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Creating a Cost Driver S-Curve

ICEAA 2019 Professional Development & Training Workshop

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Agenda

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- What is a Cost Driver S-curve
- Why make one?
- Example: From Government perspective
- Example: From Contractor perspective
- Wrap-up

What is a Cost Driver S-Curve

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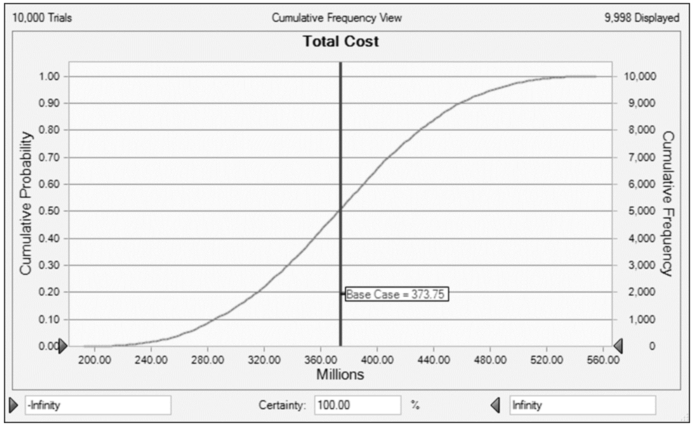
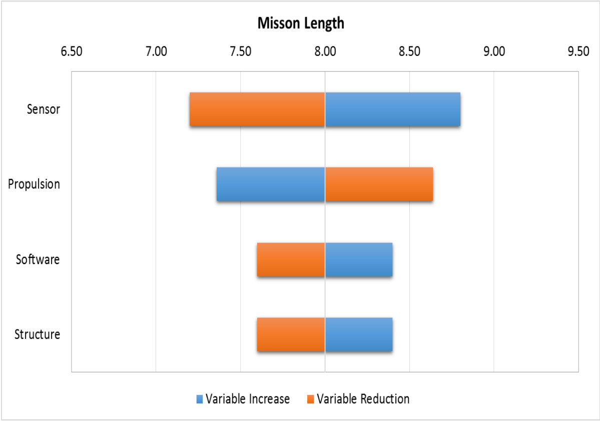
- Uses Monte Carlo similar to standard Risk S-curve
- Is not probabilistic
  - Uses Inputs and not Outcomes (results from probabilistic events)
- Uses a Uniform distribution from the min to the max
  - Inputs are choices; not subject to a distribution
- Shows range of possible Costs or Price by varying Input decisions
  - Can move up or down the curve by varying choice of inputs
- Design to Cost (DTC) possibilities

Why make one?

- Communicating choices to executives is challenging
- A solution is to use graphical depictions of choice
- Many executives understand S-curves





Steps to Create Cost Driver S-Curve

- Develop a cost model with parameters that drive variations
  - Inflation rate
  - CERs
  - Labor rates
  - Scaling factors
  - Technical parameters
- Using a Monte Carlo (MC) tool put uniform distributions on:
  - Driving parameters
  - Key elements of cost
- Run the MC tool to get S-curve and cost drivers

Example: From Government perspective

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- The US Department of Defense (DoD) wants to procure a Hypersonic Widget
- DoD cost estimators have developed an initial baseline model on 4 key drivers:

WBS	Cost Element	Unit Cost ($M)	Cost per 1% Performance Increase ($M)
1.0	Propulsion	100	6
2.0	Structure	50	2
3.0	Sensor	75	1.5
4.0	Software	100	7
5.0	SEPM (15% of WBS 1.0-4.0)	48.8	
	Total Cost	373.8	

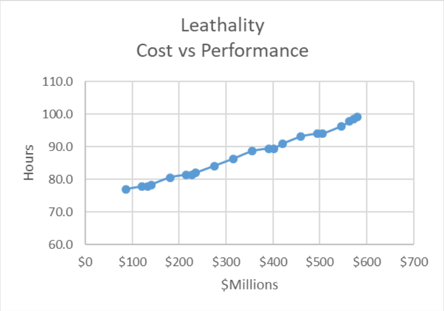
Example: From Government perspective

Key Performance Characteristics

- Mission Length – 8 hours
  - Increases with additional Structure, Sensor, and Software
  - Decreases with additional Propulsion

- Availability – 90%
  - Increases with additional Structure and Software

- Lethality – 90%
  - Increases with additional Propulsion, Sensor, and Software



- **Questions for Decision Makers:**
  - **What are the cost tradeoffs for increasing or decreasing performance?**
  - **Where should DoD set the Requirements for the Hypersonic Widget?**

Example: From Government perspective

Develop Performance Cost Model

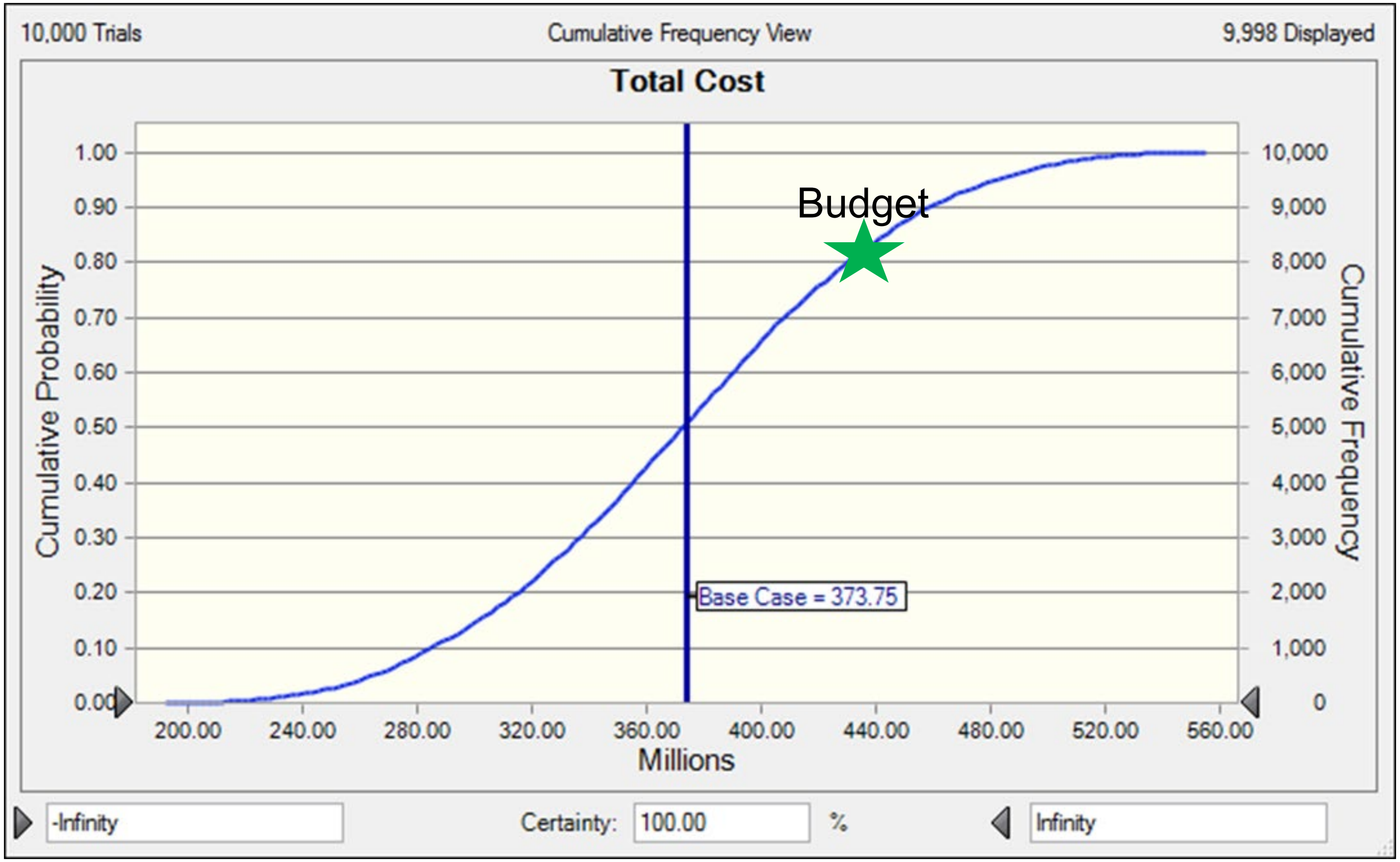
WBS	Cost Driver Elements	Unit Cost ($M)	Cost per 1% Performance Increase ($M)	Baseline	Min	Max
1.0	Propulsion	100	6	0%	-10.0%	10.0%
2.0	Structure	50	2	0%	-10.0%	10.0%
3.0	Sensor	75	1.5	0%	-10.0%	10.0%
4.0	Software	100	7	0%	-20.0%	20.0%
5.0	SEPM (15% of WBS 1.0-4.0)	48.8				
	Total Cost	373.8				

- Run a MC on the 4 Cost Driver Elements
  - Uniform Distribution between Min and Max
- Each Key Performance Characteristic has an unique formula
  - Formula helps determine the Key Performance Parameters (KPPs) that drive the requirements baseline

The Fun Part of the Job

Example: From Government perspective

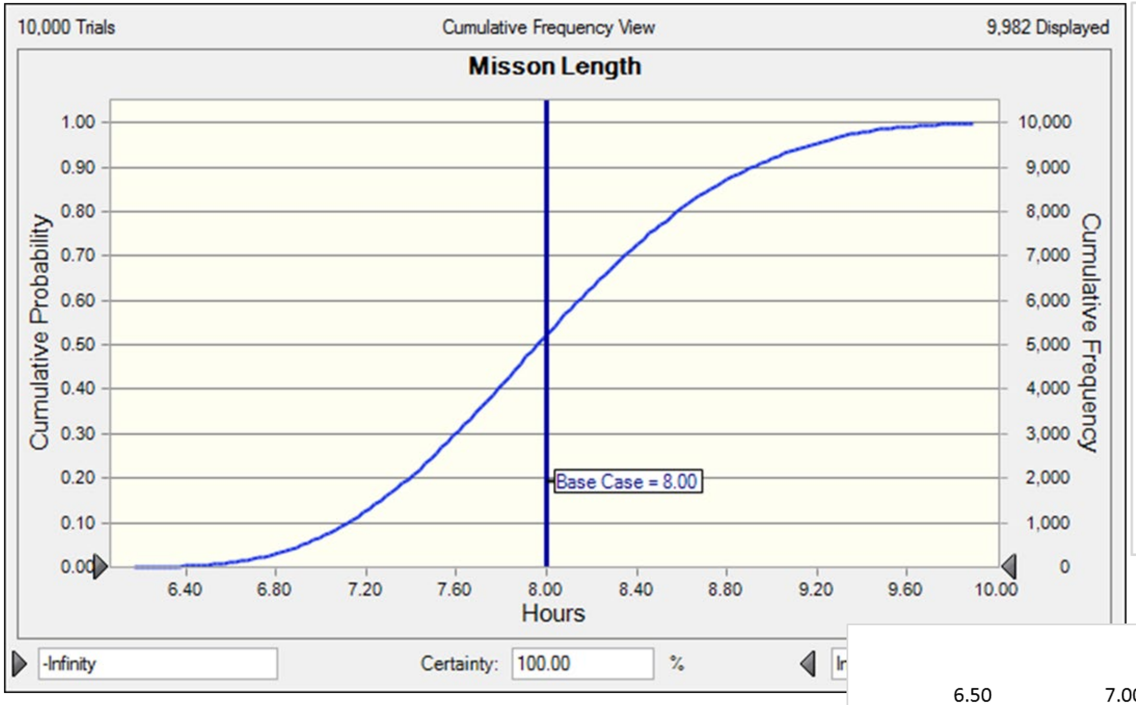
Potential Hypersonic Widget Costs (Design to Cost)

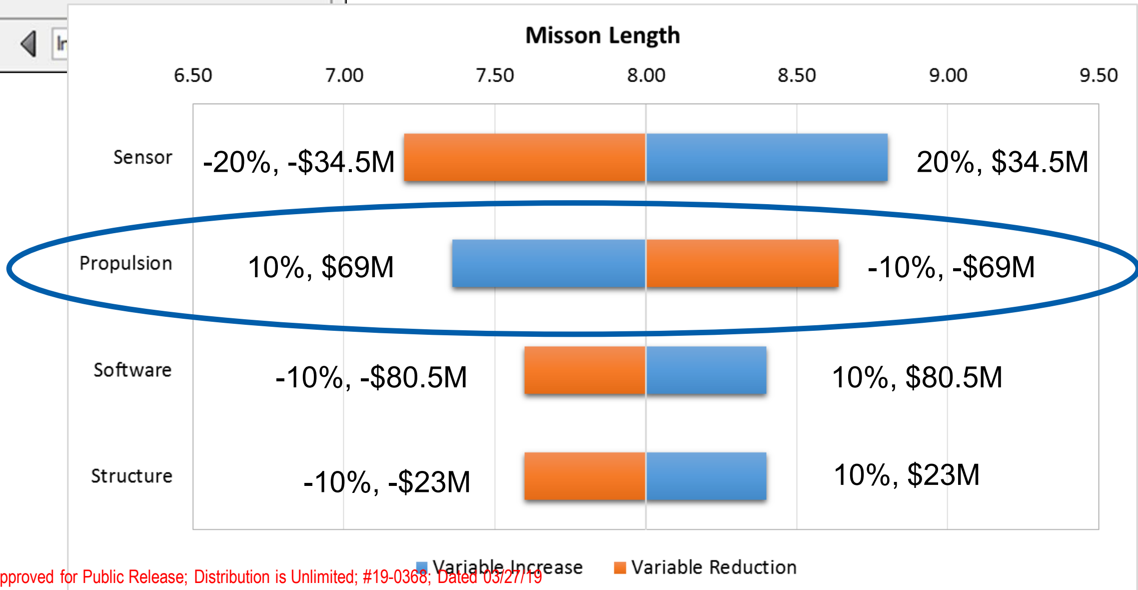


- DoD can spend between $200M and $550 per unit depending upon requirements
- How does it compare to the budget?
- Sets Government expectations for solicitation responses from contractors

Example: From Government perspective

Mission Length Performance and Cost Range





Communicating to Decision Makers

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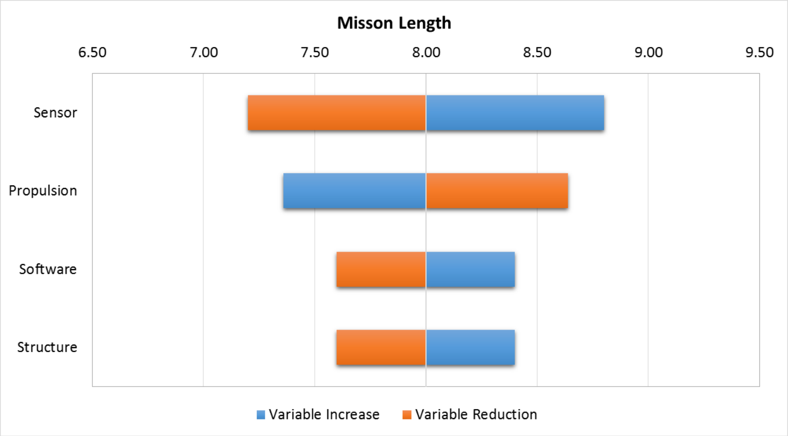
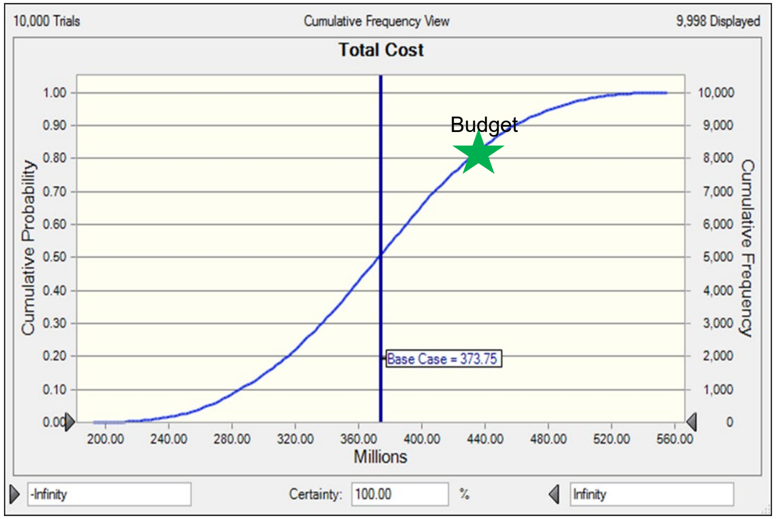
- Graphs on the range of potential costs can help narrow decisions
- Arranging the Key attributes by their sensitivities helps decide the key requirements needed for the system





Example: From Contractor perspective

- DoD has issued a solicitation for a Hypersonic Widget
- Three USA prime contractors are bidding for this work
- One prime contractor has developed the following initial estimate

WBS	Cost Element	Hours	Material ($M)
1.0	Propulsion	500,000	$20.0
2.0	Structure	300,000	$10.0
3.0	Sensor	400,000	$10.0
4.0	Software	550,000	
5.0	SEPM	262,500	
	Total	2,012,500	

Cost Element	Hours	Cost ($M)
SEPM Hours	262,500	$45.9
Technical Hours	1,750,000	
Prime Contactor Hours	1,250,000	$218.8
IWO Hours	200,000	$32.4
SubK Hours	300,000	$45.0
Material Cost		$40.0
Total	2,012,500	$382.1

Example: From Contractor perspective

Key "Knobs" Management

- Management would like to know what can be done to lower costs

Cost Knobs	Baseline Values	Min Value	Max Value	Min % Change	Max % Change
SEPM Hours	15%	12.0%	18.0%	80%	120%
Technical Hours	1,750,000	1,487,500	1,925,000	85%	110%
Prime Labor Rate	$175.00	$148.75	$192.50	85%	110%
IWO Workshare	11%	9.1%	13.7%	80%	120%
SubK Workshare	17%	13.7%	20.6%	80%	120%
SubK Labor Rate	$150.00	$127.50	$165.00	85%	110%
SubK Fee	8%	6.4%	9.6%	80%	120%
Material Cost	$40.0	$38.0	$42.0	95%	105%

Note: An enhanced model could breakdown the Technical Hours into design/performance parameters.

Example: From Contractor perspective

Building a Monte Carlo Model

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- Build a MC model that incorporates the "Knobs"

	Hours	Burdened Rate	Share	Total Cost ($M)
SEPM Hours	262,500	$175.00	15%	$45.9
Technical Hours	1,750,000			
Prime Hours	1,250,000	$175.00	71%	$218.8
IWO Hours	200,000	$162.00	11%	$32.4
Subk Hours	300,000	$150.00	17%	$45.0
Material Cost				$40.0
Total				$382.1

Monte Carlo Parameter (blue)

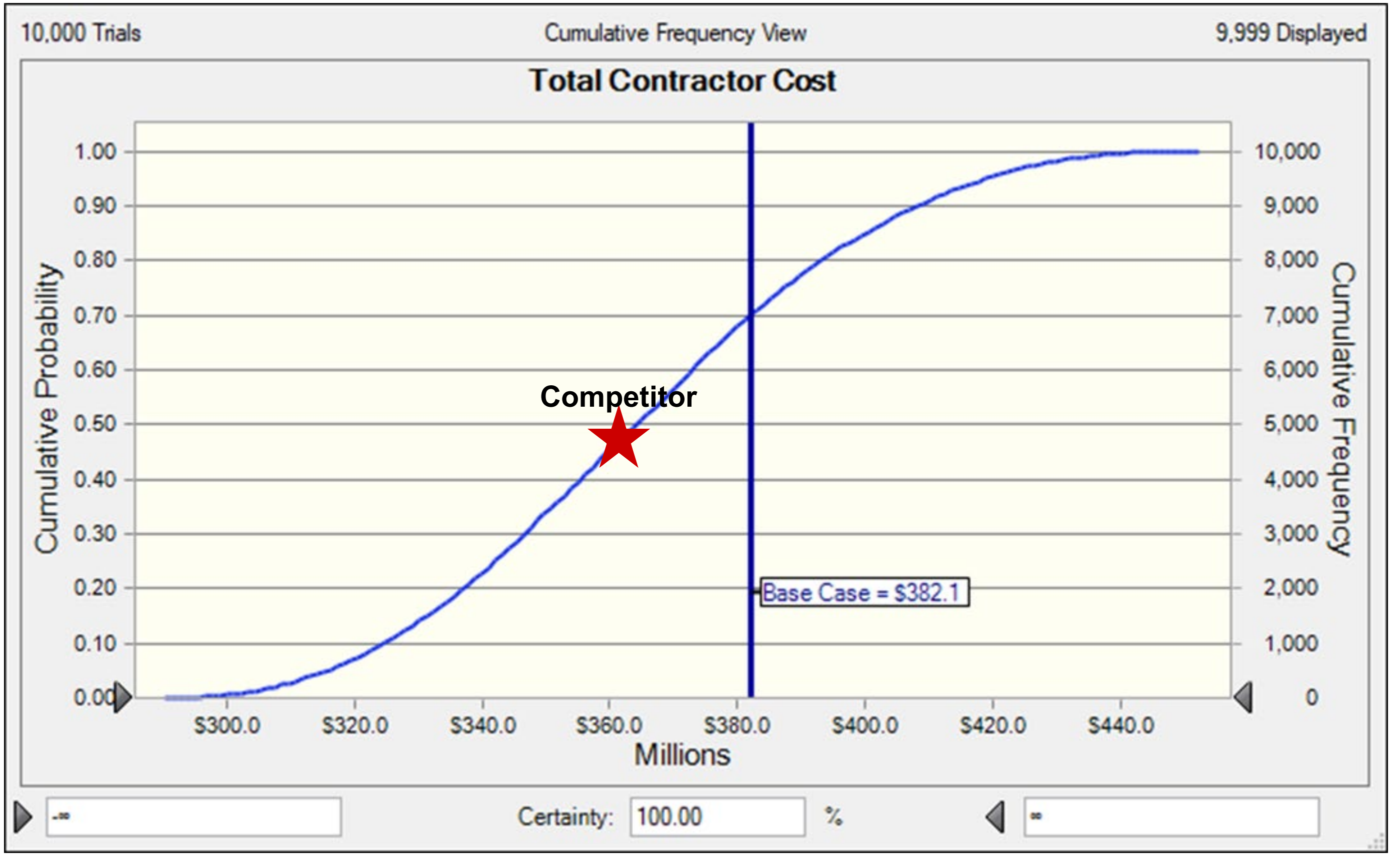
Calculated value (pink)

Cost Knobs	Baseline Values
SEPM Hours	15%
Technical Hours	1,750,000
Prime Labor Rate	$175.00
IWO Workshare	11%
SubK Workshare	17%
SubK Labor Rate	$150.00
SubK Fee	8%
Material Cost	$40.0

More Fun!

Example: From Contractor perspective

The Design to Cost (DTC) S-curve

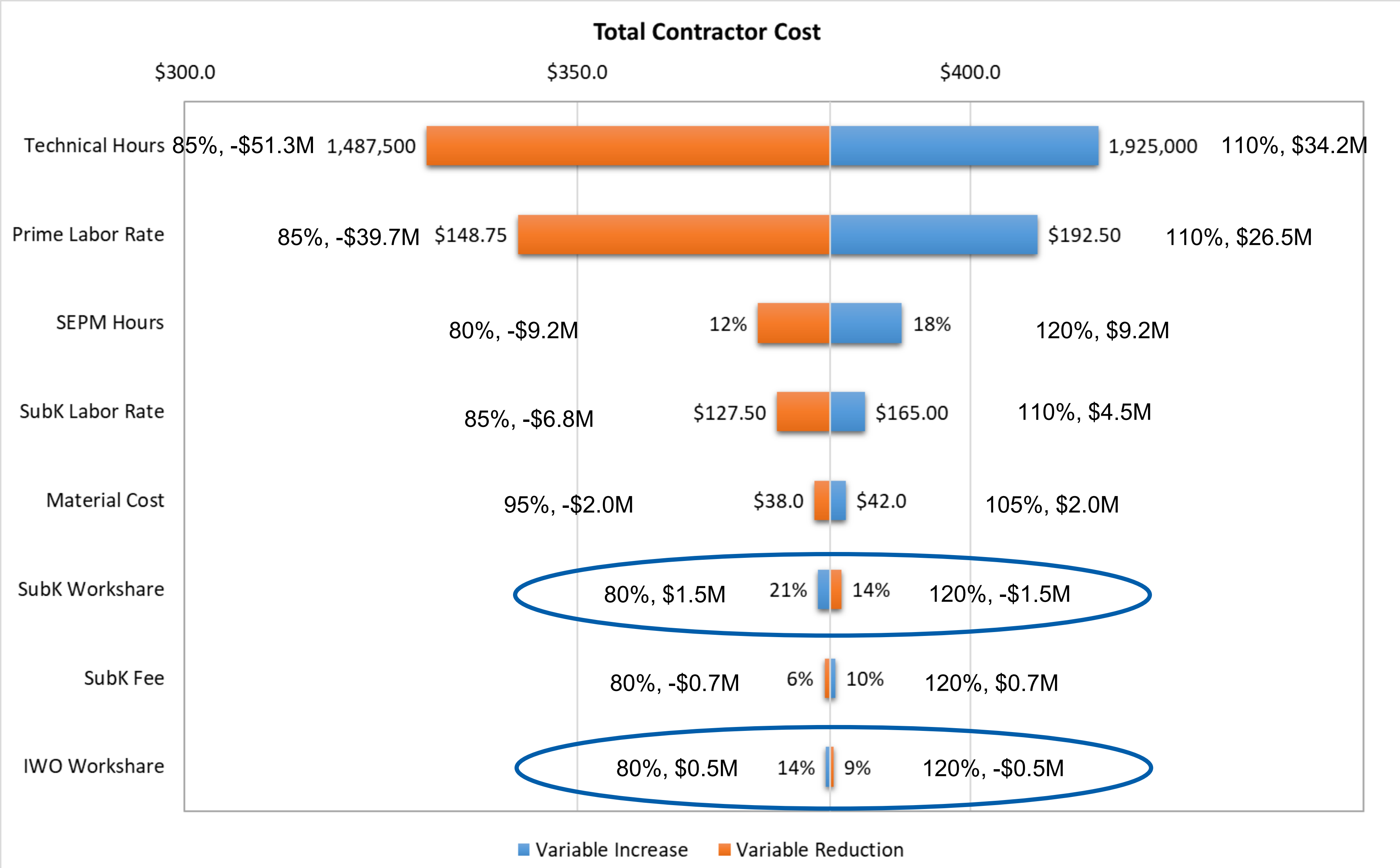


What does the DTC S-curve mean?

Needs Context; comparison to competitor

Example: From Contractor perspective

Cost Driver Sensitivities



Sometimes what is not a driver is surprising

Wrap-up

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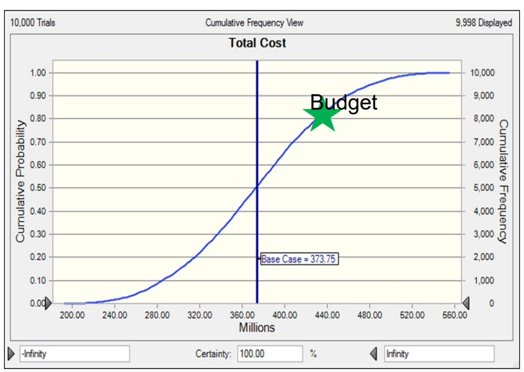
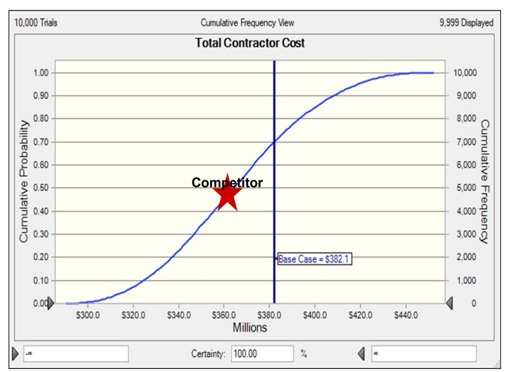
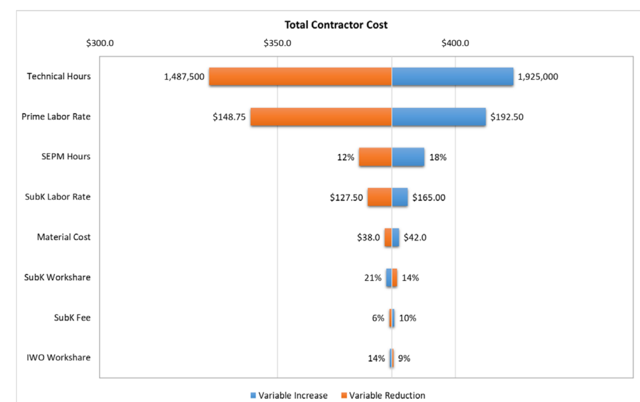
- Design to cost S-curve analysis helps in communicating:
  - Where costs can go
  - What are the key drivers

- This is a tool for both Government and Contractors







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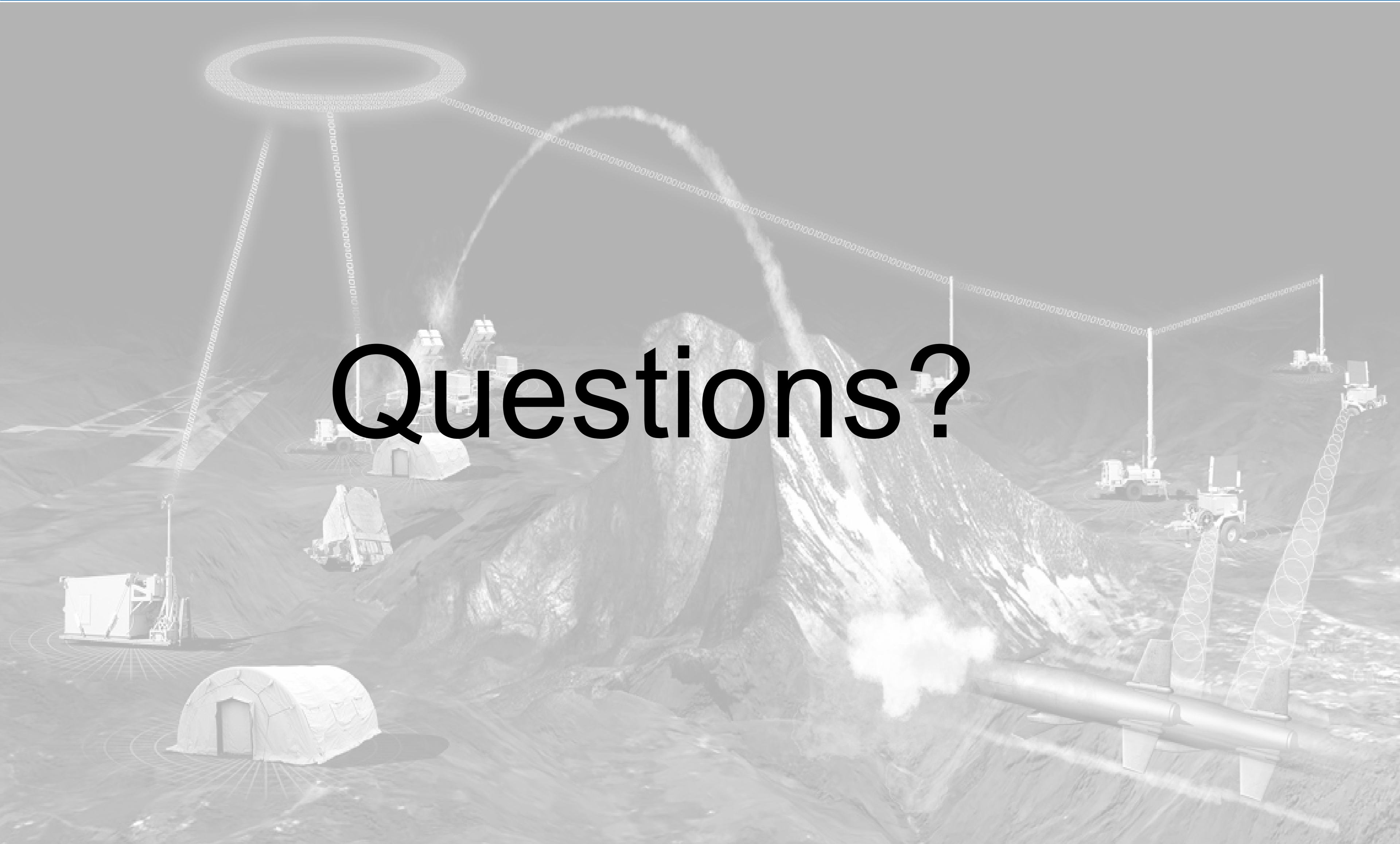

Questions?

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