The Performance Metrics Model and Study (PMMS)

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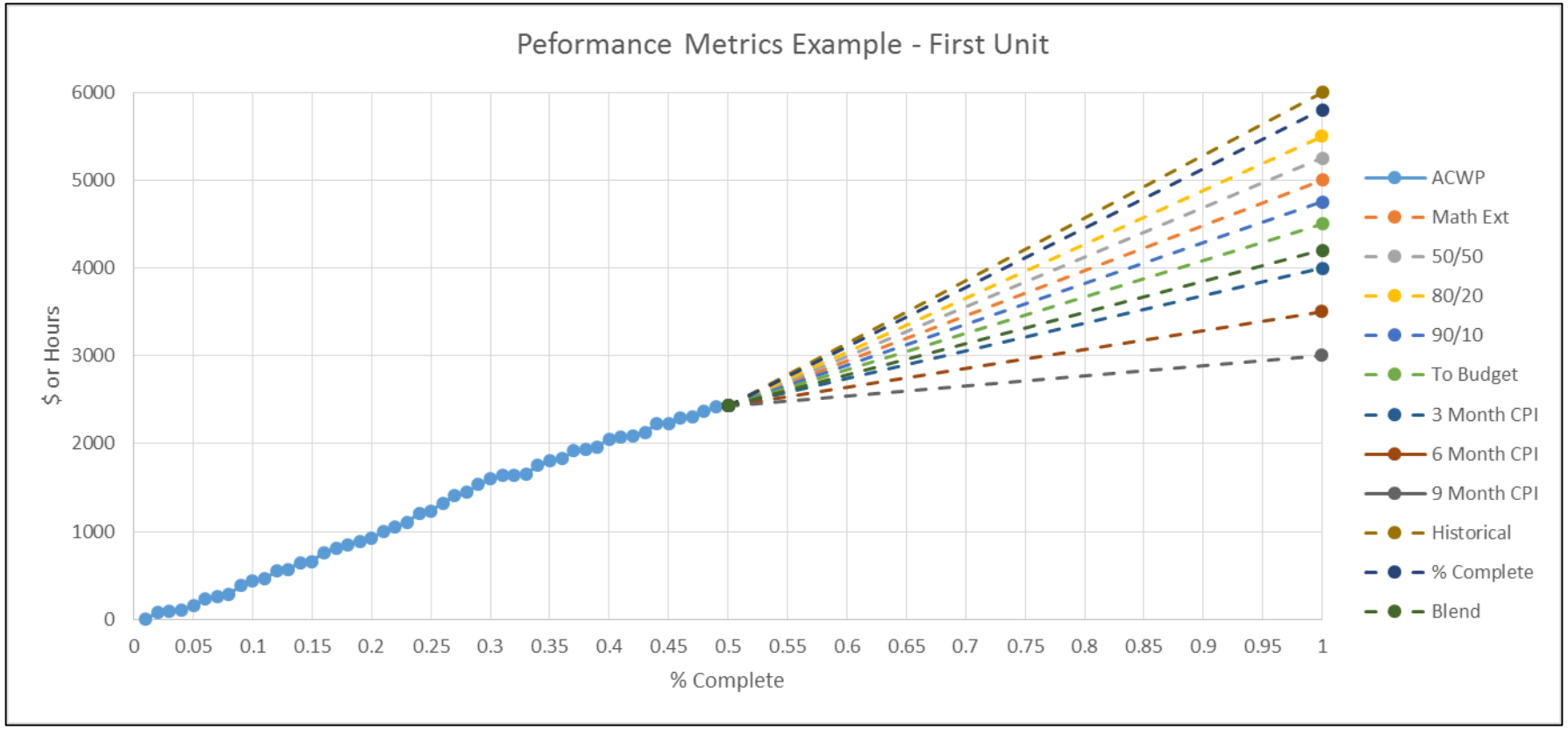
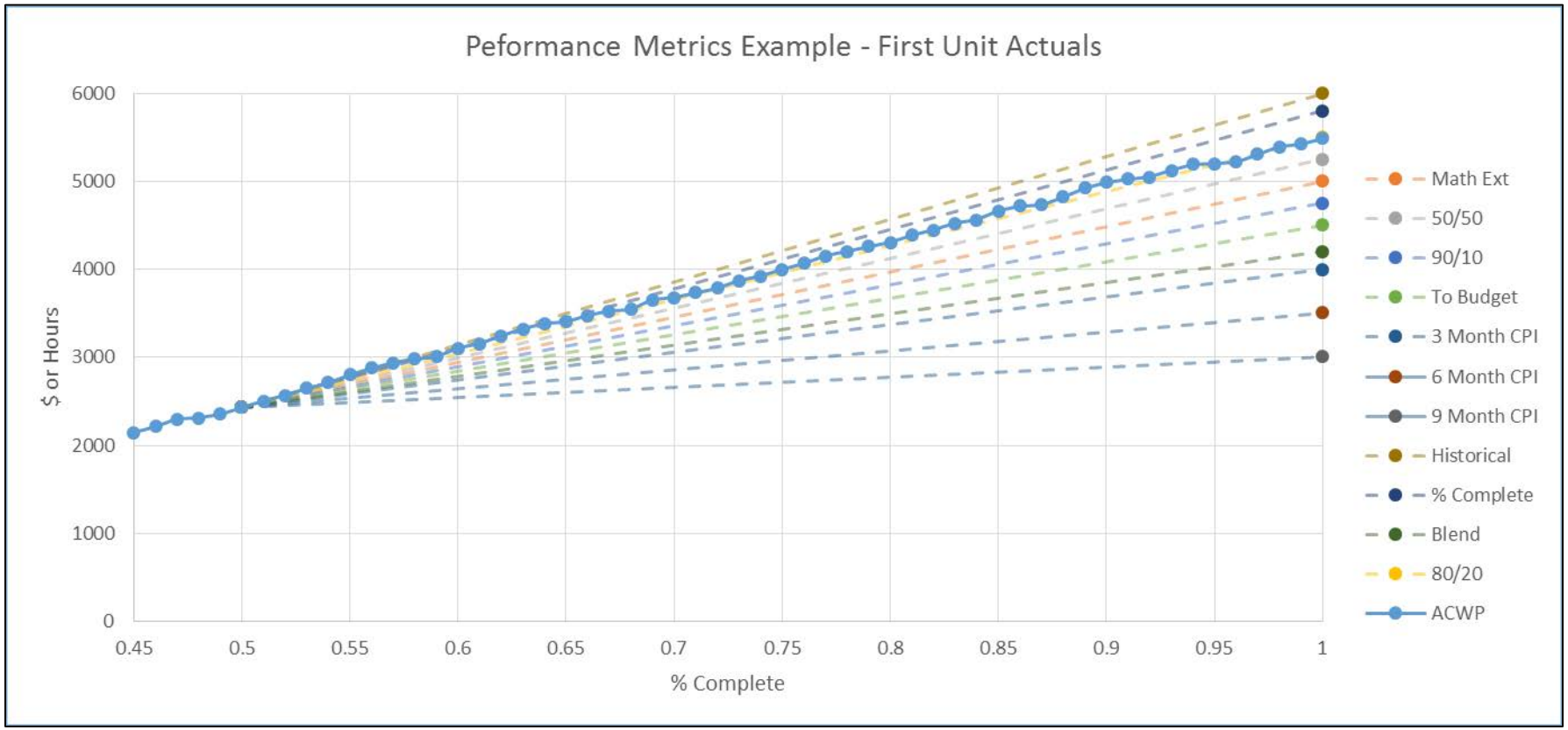
- Visualization of Process
- History
- Ground Rules / Modifications
- PMMS Set Up
- Model Execution
- Case Study
- Future Development / Ideas
- Questions/Comments

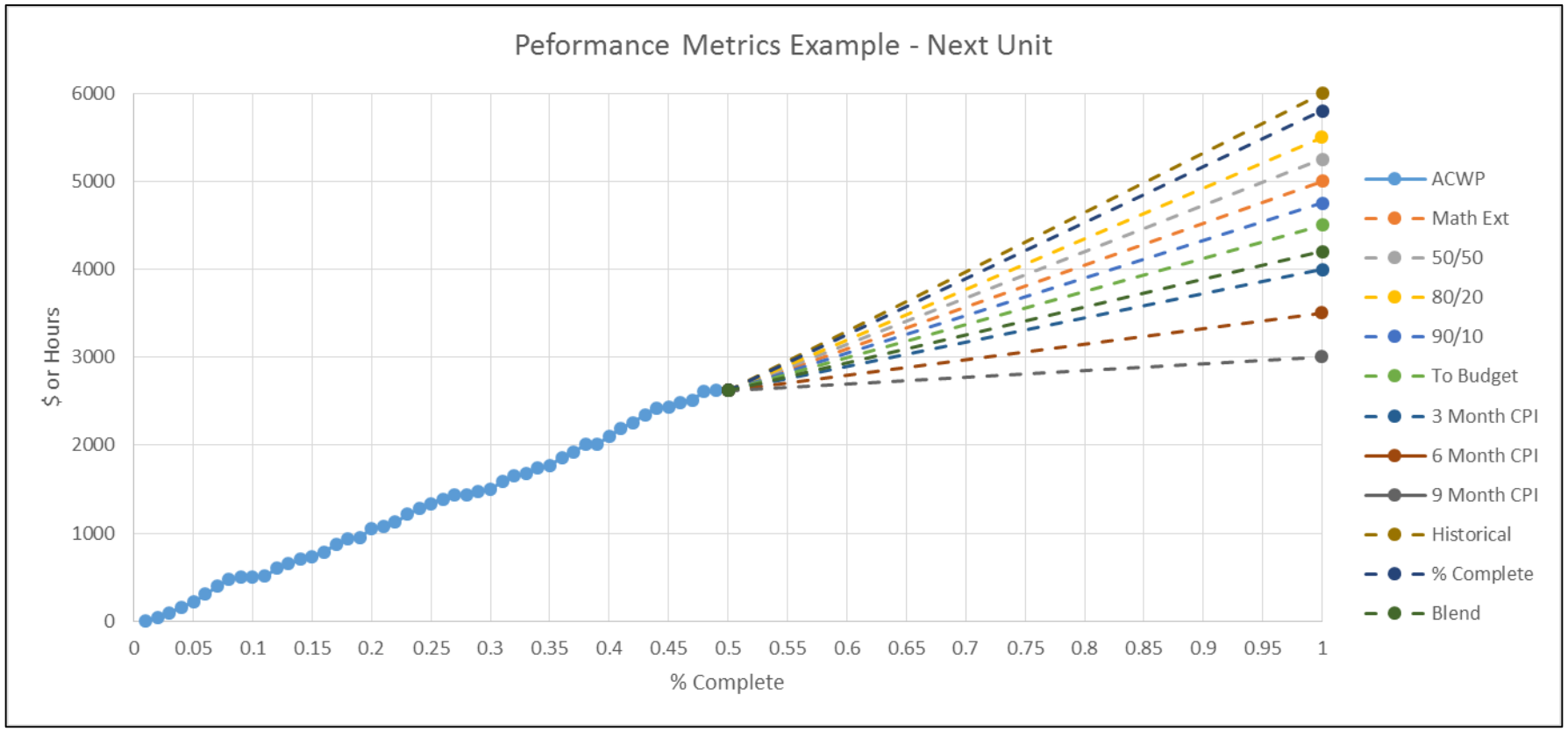


- Assume this is an element of the first unit of a large product with EVM Reporting
- It is at 50% complete, and the actuals are the blue data points.
- There are various performance metrics that can be used for generating an EAC.



- Now, assume the element is completed (at a later time), and these are the actuals
- The dashed lines show the projections that were made at 50% complete

Visualization of Process (Next Unit)



- Now, assume we have a technically similar unit to before.
- Shown here, the element for this new unit is now at 50% complete.
- Can the results of the previous unit (last slide) guide our decision?

- Sample Data:

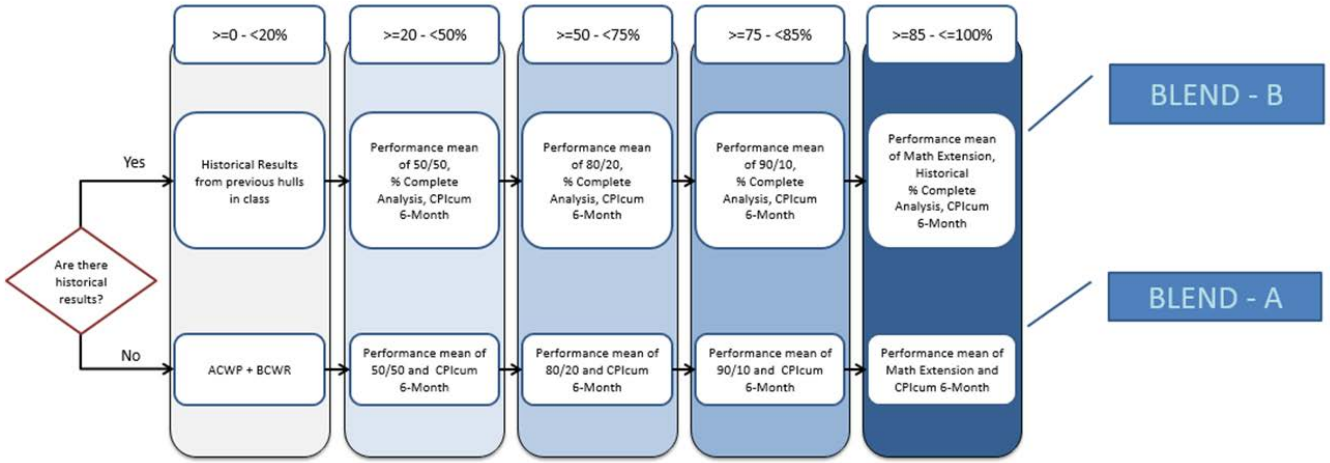
EVM Elements	BCWScum	BCWPcum	ACWPcum	BAC	CPI	SPI	EAC
Element 1	23	21	18	24	1.17	0.91	????
Element 2	20	22	25	35	0.88	1.10	????
Element 3	2	2.1	2.25	3	0.93	1.05	????

- What methodology creates a good EAC?

EVM Elements	Math Ext (CPI)	To Budget (1.0)	50/50 (CPI/SPI)	80/20 (CPI/SPI)	90/10 (CPI/SPI)	3 Month CPI	6 Month CPI	9 Month CPI	Historical	% Complete	Blend
Element 1	20.57	21.00	20.89	20.69	20.63	15.00	20.00	12.00	36.00	45.00	29.00
Element 2	39.77	38.00	38.13	39.07	39.41	26.00	27.00	30.00	10.00	11.00	27.00
Element 3	3.21	3.15	3.16	3.19	3.20	3.00	4.90	3.70	4.90	3.50	2.40

- How does our selection incorporate historical data?

Prior Estimating Methods : Blend Method



- Pros:
  - Uses multiple Performance Metric criteria
  - Incorporates current execution with historical execution to reduce risk
  - Dynamic with respect to % Complete (uses different PMs as a section progresses)
  - Once set up, easy to make changes to % Complete ranges, and PM selections.
- Cons:
  - Relies on analyst knowledge and ‘rules of thumb’
  - All Performance Metric selections weighted equally (difficult to justify different weights)
  - Some Performance Metrics may have unreasonable TCPI values (typically 3/6/9 mo. CPI)
  - Moving from one boundary to another can cause large TCPI changes (ex. 49% → 50%)

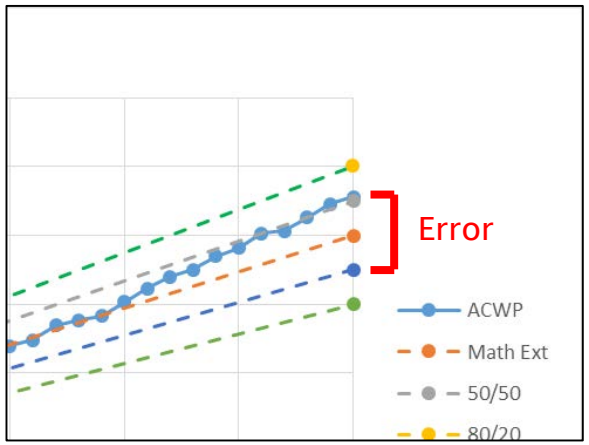
Prior Estimating Methods : Median Method

EVM Elements	Math Ext (CPI)	To Budget (1.0)	50/50 (CPI/SPI)	80/20 (CPI/SPI)	90/10 (CPI/SPI)	3 Month CPI	6 Month CPI	9 Month CPI	Historical	% Complete	Blend	Median
Element 1	20.57	21.00	20.89	20.69	20.63	15.00	20.00	12.00	36.00	45.00	29.00	20.69
Element 2	39.77	38.00	38.13	39.07	39.41	26.00	27.00	30.00	10.00	11.00	27.00	30.00
Element 3	3.21	3.15	3.16	3.19	3.20	3.00	4.90	3.70	4.90	3.50	2.40	3.20

- Pros:
  - Uses as many Performance Metrics as computed in a model
  - Eliminates unreasonable TCPI values if outliers
  - Incredibly easy to implement, and easy to explain to decision makers
- Cons:
  - Selects *very* moderate answers
  - Doesn't account historical data (individual Performance Metrics may have historical context)
  - Changes/alterations to this method difficult to justify, addition/removal of performance metrics can change the answer

- 1. Group data into bins of 5% complete (0-5%, 5-10%, etc.)
  - Modification: If data is more clustered or sparse, adjust as necessary.
- 2. Assume an EVM element (WBS mapping, Major Milestone) is "done" at 95% + complete.
  - Modification: If large ACWP changes occur between 95% and 100%, consider raising the threshold. The threshold should be when ACWPcum has 'leveled off'.
- 3. The "Best" Performance Metric is the one with the least average %error (Prediction – ACWPfinal), averaged over historical deliveries.
  - Example: An element has 2 observations in one bin (42%, 44%), the error for each Performance Metric is the average error of both observations.
  - Furthermore, if there are 3 previous units delivered, then the "best" Performance Metric for each bin is the one with the lowest average error.

- Need: Historical EVM Data (cumulative values are easier)
  - BCWP, BCWS, ACWP, BAC
- Determine: TCPI for every methodology for every historical point.
  - Math Ext for Jan 2011, Feb 2011 …
  - 50/50 for Jan 2011, Feb 2011, …
- Determine: EAC estimates using TCPI values.
  - Traditional EVM Gold Card Method: $ACWP_{cum} + [BAC - BCWP_{cum}]/TCPI$
- For elements > 95% Complete: For each Performance Metric, determine error
  - $Error = EAC – ACWP_{Final}$
- Determine Percent Error (for comparisons)
  - $Percent\ Error = Error/ACWP_{Final}$



- Set up 5% Complete Bins
- Determine: Average error for each method for each bin
  - Error (0-5%, 50/50) = Average Error for all observations between 0% and 5% complete using the 50/50 (CPI/SPI) method
- Determine: Performance Metric with minimum error in each bin
  - Error (0-5%) = Performance Metric that has the Minimum Average Error

		Method								
		Math Ext (CPI)	To Budget (1.0)	50/50 (CPI/SPI)	80/20 (CPI/SPI)	90/10 (CPI/SPI)	CPI*SPI	3 Month CPI	6 Month CPI	Best Method
Low Range	High Range	1	2	3	4	5	6	7	8	
>0	<=0.05									
>0.05	<=0.1	86%	**6%**	15%	84%	69%	6%	72%	21%	**2**
>0.1	<=0.15	73%	48%	88%	97%	92%	40%	**2%**	79%	**7**
>0.15	<=0.2	82%	70%	21%	74%	89%	55%	**21%**	65%	**7**
>0.2	<=0.25	**2%**	59%	79%	95%	19%	20%	90%	83%	**1**
>0.25	<=0.3									
>0.3	<=0.35	35%	70%	44%	63%	83%	41%	**9%**	53%	**7**
>0.35	<=0.4									
>0.4	<=0.45	18%	75%	96%	35%	20%	**14%**	65%	92%	**6**
>0.45	<=0.5									
>0.5	<=0.55	**2%**	28%	25%	13%	10%	24%	45%	92%	**1**
>0.55	<=0.6									
>0.6	<=0.65									
>0.65	<=0.7	41%	67%	7%	**3%**	44%	52%	26%	22%	**4**
>0.7	<=0.75									
>0.75	<=0.8	61%	93%	81%	97%	65%	**34%**	90%	87%	**6**
>0.8	<=0.85	70%	93%	55%	57%	58%	**16%**	88%	77%	**6**
>0.85	<=0.9									
>0.9	<=0.95	**31%**	31%	99%	95%	90%	40%	32%	71%	**1**
>0.95	<1	95%	22%	80%	92%	**19%**	52%	70%	47%	**5**

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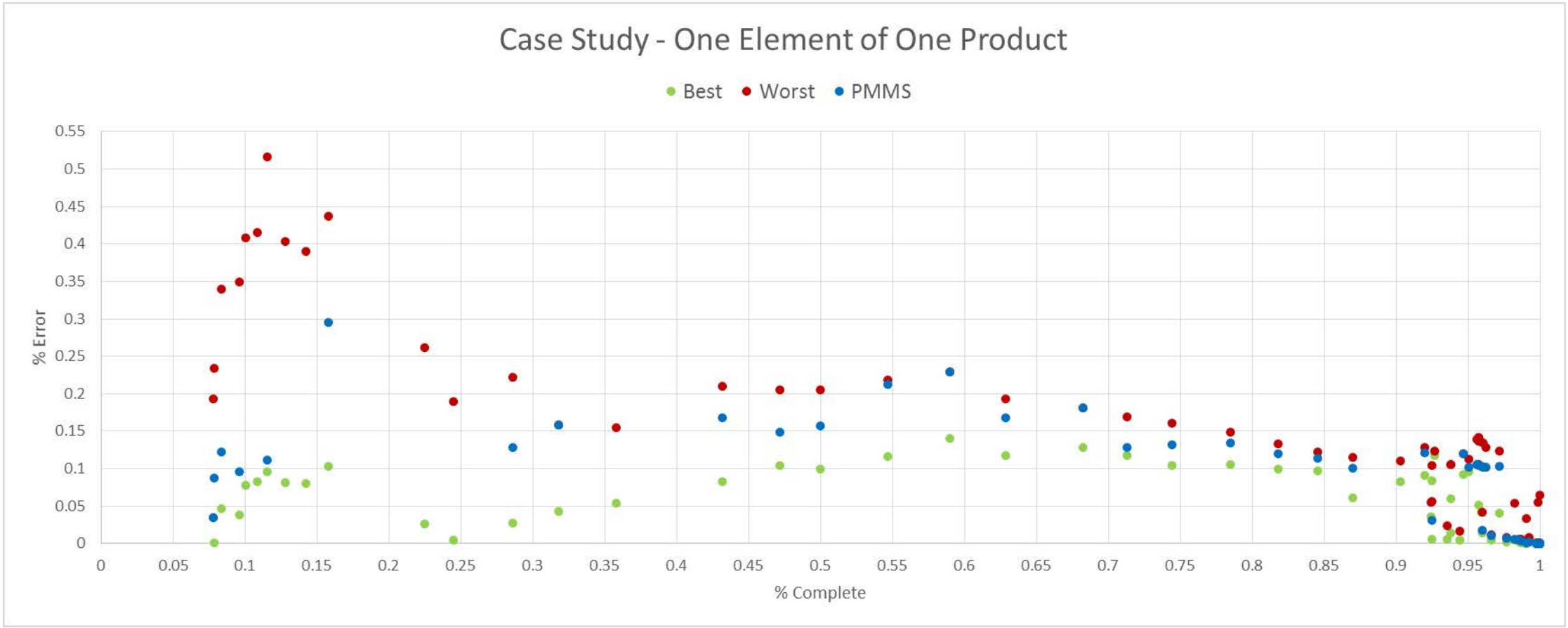
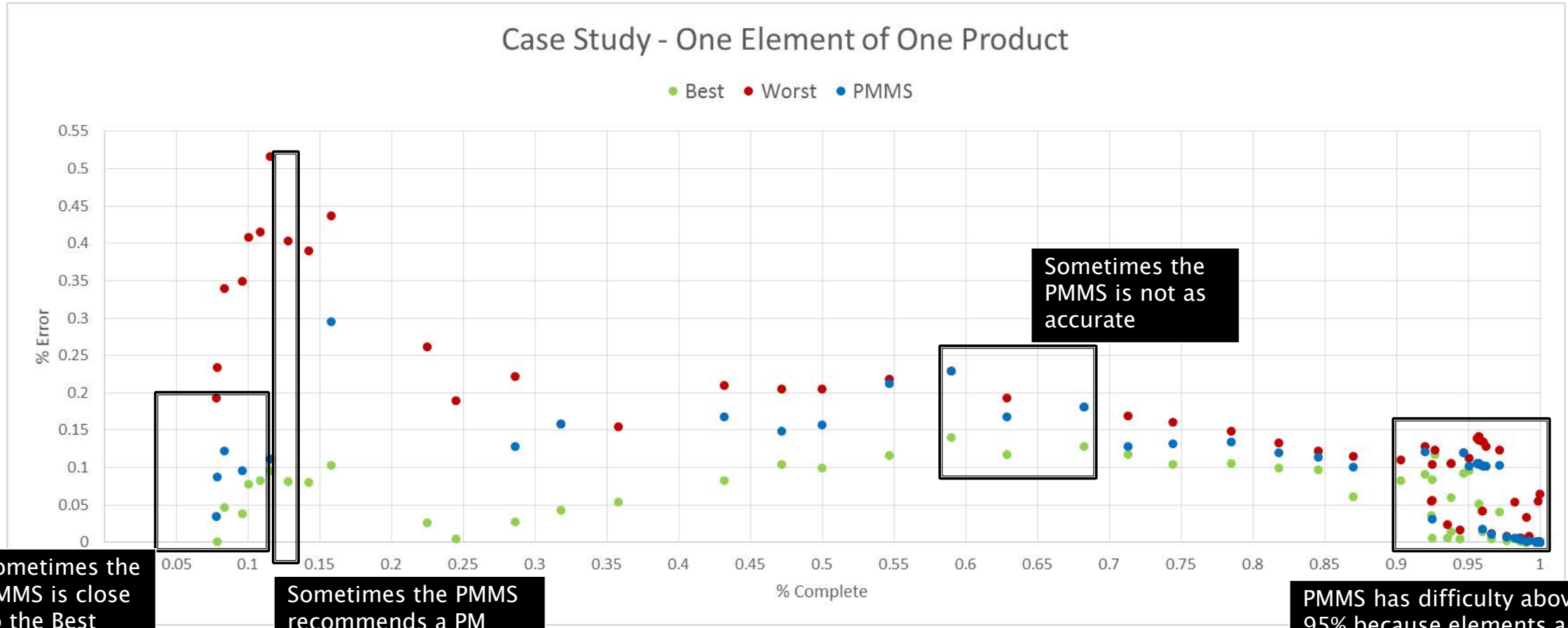
					Selected					Recommended	(Populated From Perf Metrics Study)			
Element	Unit Number	SPI	CPI	% Complete	Estimation Method	TCPI	EAC	VAC	CPI @ Complete	Estimation Method	TCPI	EAC	VAC	CPI @ Complete
Element 1	1	0.91	1.17	49.4%	Math Ext (CPI)	1.17	122	40	0.44	Math Ext (CPI)	1.17	122	40	0.44
Element 2	1	1.10	0.88	45.3%	6 Month CPI	1.04	186	-49	0.32	6 Month CPI	1.04	186	-49	0.32
Element 3	1	1.05	0.93	30.0%	Blend A	1.08	157	-14	0.21	Blend A	1.08	157	-14	0.21
Element 1	2	0.63	0.92	14.7%	Historical	1.00	170	-29	0.95	50/50	0.77	470	-329	0.80
Element 2	2	0.62	0.91	17.4%	50/50	0.97	162	-4	0.75	50/50	0.97	162	-4	0.75
Element 3	2	0.22	0.35	74.3%	80/20	0.97	149	-49	0.11	80/20	0.97	149	-49	0.11
Element 1	3	0.72	0.71	86.0%	9 Month CPI	1.07	182	37	0.91	9 Month CPI	1.07	182	37	0.91
Element 2	3	0.36	0.87	77.9%	90/10	1.09	148	41	0.20	90/10	1.09	148	41	0.20
Element 3	3	0.08	0.89	59.3%	To Budget (1.0)	1.00	107	-3	0.31	To Budget (1.0)	1.00	107	-3	0.31

- Analyst still makes decisions on Performance Metrics selections.
  - At times PMMS may give recommendations that aren't sensible. This is usually because there isn't enough historical data.
- PMMS can serve as a second opinion, a tie breaker, or for helping defend an analyst performance metric selection.


Case Study - One Element of One Product
Best
Worst
PMMS
% Error
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
% Complete


Case Study - One Element of One Product
Best
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% Error
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
% Complete
Sometimes the PMMS is not as accurate
Sometimes the PMMS is close to the Best
Sometimes the PMMS recommends a PM that can't be calculated
PMMS has difficulty above 95% because elements are considered "complete" at 95%

- Expand Case Study
  - Determine how effective PMMS is across multiple elements/products
  - Find areas for improvement to the PMMS
- Use Case Study Results to Improve PMMS
  - Example: PMMS should have a second recommendation if the one it recommends can not be computed (as seen on previous slide)
- Apply PMMS to other programs
  - The PMMS appears to be a good candidate for any program that delivers multiple quantities of similar products and has Earned Value data (Aircraft, Submarines, Surface Ships, UAV, etc.)
- Incorporate earlier techniques in an innovative way
  - Guide logic for making/adjusting blends with PMMS
  - Have PMMS work as a ‘warning system’ to indicate where programs were having Cost/Schedule troubles historically.

- Thank you for your time.

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