT RISK MITIGATION ACTIVITIES ARE ALREADY INCLUDED IN THE ESTIMATE?

1) ARE THERE ANY CIRCUMSTANCES WHERE COST ELEMENTS COULD BE REMOVED? _____

2) IF YOU ATTEMPTED DOING THIS EFFORT 20 TIMES, WHAT IS THE LEAST IT WOULD COST?

3) IF SUCCESS WERE IMMEDIATE WHAT PORTION OF THE PROGRAM COULD BE AVOIDED?

4) IF ALL WORKAROUND (PARALLEL PATHS) WERE REMOVED, HOW MUCH COULD BE SAVED?

5) FOR EACH OF THE RISKS + OPPORTUNITIES ESTABLISH A MOST PROBABLE COST:

6) LOWEST: ❒

7) HIGHEST: ❒

8) EXPLORE AND RECORD THE CHANCE OF THE EVENT HAPPENING. 0 – 100% ❒

Run Statistical Model

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Method:

1. Create spreadsheet with "Risktriang(xx,xx,xx)"command as the final cell
2. Activate Risk module (click on @Risk)
3. Select sum of "Risk Triang"cells as the target cell (Add Output)
4. Change simulation settings to 10,000 (Sim Settings)
5. Start simulation
6. Graph Histogram (Graph, Curve)
7. Graph "S" curve (Graph, Cum Ascending)

Create a Spreadsheet

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	Contributor	lo cost	nom cost	high cost	probability	min	nom	max	monte carlo value
Proposal xyz baseline	Jackson	70200000	78000000	85800000	1	70200000	78000000	85800000	#NAME?
Labor Risks:									
Drawing format requires new drawing package	Williams	1000000	3000000	5000000	0.2	200000	600000	1000000	#NAME?
Propellant ingredient obsolete-requires prop requal	Smith	1000000	2000000	2500000	0.3	300000	600000	750000	#NAME?
Change in requirements-higher launch loads	Williams	500000	750000	1000000	0.1	50000	75000	100000	#NAME?
obsolete case material	Jones	250000	500000	1000000	0.5	125000	250000	500000	#NAME?
Labor Opportunities:									
no retraining required	Baldwin	-1000000	-500000	-250000	0.5	-500000	-250000	-125000	#NAME?
tools are found usable	Baldwin	-200000	-250000	-250000	0.9	-250000	-225000	-225000	#NAME?
first 3 tests show nominal performance	Williams	-150000	-100000	-75000	0.25	-37500	-25000	-18750	#NAME?
larger batches used-	Jackson	-2000000	-1750000	-1500000	0.7	-1400000	-1225000	-1050000	#NAME?
New Digital x-Ray works	Varney	-3000000	-2000000	-1500000	0.8	-2400000	-1600000	-1200000	#NAME?
Material Risks:									
New drawings and specs	Naly	1000000	3000000	5000000	0.2	200000	600000	1000000	#NAME?
propellant requal	Smith	1000000	2000000	2500000	0.3	300000	600000	750000	#NAME?
case mod due to launch loads	Williams	500000	750000	1000000	0.1	50000	75000	100000	#NAME?
supplier tooling not available	Naly	250000	500000	1000000	0.4	100000	200000	400000	#NAME?
more tooling required by large batches	Jackson	250000	500000	1000000	0.7	175000	350000	700000	#NAME?
Material Opportunities:									
use 50 previous cases	Jackson	-150000	-100000	-75000	0.3	-45000	-30000	-22500	#NAME?
save propellant due to larger batches.	Smith	-2000000	-1750000	-1500000	0.7	-1400000	-1225000	-1050000	#NAME?
New digital X-ray works	Varney	-3000000	-2000000	-1500000	0.8	-2400000	-1600000	-1200000	#NAME?
									#NAME?

Spreadsheet With @Risk Activated

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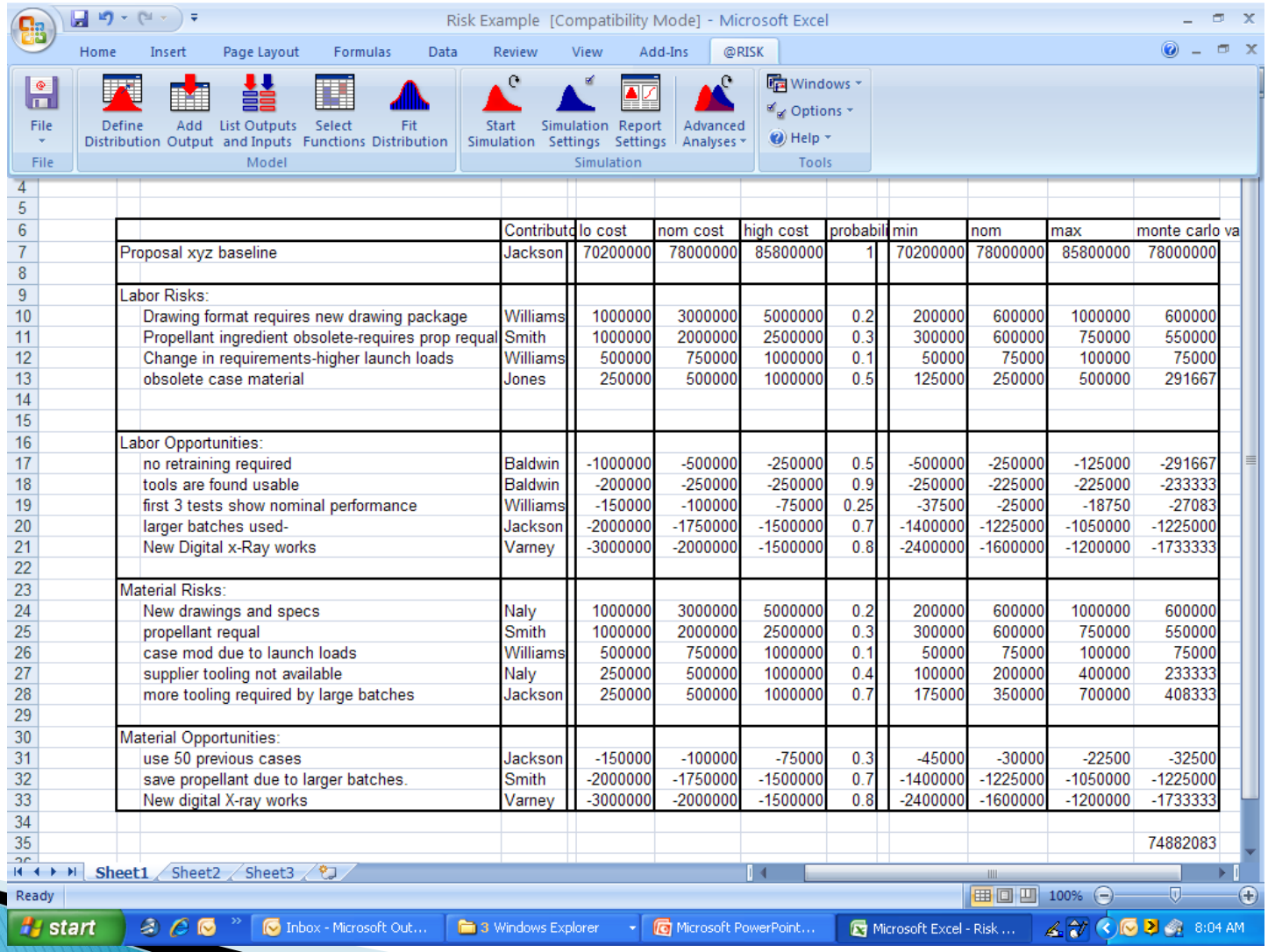

	Contributo	lo cost	nom cost	high cost	probabili	min	nom	max	monte carlo va
Proposal xyz baseline	Jackson	70200000	78000000	85800000	1	70200000	78000000	85800000	78000000
Labor Risks:									
Drawing format requires new drawing package	Williams	1000000	3000000	5000000	0.2	200000	600000	1000000	600000
Propellant ingredient obsolete-requires prop requal	Smith	1000000	2000000	2500000	0.3	300000	600000	750000	550000
Change in requirements-higher launch loads	Williams	500000	750000	1000000	0.1	50000	75000	100000	75000
obsolete case material	Jones	250000	500000	1000000	0.5	125000	250000	500000	291667
Labor Opportunities:									
no retraining required	Baldwin	-1000000	-500000	-250000	0.5	-500000	-250000	-125000	-291667
tools are found usable	Baldwin	-200000	-250000	-250000	0.9	-250000	-225000	-225000	-233333
first 3 tests show nominal performance	Williams	-150000	-100000	-75000	0.25	-37500	-25000	-18750	-27083
larger batches used-	Jackson	-2000000	-1750000	-1500000	0.7	-1400000	-1225000	-1050000	-1225000
New Digital x-Ray works	Varney	-3000000	-2000000	-1500000	0.8	-2400000	-1600000	-1200000	-1733333
Material Risks:									
New drawings and specs	Naly	1000000	3000000	5000000	0.2	200000	600000	1000000	600000
propellant requal	Smith	1000000	2000000	2500000	0.3	300000	600000	750000	550000
case mod due to launch loads	Williams	500000	750000	1000000	0.1	50000	75000	100000	75000
supplier tooling not available	Naly	250000	500000	1000000	0.4	100000	200000	400000	233333
more tooling required by large batches	Jackson	250000	500000	1000000	0.7	175000	350000	700000	408333
Material Opportunities:									
use 50 previous cases	Jackson	-150000	-100000	-75000	0.3	-45000	-30000	-22500	-32500
save propellant due to larger batches.	Smith	-2000000	-1750000	-1500000	0.7	-1400000	-1225000	-1050000	-1225000
New digital X-ray works	Varney	-3000000	-2000000	-1500000	0.8	-2400000	-1600000	-1200000	-1733333
									74882083

Run Model and Get Histogram

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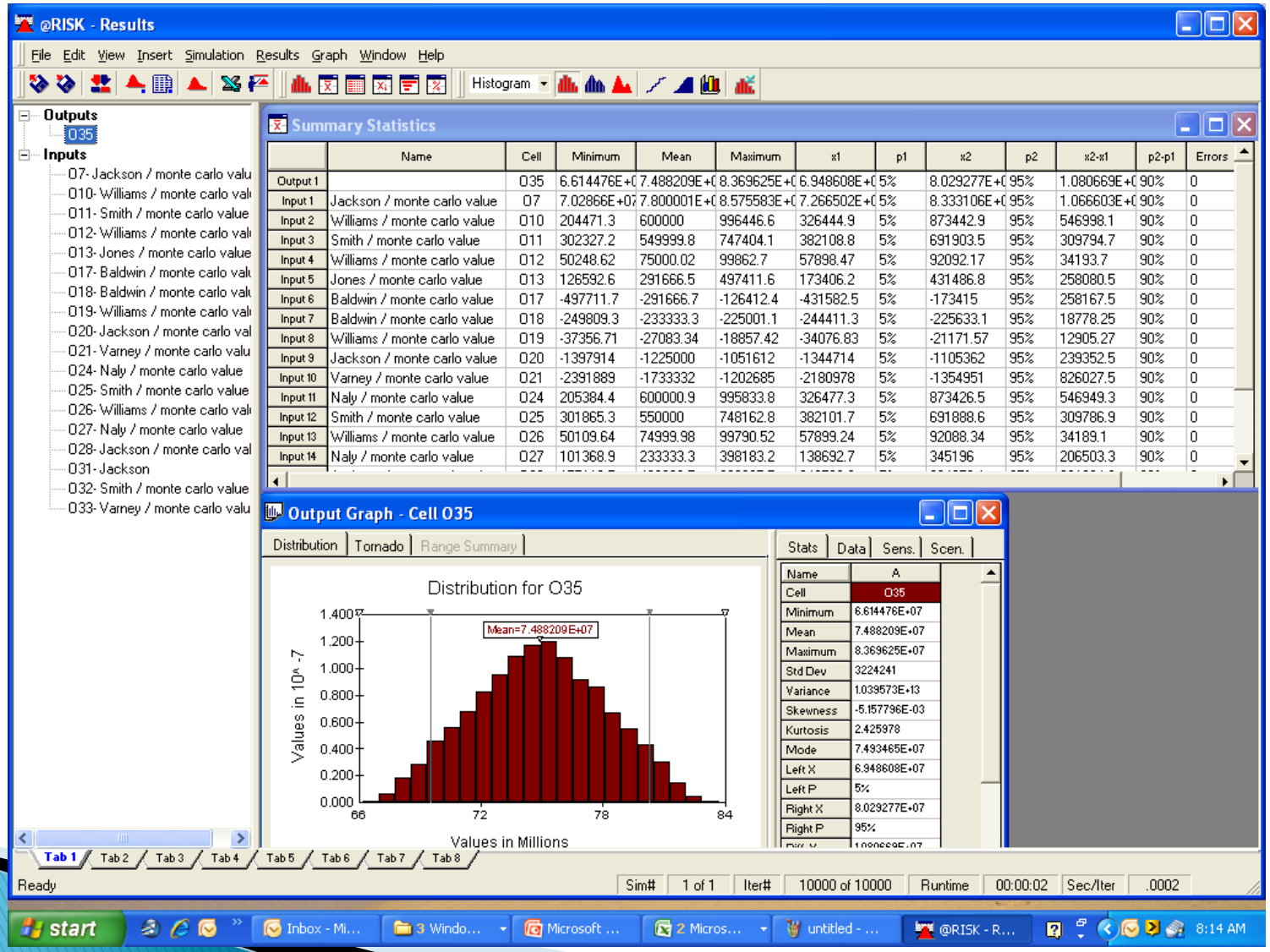

Plot “S” Curve

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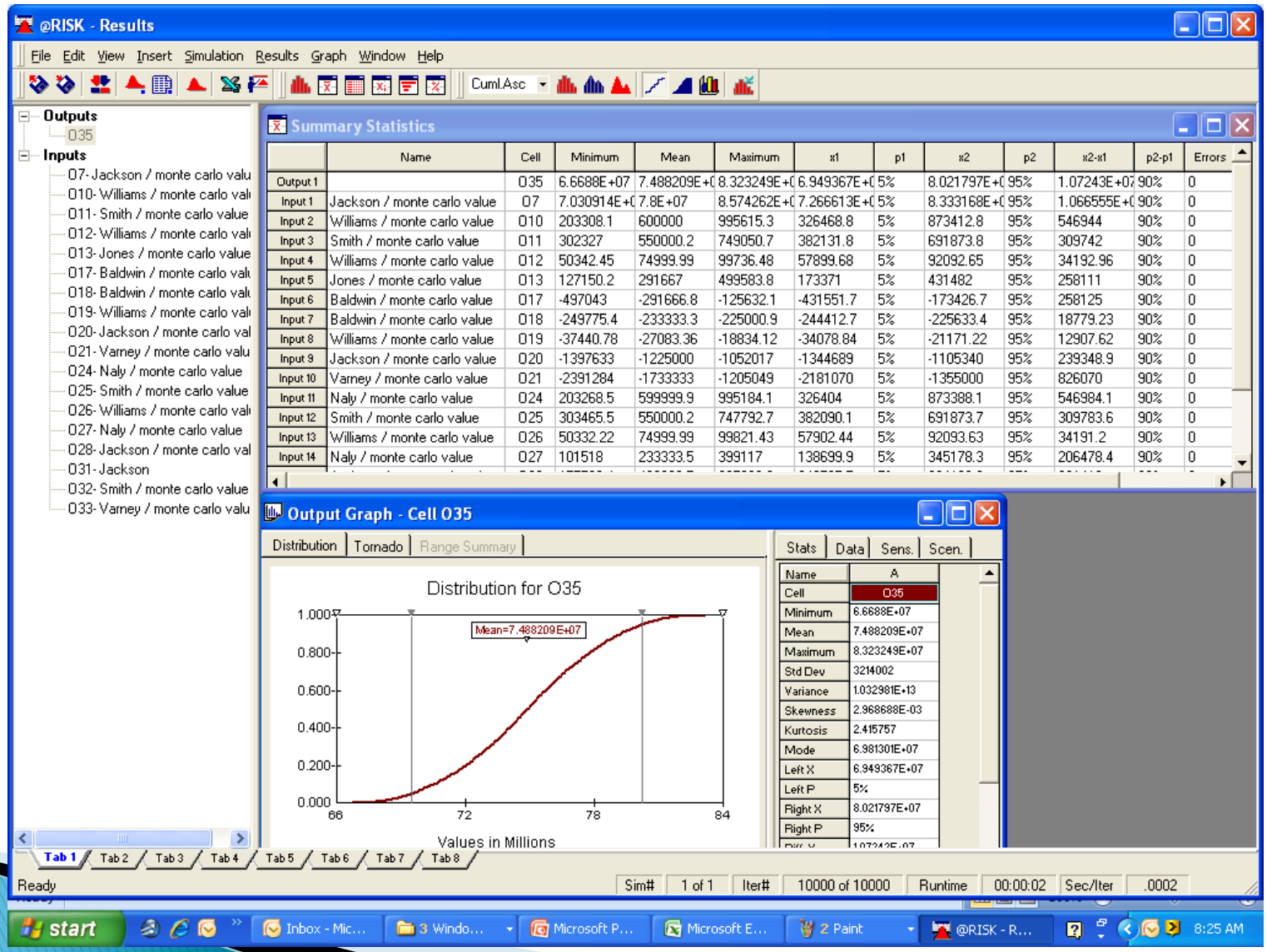

	Name	Cell	Minimum	Mean	Maximum	x1	p1	x2	p2	x2-x1	p2-p1	Errors
Output 1		O35	6.6688E+07	7.488209E+0	8.323249E+0	6.949367E+0	5%	8.021797E+0	95%	1.07243E+07	90%	0
Input 1	Jackson / monte carlo value	O7	7.030914E+0	7.8E+07	8.574262E+0	7.266613E+0	5%	8.333168E+0	95%	1.066555E+0	90%	0
Input 2	Williams / monte carlo value	O10	203308.1	600000	995615.3	326468.8	5%	873412.8	95%	546944	90%	0
Input 3	Smith / monte carlo value	O11	302327	550000.2	749050.7	382131.8	5%	691873.8	95%	309742	90%	0
Input 4	Williams / monte carlo value	O12	50342.45	74999.99	99736.48	57899.68	5%	92092.65	95%	34192.96	90%	0
Input 5	Jones / monte carlo value	O13	127150.2	291667	499583.8	173371	5%	431482	95%	258111	90%	0
Input 6	Baldwin / monte carlo value	O17	-497043	-291666.8	-125632.1	-431551.7	5%	-173426.7	95%	258125	90%	0
Input 7	Baldwin / monte carlo value	O18	-249775.4	-233333.3	-225000.9	-244412.7	5%	-225633.4	95%	18779.23	90%	0
Input 8	Williams / monte carlo value	O19	-37440.78	-27083.36	-18834.12	-34078.84	5%	-21171.22	95%	12907.62	90%	0
Input 9	Jackson / monte carlo value	O20	-1397633	-1225000	-1052017	-1344689	5%	-1105340	95%	239348.9	90%	0
Input 10	Varney / monte carlo value	O21	-2391284	-1733333	-1205049	-2181070	5%	-1355000	95%	826070	90%	0
Input 11	Naly / monte carlo value	O24	203268.5	599999.9	995184.1	326404	5%	873388.1	95%	546984.1	90%	0
Input 12	Smith / monte carlo value	O25	303465.5	550000.2	747792.7	382090.1	5%	691873.7	95%	309783.6	90%	0
Input 13	Williams / monte carlo value	O26	50332.22	74999.99	99821.43	57902.44	5%	92093.63	95%	34191.2	90%	0
Input 14	Naly / monte carlo value	O27	101518	233333.5	399117	138699.9	5%	345178.3	95%	206478.4	90%	0

Name	A
Cell	O35
Minimum	6.6688E+07
Mean	7.488209E+07
Maximum	8.323249E+07
Std Dev	3214002
Variance	1.032981E+13
Skewness	2.968688E-03
Kurtosis	2.415757
Mode	6.981301E+07
Left X	6.949367E+07
Left P	5%
Right X	8.021797E+07
Right P	95%

Data Uses

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- Software has hundreds of data presentation options
- Histogram—shows program balance
- “S” curve—usually used for pricing discussions
- Spreadsheet—can act as the basis of risk mitigation and operation plans
- Follow-up to be effective, it must be updated periodically and risk mitigations must be brainstormed with all stakeholders

Conclusion

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- The use of statistical software to calculate program cost risk is useful for getting stakeholder acceptance of the program plan. And, can act as the basis for designing and controlling the detail operation plan to ensure successful completion.