Earned Schedule: Principles and Practice

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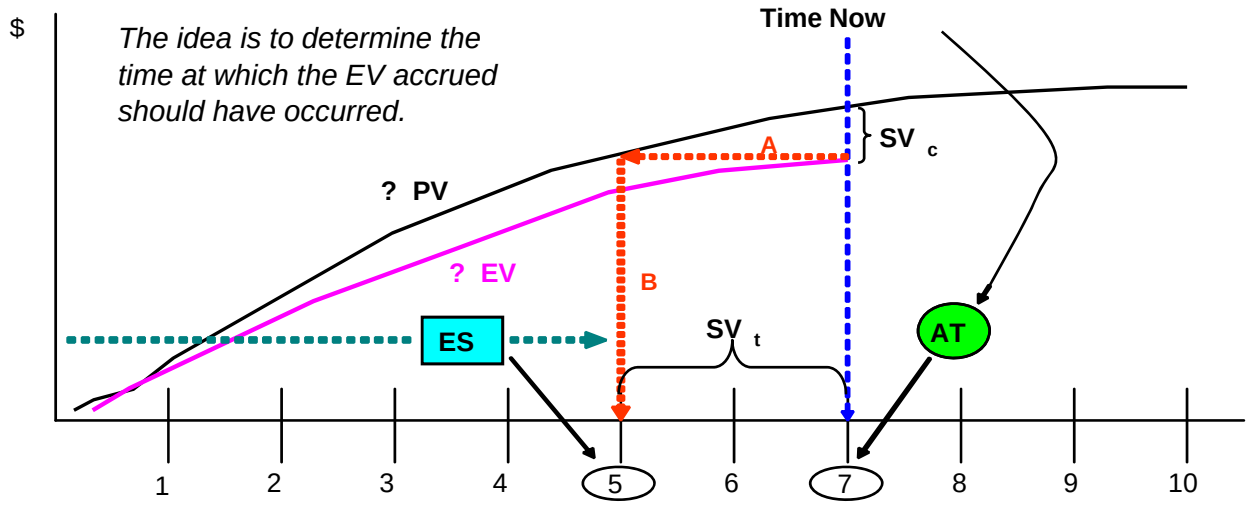


For the above example, ES = 5 months … that is the time associated with the PMB at which PV equals the EV accrued at month 7.

Introduction

- What is Earned Schedule?
  - History and background
- What are the benefits of using Earned Schedule?
- How does Earned Schedule work?
- What are the similarities and differences between Earned Value and Earned Schedule?
- What behaviours need to be embedded in the organisation for successful Earned Schedule Implementation?
- How can Earned Schedule be integrated with other Project Management techniques?
- Sanitised examples:
  - Design and development project
  - In-service (operations) project

Playing Devil's Advocate

- Why do I need another project management tool?
- I've already got a link between cost and schedule!
- Does this technique REALLY provide better decision making?
- I've heard this technique is used on development projects…but does it work for ongoing operations?
- Are you saying that Earned Value doesn't work!?

So what's wrong with Earned Value, then?

- It's good as a Project management technique

  …however…

  - Schedule indicators are flawed for late projects
  - Extremely limited for schedule performance analysis
  - EVM practitioners pay attention to Cost – not schedule
  - EVM has, in some areas, become focused in financial management
  - Indicators are not directly connected to deliverables
  - EV is not required to be synchronous with the schedule
  - EVM does not offer management guidance for project control and schedule control

Earned Schedule – a brief history

- The original phrase “Time is money” was first posed by Antiphon
  - Greek writer and educator
  - Around 430 BC
  - “The most costly outlay is time”
- This statement was ahead of its time!
- In 2006, Dr. Steve Gumley, CEO Defence Materiel Organisation (Australia) stated…

  “We need to maintain our attention on schedule delivery. Data tells us that since July 2003, real cost increase in projects accounted for less than 3 percent of the total cost growth. …*Therefore, our problem is not cost, it is SCHEDULE*.”

Earned Schedule – a brief history

- Earned Schedule papers first published in USA – in 2003
- “Schedule is different”, Measurable News
- Concept was verified with actual project data
- Continued development from 2003 to present

Benefits of using Earned Schedule (1)

- Converting money into time
- Connects EVM to the project schedule
- Project Managers have a schedule analysis tool that improves the confidence in forecasting delivery dates
- Improves decision making
- Adds to trend analysis
- Integrates and supports risk management activities
  - Schedule indicators are flawed for late projects
  - Extremely limited for schedule performance analysis
  - Practitioners pay attention to Cost - only
  - EVM has become focused in financial management
  - Indicators are not directly connected to deliverables
  - EV is not required to be synchronous with the schedule
  - EVM does not offer management guidance for project control

Benefits of using Earned Schedule (2)

- ES can be applied to any level of the WBS, to include task groupings such as the Critical Path
  - Requires creating PMB for the area of interest
  - EV for the area of interest is used to determine its ES
- Enables comparison of forecasts, total project duration (TP) to Critical Path (CP) duration
  - Desired result: forecasts are equal
  - When TP forecast > CP forecast, CP has changed
  - When CP > TP, possibility of future problems

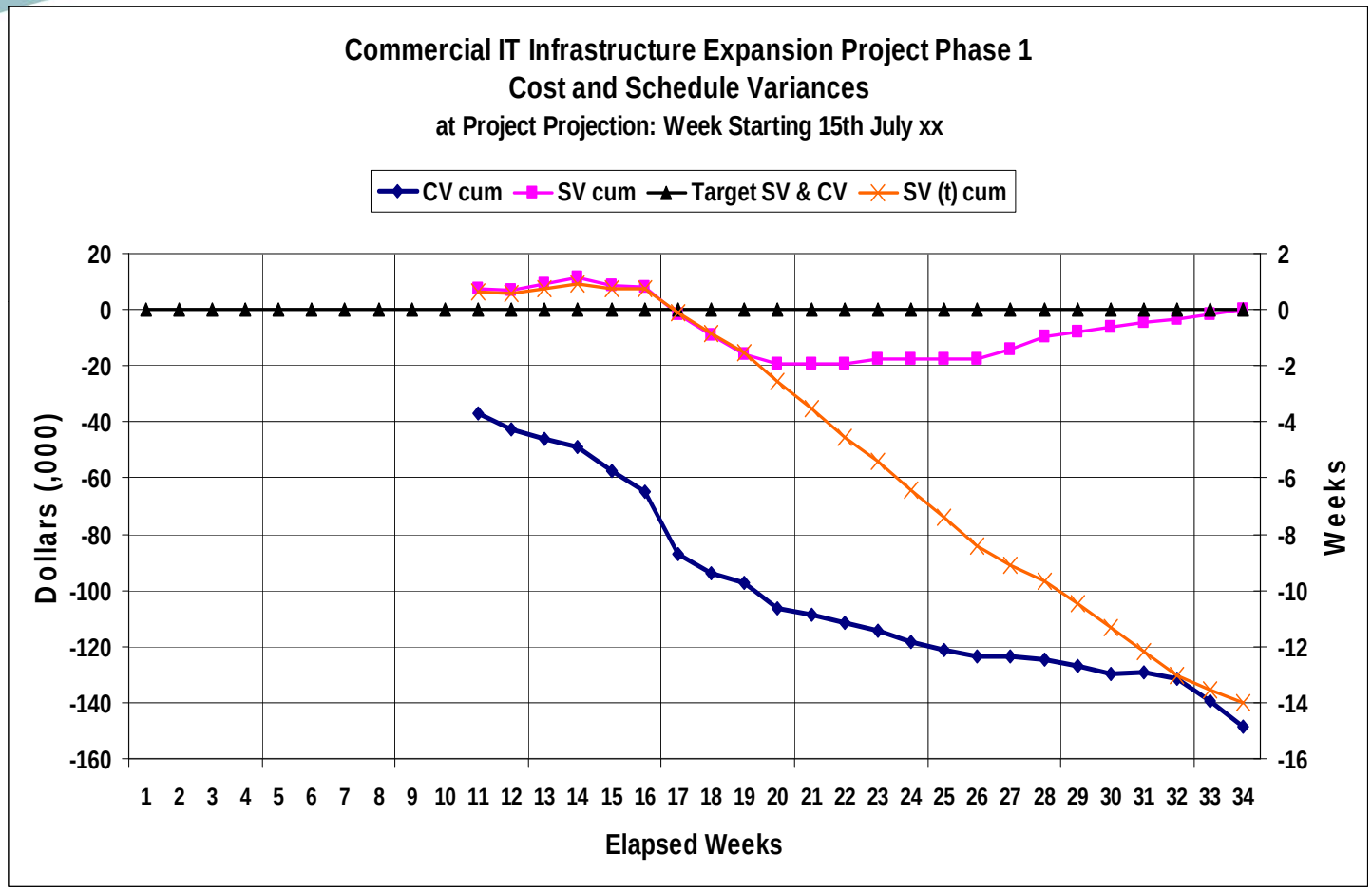
Benefits of using Earned Schedule (3)

- Earned Schedule works!
- How do we know?
- Evidence from a number of projects
- IEAC(t) & SPI(t) studies by K. Henderson, Dr. Vanhoucke & S. Vandevoorde (2003 – present)
  - Henderson & Vandevoorde validated ES concept with real data
  - Using simulation Vanhoucke & Vandevoorde showed ES to be a better schedule predictor than other EVM-based methods
- *"The results ..confirm ..that the ES method outperforms, on average, the other forecasting methods"* - Vanhoucke & Vandevoorde
- Takes Earned Value Management into a new dimension

Why use Earned Schedule?

- Schedule Variance (SV) and Schedule Performance Indicator (SPI) behave erratically – especially for projects behind schedule
- SPI improves and concludes at 1.00 at end of project
- Why is this?
- EV=BAC at completion
- PV=BAC at completion
- Hence SPI(£)=1 and SV(£) = 0
- Classical Schedule Variance is measured in money – not time!

Comparison of Schedule Variances



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Earned Schedule Calculation

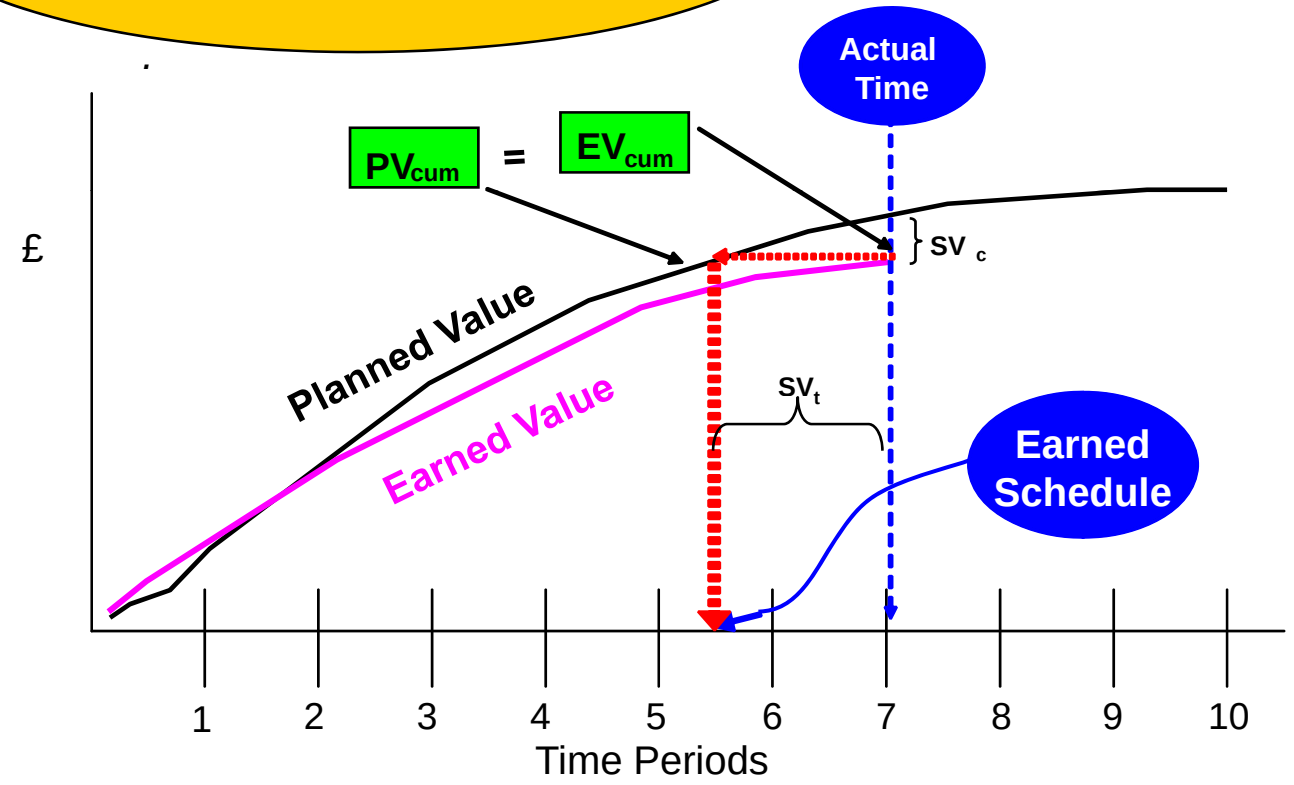
- ES (cumulative) is the:
  Number of complete PV time increments EV equals or exceeds PV + the fraction of the incomplete PV increment

- ES = C + I where:
  C = number of time increments for EV ≥ PV (BCWP ≥ BCWS)

  $I = (EV - PV_C) / (PV_{C+1} - PV_C)$

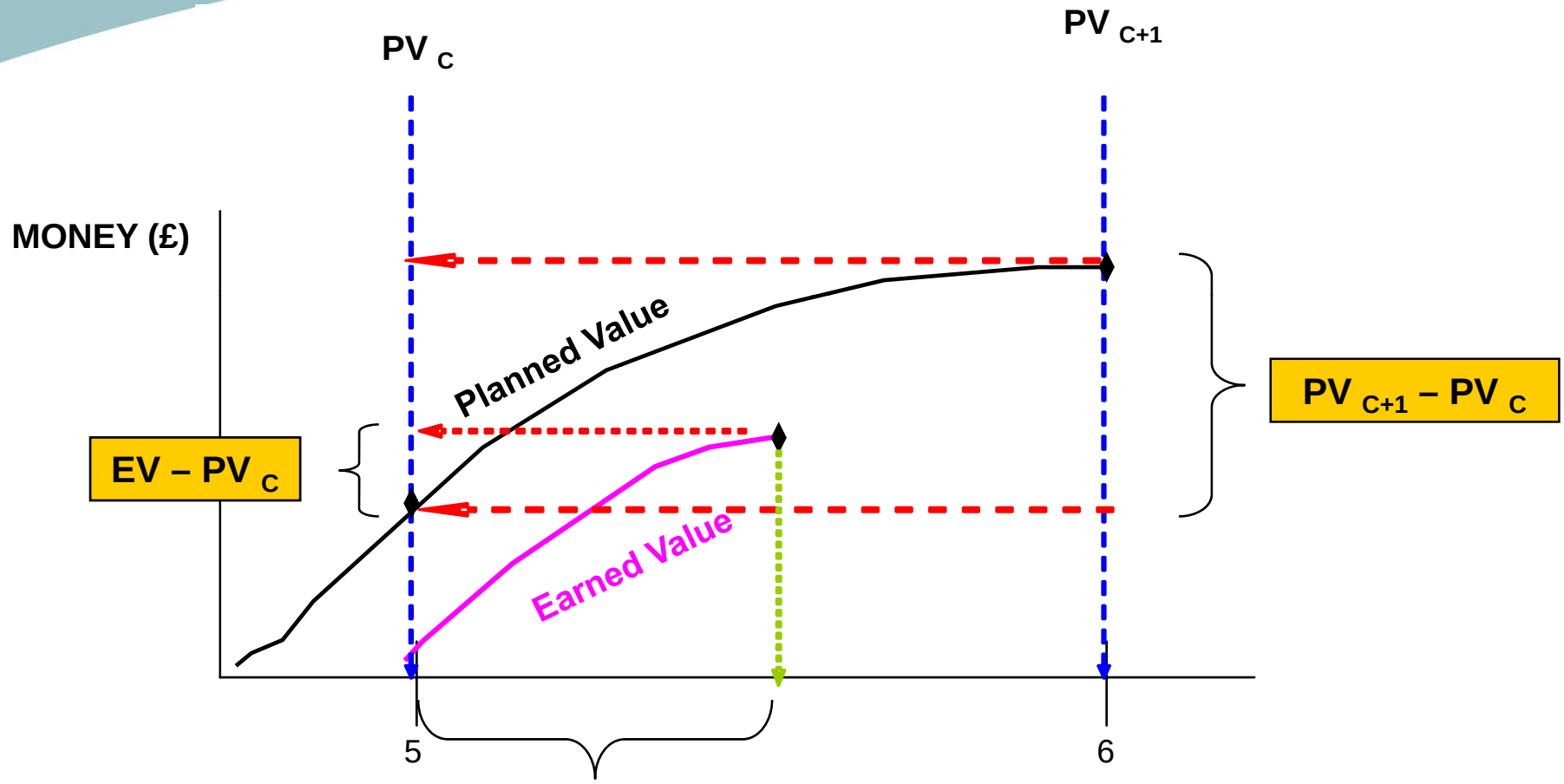
EVM & ES Duration Forecasting

The ES idea is to determine the time at which the EV accrued should have occurred



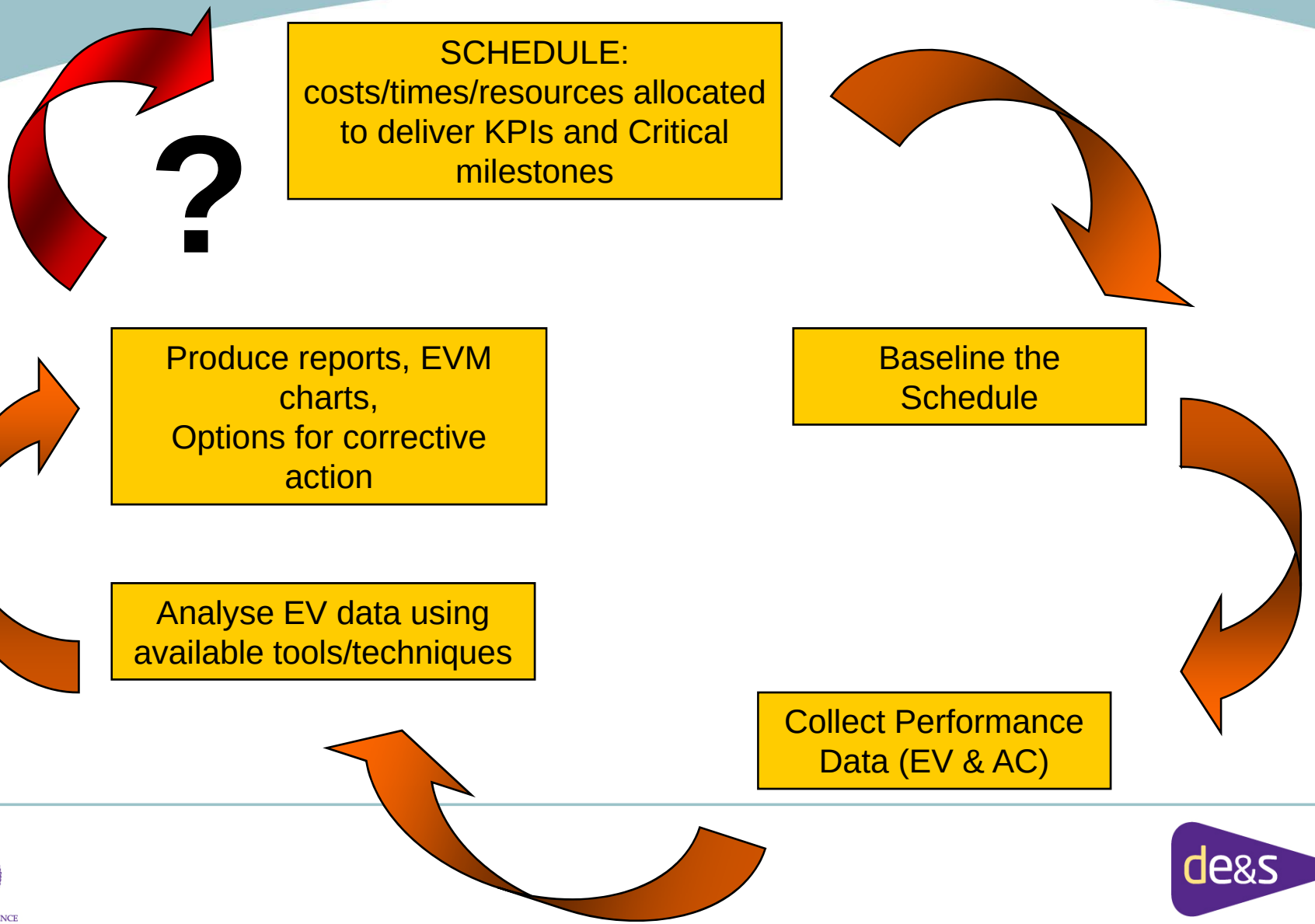
Time based schedule performance efficiency: SPI(t) = ES / AT

Calculating the Increment I



I - expressed as a fraction of time

EVM and Earned Schedule – the Missing Link



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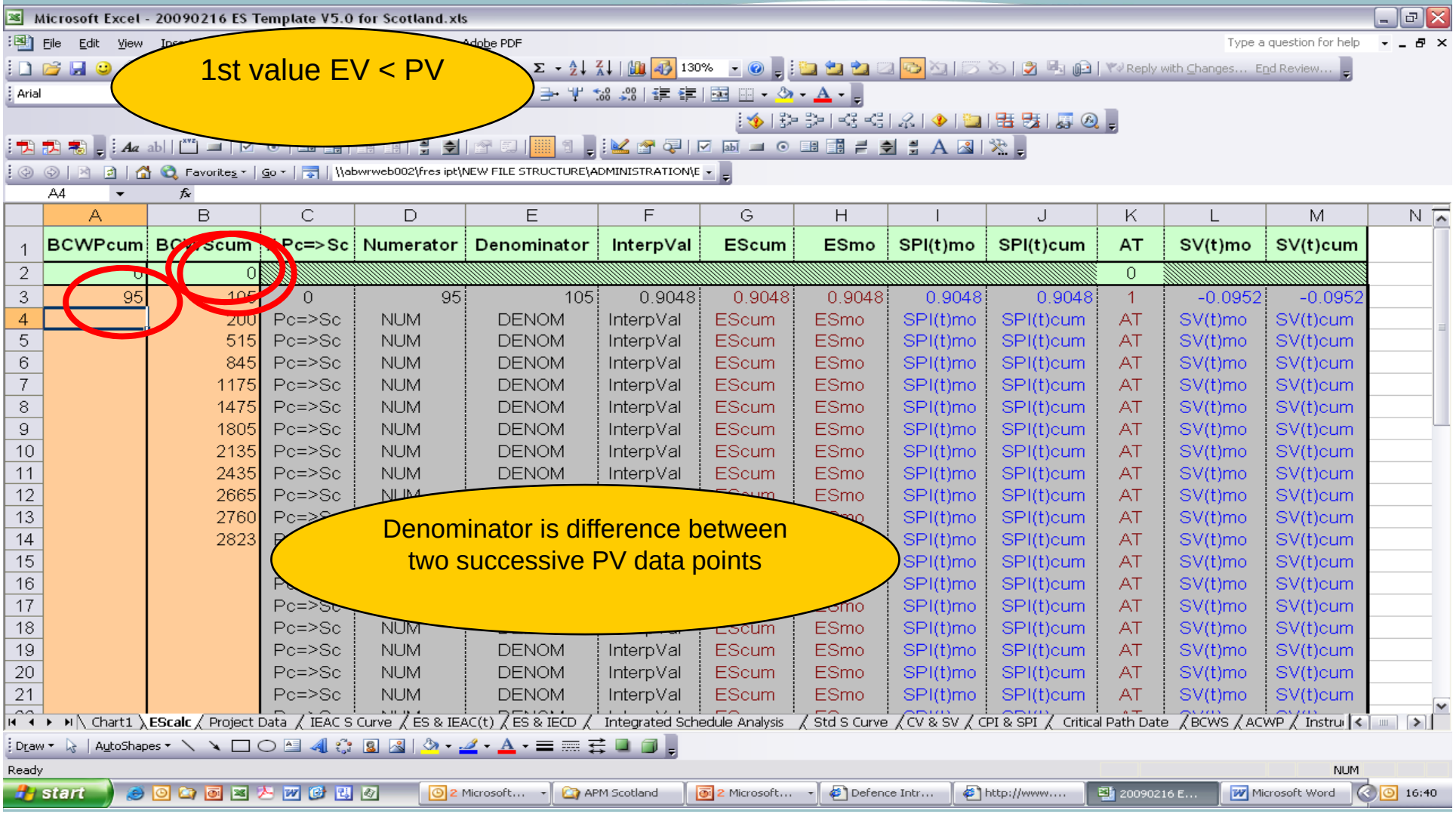
Calculating Earned Schedule (1)



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2	0	0									0			
3	95	105	0	95	105	0.9048	0.9048	0.9048	0.9048	0.9048	1	-0.0952	-0.0952	
4		200	Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
5		515	Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
6		845	Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
7		1175	Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
8		1475	Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
9		1805	Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
10		2135	Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
11		2435	Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
12		2665	Pc=>Sc					ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
13		2760	Pc=>Sc						SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
14		2823							SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
15									SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
16									SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
17			Pc=>Sc					Smo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
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19			Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
20			Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
21			Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	

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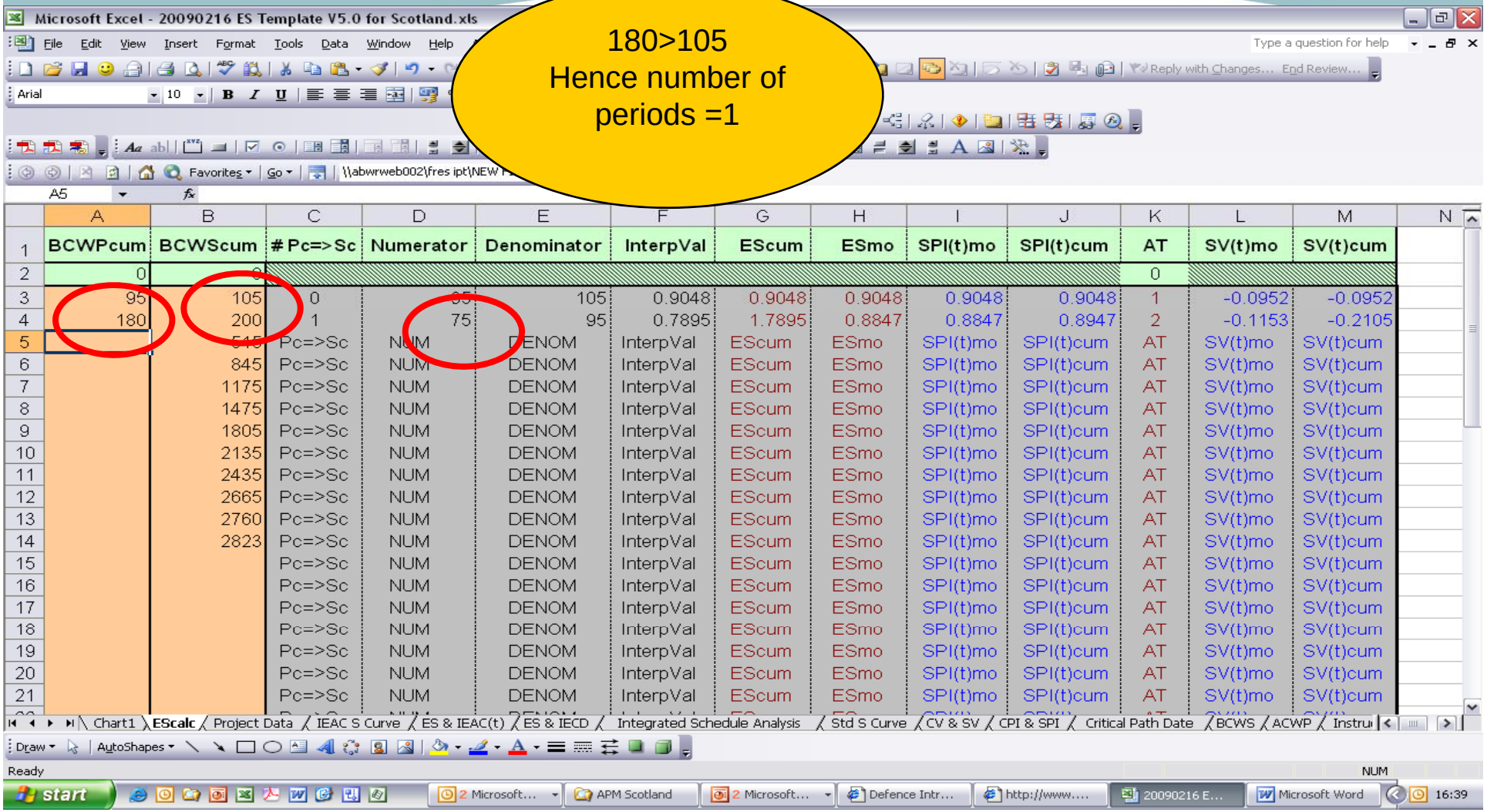
Calculating Earned Schedule (2)

180>105
Hence number of periods =1



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3	95	105	0	95	105	0.9048	0.9048	0.9048	0.9048	0.9048	1	-0.0952	-0.0952	
4	180	200	1	75	95	0.7895	1.7895	0.8847	0.8847	0.8947	2	-0.1153	-0.2105	
5		515	Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
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21			Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	

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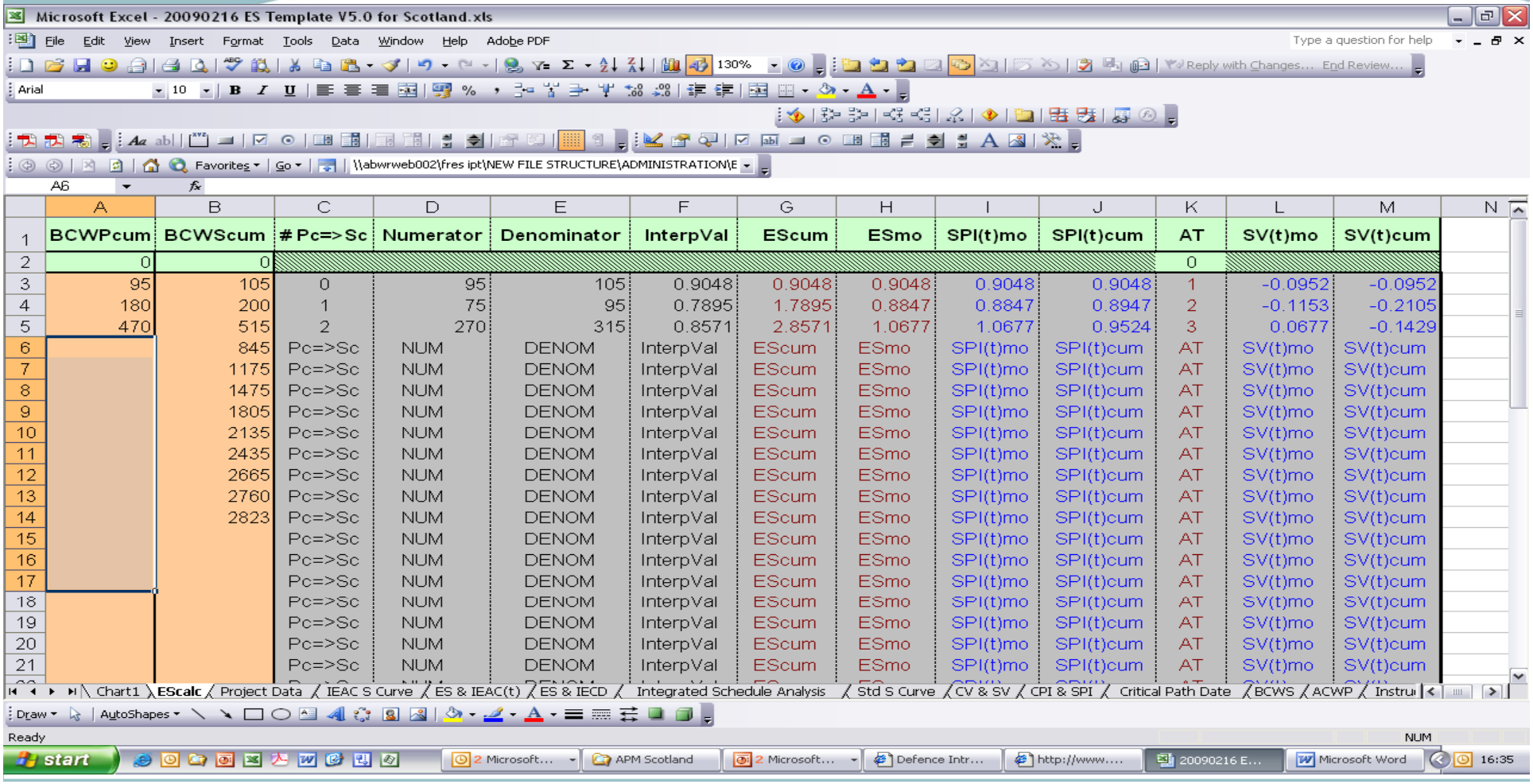
Calculating Earned Schedule (3)



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3	95	105	0	95	105	0.9048	0.9048	0.9048	0.9048	0.9048	1	-0.0952	-0.0952	
4	180	200	1	75	95	0.7895	1.7895	0.8847	0.8847	0.8947	2	-0.1153	-0.2105	
5	470	515	2	270	315	0.8571	2.8571	1.0677	1.0677	0.9524	3	0.0677	-0.1429	
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7		1175	Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	
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21			Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	

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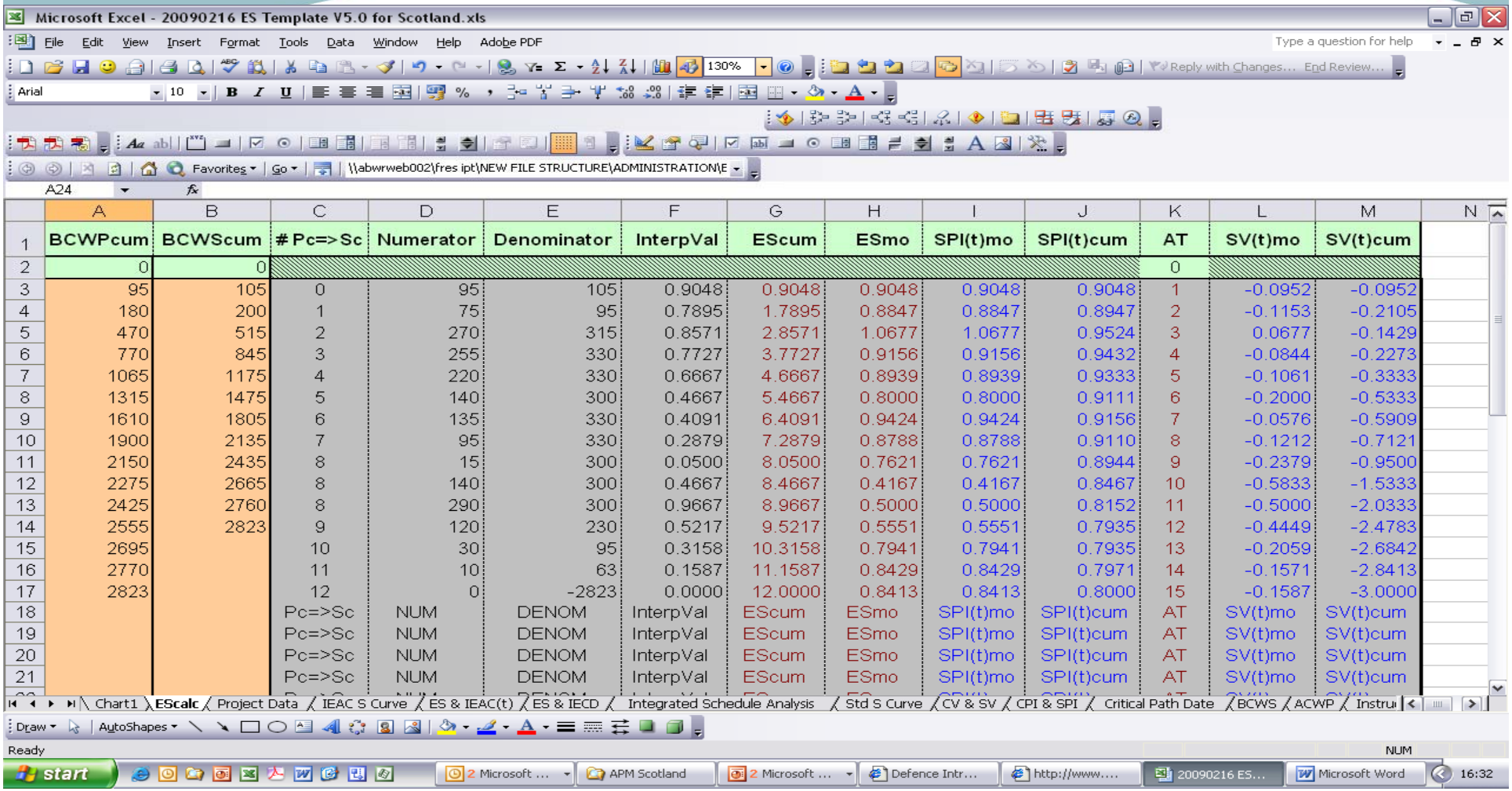
Calculating Earned Schedule (4)



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3	95	105	0	95	105	0.9048	0.9048	0.9048	0.9048	0.9048	1	-0.0952	-0.0952	
4	180	200	1	75	95	0.7895	1.7895	0.8847	0.8847	0.8947	2	-0.1153	-0.2105	
5	470	515	2	270	315	0.8571	2.8571	1.0677	1.0677	0.9524	3	0.0677	-0.1429	
6	770	845	3	255	330	0.7727	3.7727	0.9156	0.9156	0.9432	4	-0.0844	-0.2273	
7	1065	1175	4	220	330	0.6667	4.6667	0.8939	0.8939	0.9333	5	-0.1061	-0.3333	
8	1315	1475	5	140	300	0.4667	5.4667	0.8000	0.8000	0.9111	6	-0.2000	-0.5333	
9	1610	1805	6	135	330	0.4091	6.4091	0.9424	0.9424	0.9156	7	-0.0576	-0.5909	
10	1900	2135	7	95	330	0.2879	7.2879	0.8788	0.8788	0.9110	8	-0.1212	-0.7121	
11	2150	2435	8	15	300	0.0500	8.0500	0.7621	0.7621	0.8944	9	-0.2379	-0.9500	
12	2275	2665	8	140	300	0.4667	8.4667	0.4167	0.4167	0.8467	10	-0.5833	-1.5333	
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16	2770		11	10	63	0.1587	11.1587	0.8429	0.8429	0.7971	14	-0.1571	-2.8413	
17	2823		12	0	-2823	0.0000	12.0000	0.8413	0.8413	0.8000	15	-0.1587	-3.0000	
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21			Pc=>Sc	NUM	DENOM	InterpVal	EScum	ESmo	SPI(t)mo	SPI(t)cum	AT	SV(t)mo	SV(t)cum	

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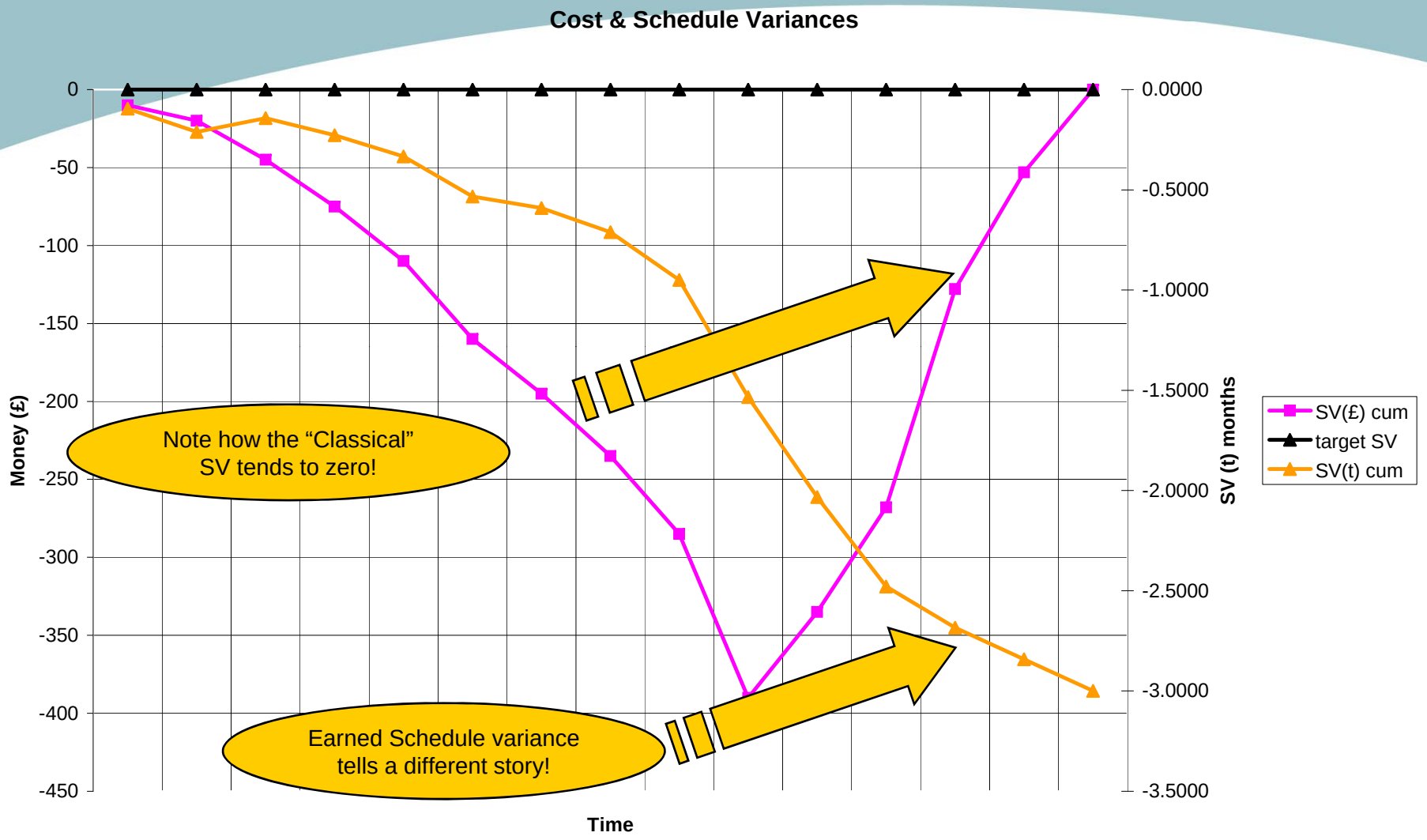
Variances – which would you believe?



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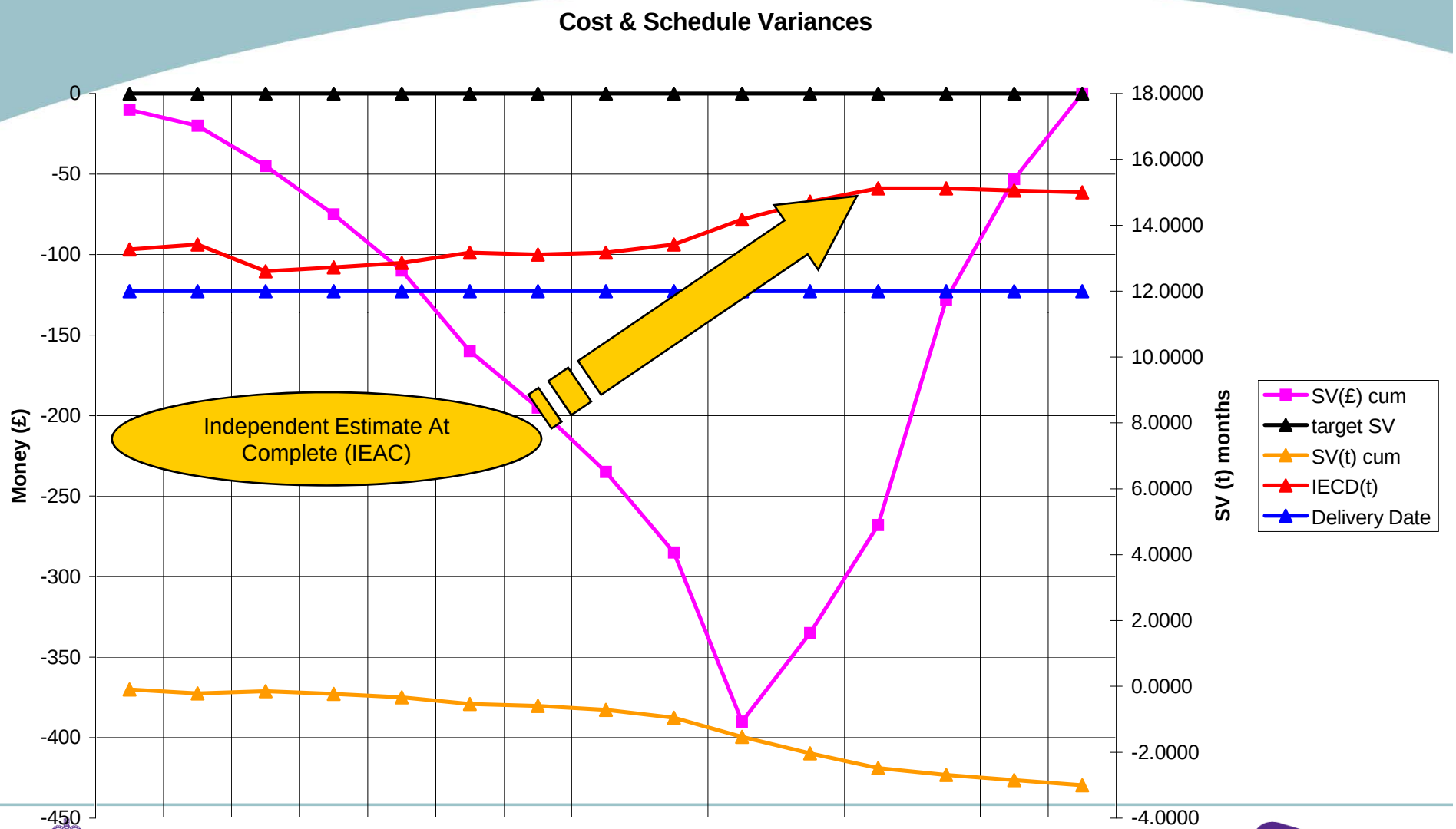
Variances – which would you believe?



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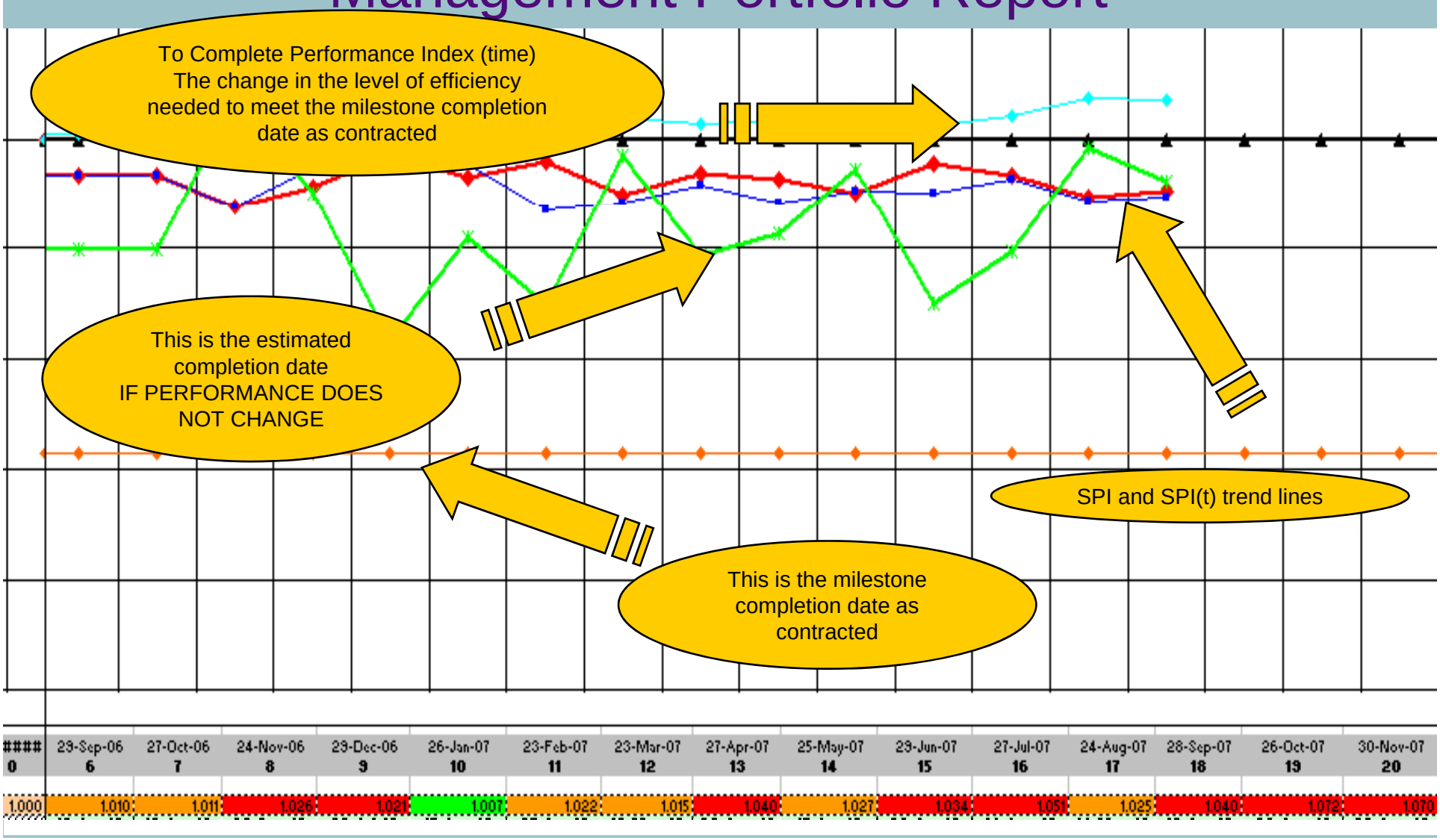
Management Portfolio Report



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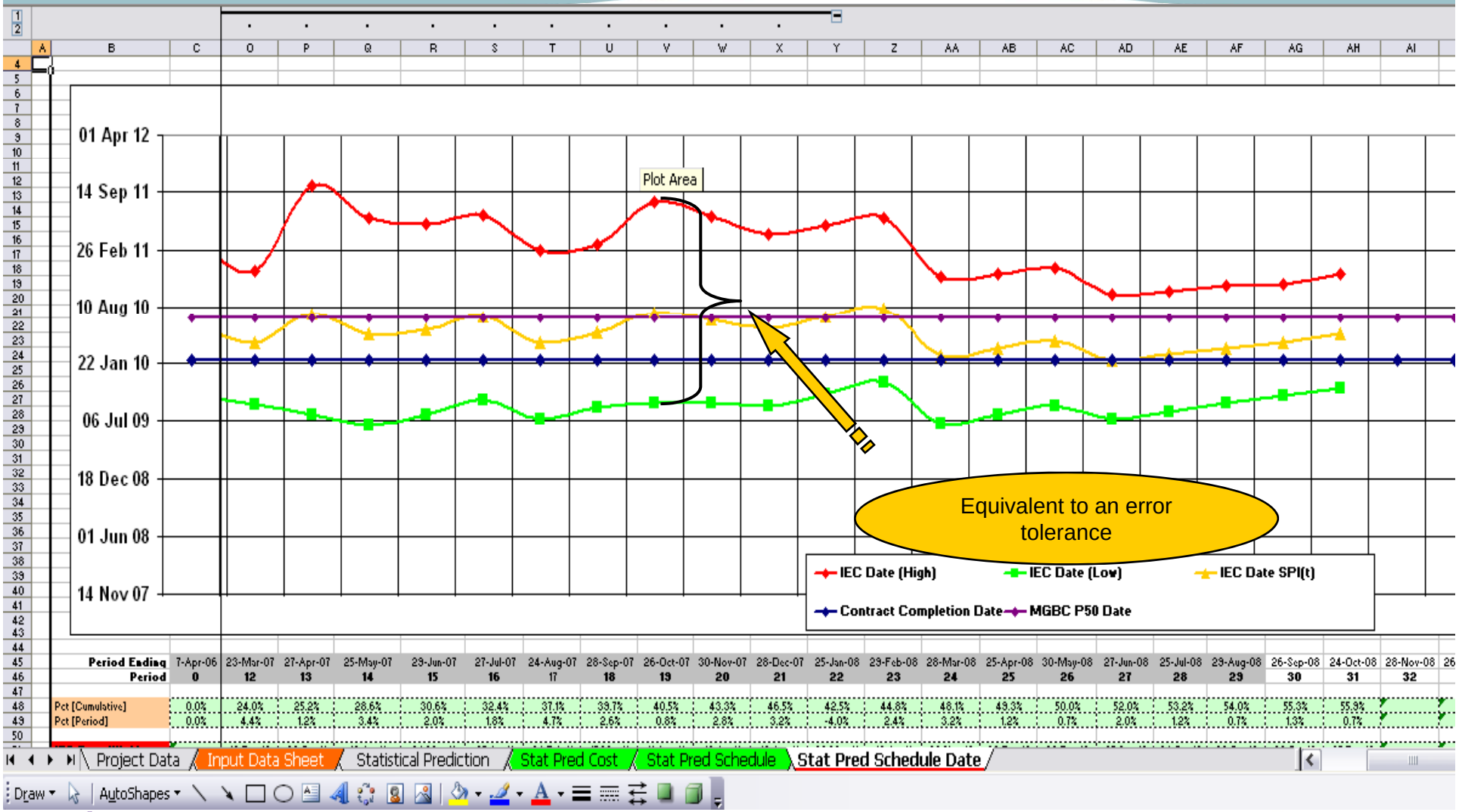
Prediction of Project Completion (1)



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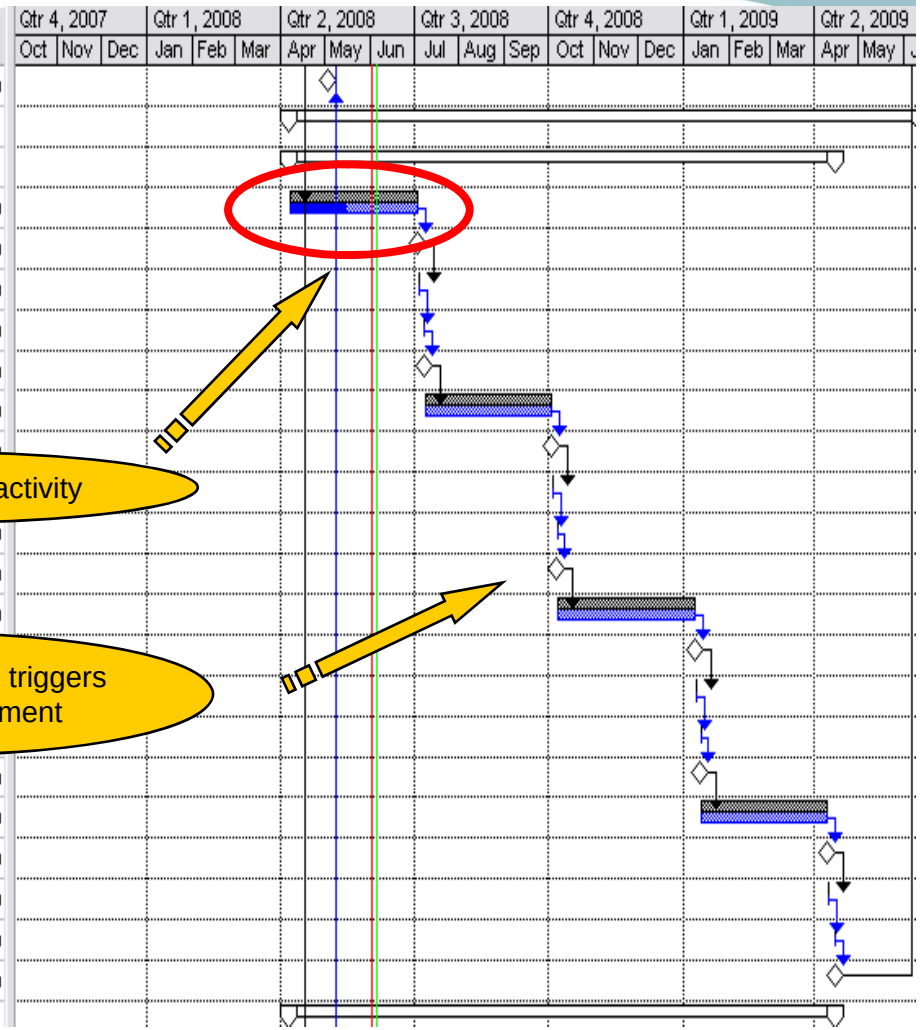
Use of ES in Operations (1)

	Name	% Complete	Hammock	Duration	Work
7	Training Requirement Met	0%	No	0d	0h
8	**- In-Service Support Programme**	**2%**	**No**	**296d**	**1,164h**
9	**- Ptarmigan**	**11%**	**No**	**256d**	**0h**
10	ILS/CLS Management QTR1	45%	No	62d	0h
11	**INPUT: ILS/CLS KPI Data delivery - QTR1**	0%	No	0d	0h
12	ILS/CLS performance review meeting - QTR1	0%	No	1d	0h
13	Customer Acceptance of KPI data - QTR1	0%	No	1d	0h
14	**OUTPUT: Contractor ILS/CLS payment - QTR1**	0%	No	0d	0h
15	ILS/CLS Management QTR2	0%	No	62d	0h
16	**INPUT:ILS/CLS KPI Data delivery - QTR2**	0%	No	0d	0h
17	ILS/CLS performance review meeting - QTR2	0%	No	1d	0h
18	Customer Acceptance of KPI data - QTR2	0%	No	1d	0h
19	**OUTPUT:Contractor ILS/CLS payment - QTR2**	0%	No	0d	0h
20	ILS/CLS Management QTR3	0%	No	62d	0h
21	INPUT:ILS/CLS KPI Data delivery - QTR3	0%	No	0d	0h
22	ILS/CLS performance review meeting - QTR3	0%	No	1d	0h
23	Customer Acceptance of KPI data - QTR3	0%	No	1d	0h
24	**OUTPUT:Contractor ILS/CLS payment - QTR3**	0%	No	0d	0h
25	ILS/CLS Management QTR4	0%	No	62d	0h
26	INPUT:ILS/CLS KPI Data delivery - QTR4	0%	No	0d	0h
27	ILS/CLS performance review meeting - QTR4	0%	No	1d	0h
28	Customer Acceptance of KPI data - QTR4	0%	No	1d	0h
29	**OUTPUT:Contractor ILS/CLS payment - QTR4**	0%	No	0d	0h
30	**+ Gate**	**0%**	**No**	**256d**	**0h**



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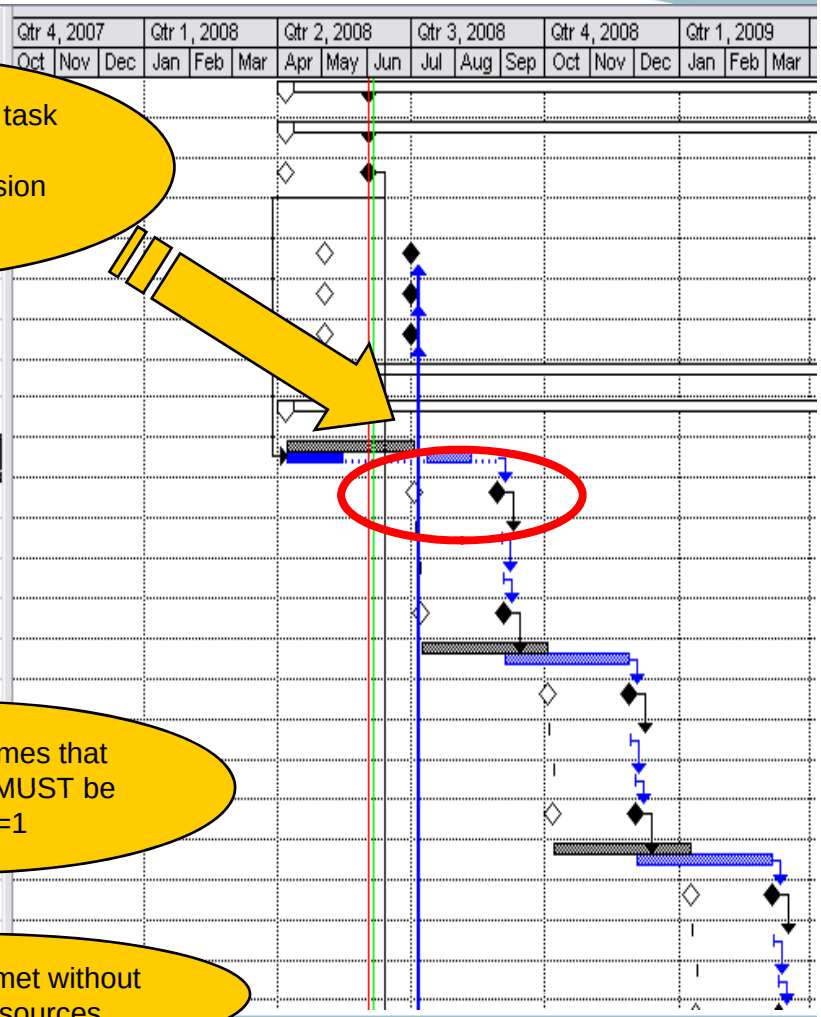
Use of ES in Operations (2)

	Task Name	Duration	Start	% Complete	Baseline Finish	Finish
1	- **Milestones**	**257d**	**02/06/2008**			
2	- **Business Plan Milestones**	**257d**	**02/06**			
3	FY 08/09 start	0d	02/0			
4	Core outputs for FY08/09 delivered	0d	11/06/2			
5	People, Leadership and Performance Mgt	0d	30/06/2008			
6	PDR completion	0d	30/06/2008	0%	02/05/2008	30/06/2008
7	Training Requirement Met	0d	30/06/2008	0%	02/05/2008	30/06/2008
8	- **In-Service Support Programme**	**296d**	**07/04/2008**	**2%**	**11/06/2009**	**11/06/2009**
9	- **Ptarmigan**	**296d**	**07/04/2008**	**9%**	**14/04/2009**	**11/06/2009**
10	ILS/CLS Management QTR1	102d	07/04/2008	27%	03/07/2008	29/08/200
11	**INPUT: ILS/CLS KPI Data delivery - QTR1**	0d	29/08/2008	0%	03/07/2008	29/08/2008
12	ILS/CLS performance review meeting - QTR1	1d	01/09/2008	0%	04/07/2008	01/09/2008
13	Customer Acceptance of KPI data - QTR1	1d	02/09/2008	0%	07/07/2008	02/09/2008
14	**OUTPUT: Contractor ILS/CLS payment - QTR1**	0d	02/09/2008	0%	07/07/2008	02/09/2008
15	ILS/CLS Management QTR2	62d	03/09/2008	0%	02/10/2008	27/11/2008
16	**INPUT:ILS/CLS KPI Data delivery - QTR2**	0d	27/11/2008	0%	02/10/2008	27/11/2008
17	ILS/CLS performance review meeting - QTR2	1d	28/11/2008			
18	Customer Acceptance of KPI data - QTR2	1d	01/12/2008			
19	**OUTPUT:Contractor ILS/CLS payment - QTR2**	0d	01/12/2008			
20	ILS/CLS Management QTR3	62d	02/12/2008	0%		
21	INPUT:ILS/CLS KPI Data delivery - QTR3	0d	05/03/2009	0%	08/01/2009	05/03/2009
22	ILS/CLS performance review meeting - QTR3	1d	06/03/2009	0%	09/01/2009	
23	Customer Acceptance of KPI data - QTR3	1d	09/03/2009			



Hours booked to the task are < baseline: CAUSED BY: diversion activity

Schedule assumes that next milestone MUST be met: SPI=1

KPI cannot be met without additional resources

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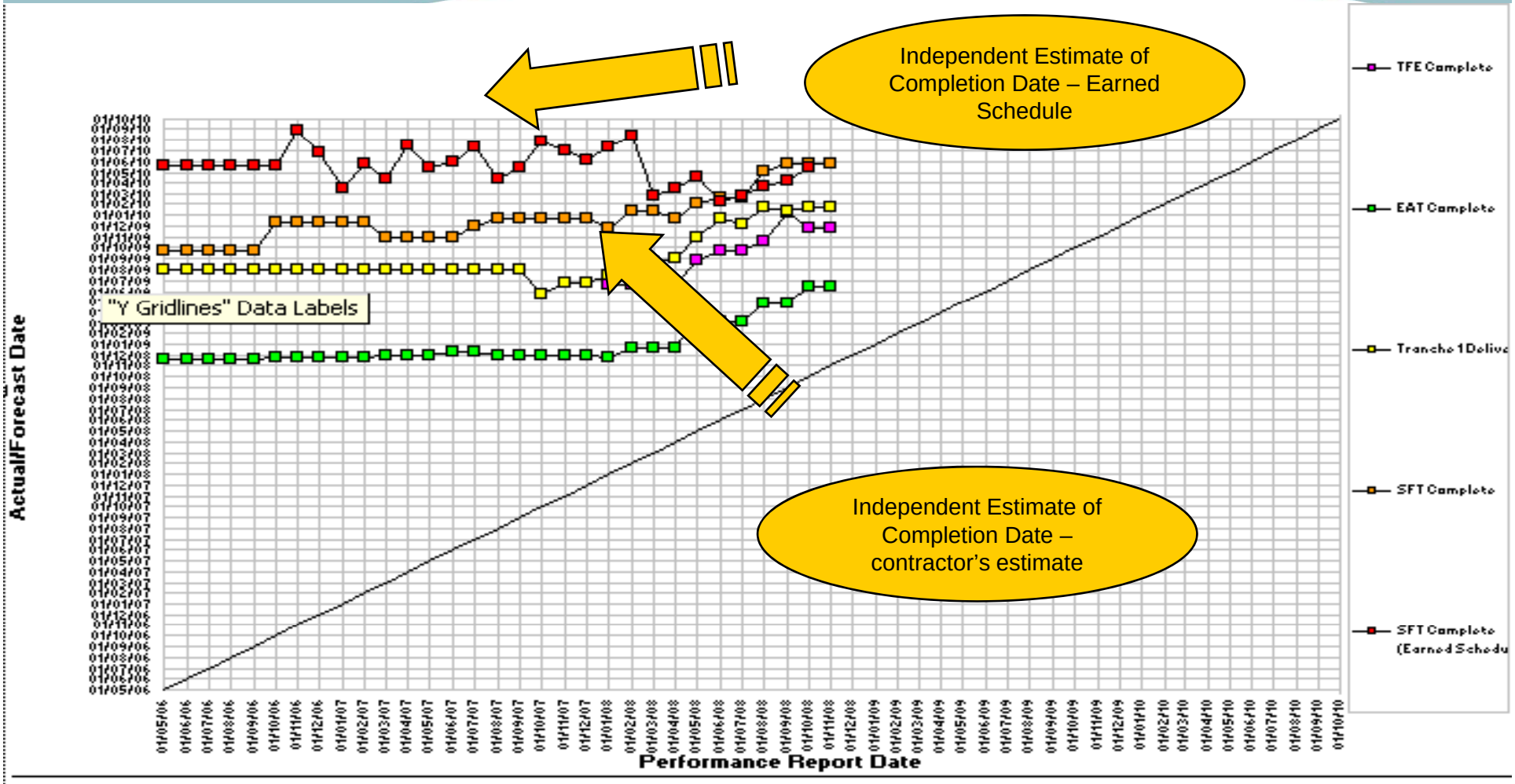
Milestone tracking – seeing is believing!



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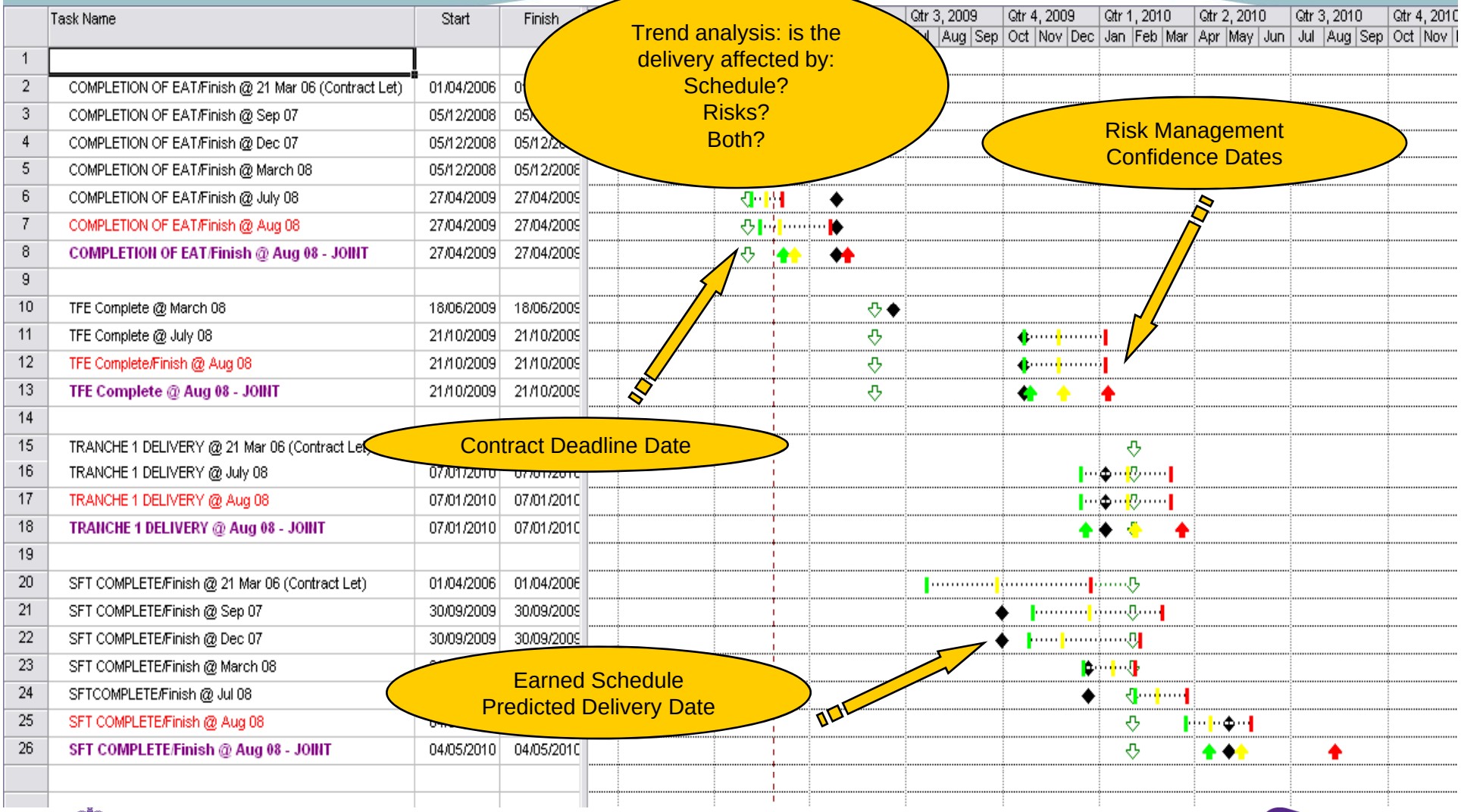
Integration of ES, risk and deadlines



	Task Name	Start	Finish
1			
2	COMPLETION OF EAT/Finish @ 21 Mar 06 (Contract Let)	01/04/2006	0
3	COMPLETION OF EAT/Finish @ Sep 07	05/12/2008	05/
4	COMPLETION OF EAT/Finish @ Dec 07	05/12/2008	05/12/2
5	COMPLETION OF EAT/Finish @ March 08	05/12/2008	05/12/2008
6	COMPLETION OF EAT/Finish @ July 08	27/04/2009	27/04/2009
7	COMPLETION OF EAT/Finish @ Aug 08	27/04/2009	27/04/2009
8	**COMPLETION OF EAT/Finish @ Aug 08 - JOINT**	27/04/2009	27/04/2009
9			
10	TFE Complete @ March 08	18/06/2009	18/06/2009
11	TFE Complete @ July 08	21/10/2009	21/10/2009
12	TFE Complete/Finish @ Aug 08	21/10/2009	21/10/2009
13	**TFE Complete @ Aug 08 - JOINT**	21/10/2009	21/10/2009
14			
15	TRANCHE 1 DELIVERY @ 21 Mar 06 (Contract Let)		
16	TRANCHE 1 DELIVERY @ July 08	07/01/2010	07/01/2010
17	TRANCHE 1 DELIVERY @ Aug 08	07/01/2010	07/01/2010
18	**TRANCHE 1 DELIVERY @ Aug 08 - JOINT**	07/01/2010	07/01/2010
19			
20	SFT COMPLETE/Finish @ 21 Mar 06 (Contract Let)	01/04/2006	01/04/2006
21	SFT COMPLETE/Finish @ Sep 07	30/09/2009	30/09/2009
22	SFT COMPLETE/Finish @ Dec 07	30/09/2009	30/09/2009
23	SFT COMPLETE/Finish @ March 08		
24	SFTCOMPLETE/Finish @ Jul 08		
25	SFT COMPLETE/Finish @ Aug 08		
26	**SFT COMPLETE/Finish @ Aug 08 - JOINT**	04/05/2010	04/05/2010

Qtr 3, 2009			Qtr 4, 2009			Qtr 1, 2010			Qtr 2, 2010			Qtr 3, 2010			Qtr 4, 2010
Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov

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Schedule Adherence – are you doing it right?

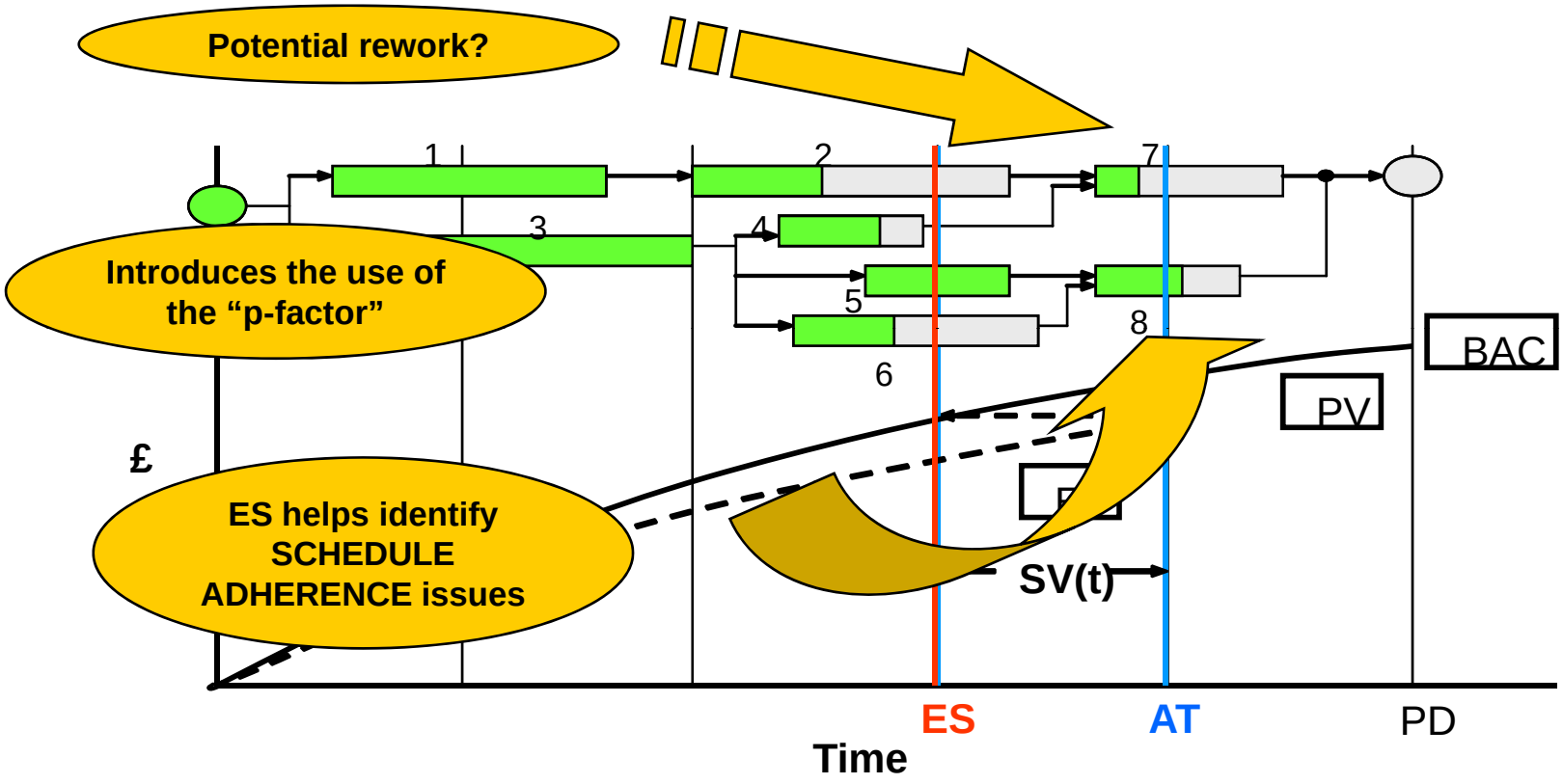
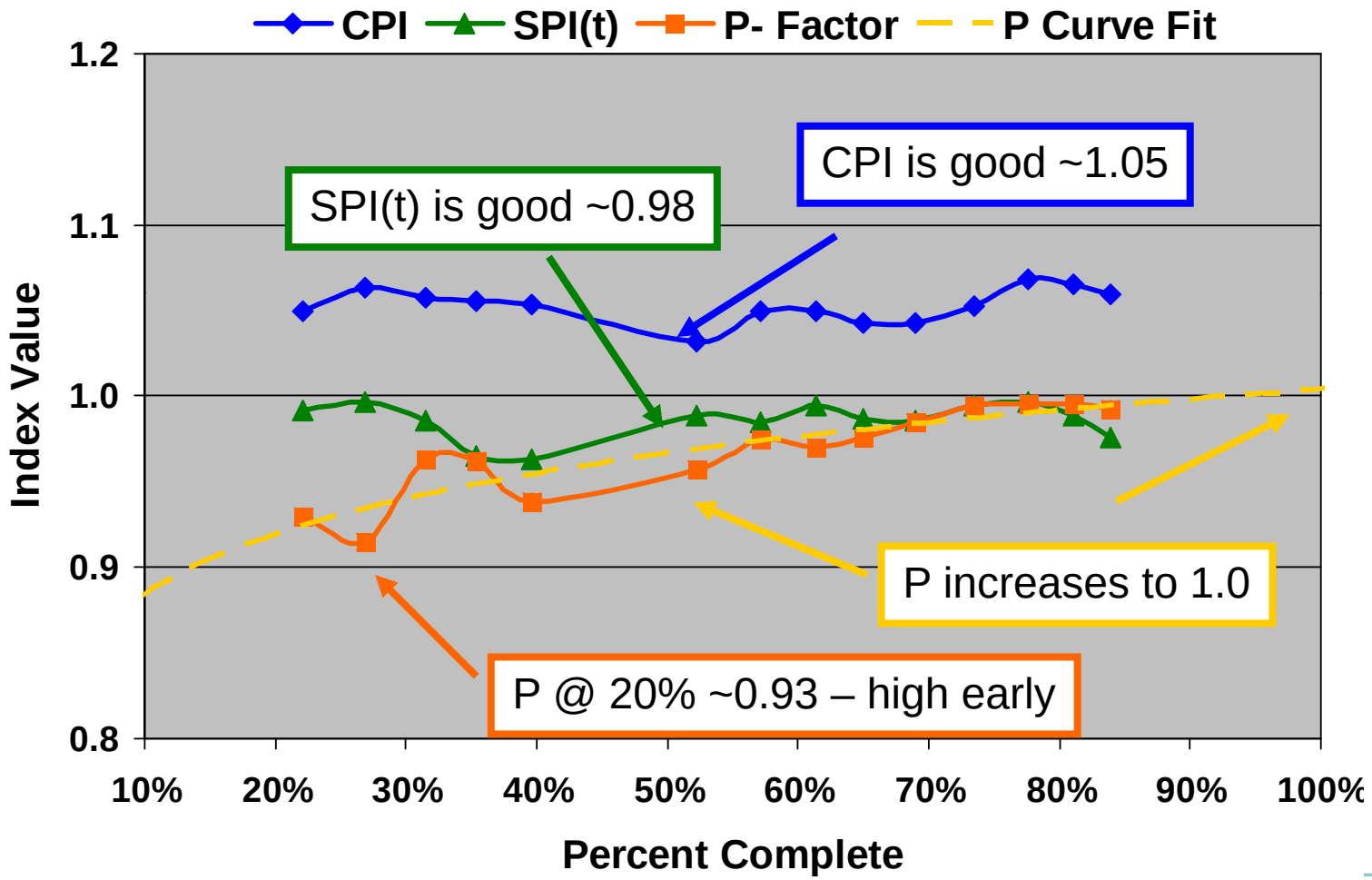


Figure 3. Earned Schedule - *Bridges EVM to Schedule* (Actual)

Real Data Results



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Thank you to…

- Walt Lipke and Kym Henderson
  - for use of Earned Schedule training material
- Project FALCON and Special Projects Team
  - For use of sanitized data

Available Resources

- PMI-Sydney http://sydney.pmichapters-australia.org.au/
  - Repository for ES Papers and Presentations
- Earned Schedule Website
- http://www.earnedschedule.com/
  - Established February 2006
  - Contains News, Papers, Presentations, ES Terminology, ES Calculators
  - Identifies Contacts & Training to assist with application
- Wikipedia references Earned Schedule
- http://en.wikipedia.org/wiki/Earned_Schedule

Earned Schedule References

- "A Case Study of Earned Schedule to do Predictions," *The Measurable News*, Winter 2007-2008: 16-18 [Hecht]
- "A Simulation and Evaluation of Earned Value Metrics to Forecast Project Duration," *Journal of Operations Research Society*, October 2007, Vol 58: 1361-1374 [Vanhoucke & Vandevoorde]
- "Measuring the Accuracy of Earned Value/Earned Schedule Forecasting Predictors," *The Measurable News*, Winter 2007-2008: 26-30 [Vanhoucke & Vandevoorde]
- Earned Schedule Website: www.earnedschedule.com