

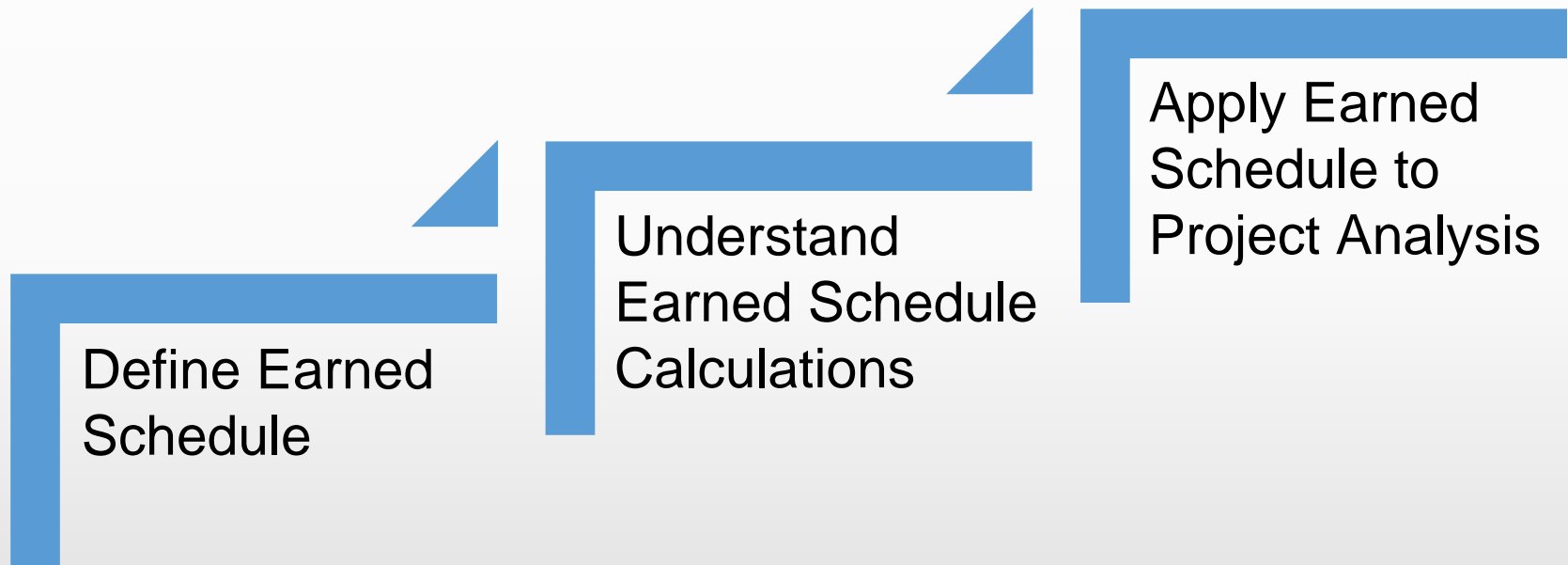


Earned Value Management Practitioners Forum 2019

Implementing and Using Earned Schedule at Idaho National Laboratory

Andrea K. Gilstrap, PMP, EVP
Integrated Project Planning Office Lead
Idaho National Laboratory

Learning Objectives



Traditional Analysis

Critical Path Method (CPM)

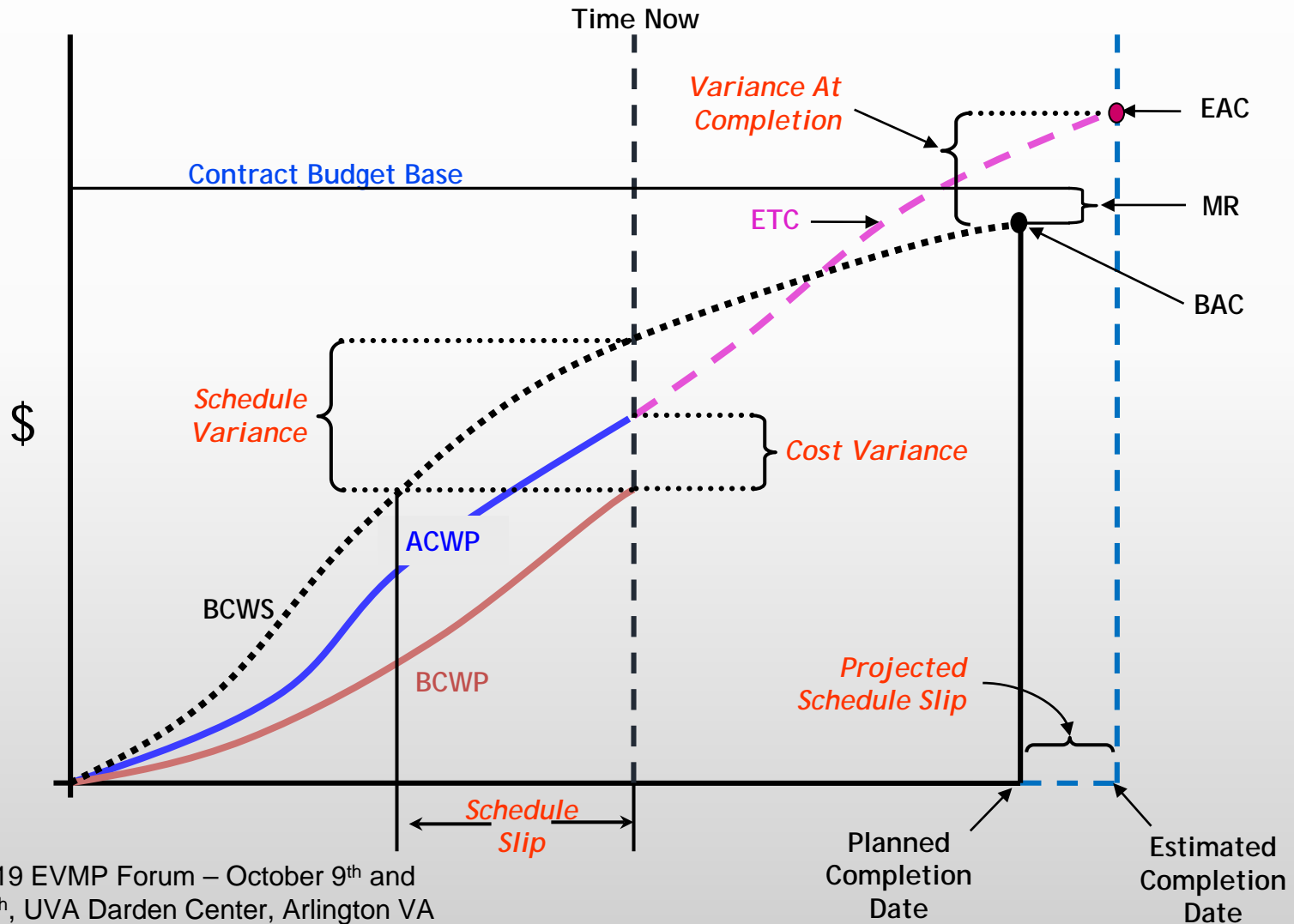
- Primarily a planning tool
- Used for schedule forecasting
- Generally assumes future performance will follow plan
- Problems and opportunities that affected performance in the past may not be reflected in the current schedule

Traditional Analysis (continued)

Earned Value Management (EVM)

- Primarily a monitoring and control tool
- Used for cost forecasting
- Assumes past performance is a good predictor of future performance
- Schedule Variance is shown in dollars

Traditional Analysis (continued)



Traditional Analysis (continued)

- EVM has CV, CPI, TCPI, EAC to portray overruns, underruns, and projected cost at completion
- As EV moves toward the BAC...
 - SV moves toward \$0
 - SPI moves toward 1.0
- Once complete...
 - $SV = \$0$
 - $SPI = 1.0$

What Is Earned Schedule?

Earned Schedule identifies the time at which the amount of Earned Value accrued should have been earned.

“Earned Schedule (ES) provides the ability to predict project completion dates and is the bridge for performing meaningful schedule analysis from the EVM data.”

<http://earnedschedule.com/>

Earned Schedule Terminology

Earned Schedule (ES) – Value in time at which the amount of Earned Value accrued should have been earned

- EVM Counterpart: BCWP or EV
- Represented in Periods (weekly, monthly)

ES = Earned Schedule Date – Baseline Start

Earned Schedule Terminology

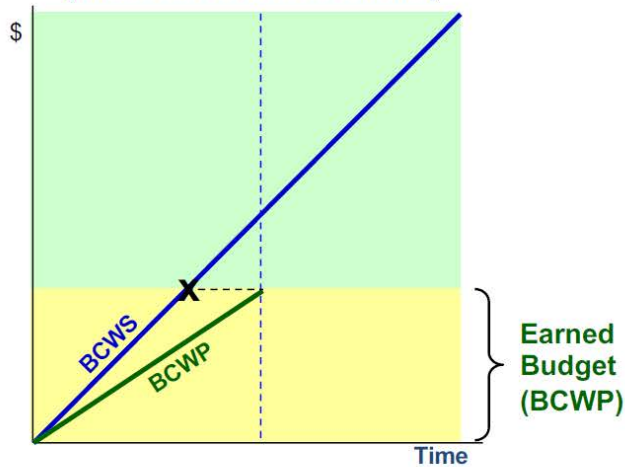
(continued)

- Actual Time (AT) – Periods from Start to Time Now
- Planned Duration (PD) – Planned Periods
 - EVM Counterpart: time-phased BCWS/all periods
- Estimated Duration (ED) – Estimated Periods
 - EVM Counterpart: time-phased ETC/all periods

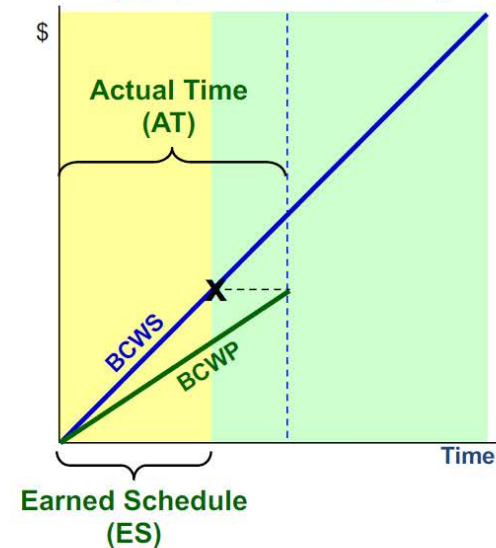


Earned Schedule (ES)

Traditional Performance
(Measured in Dollars)



Earned Schedule
(Measured in Time)



ES = Duration that was planned to have taken to earn our current **BCWP**

Schedule Variance – Time (SV_t)

SV_t – measure of the duration (ahead/behind) plan

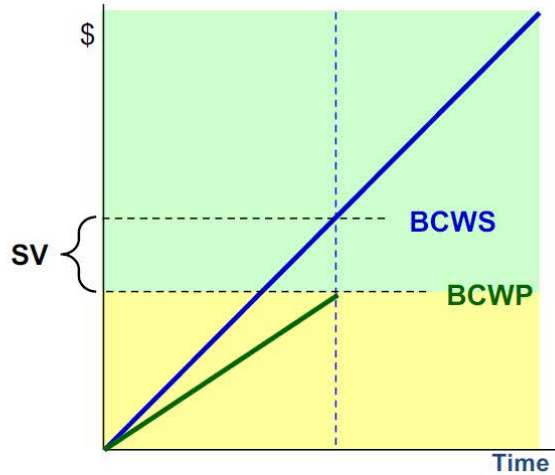
- EVM Counterpart: Schedule Variance \$
- $SV_t < 0$ Behind Schedule or Finished Late
- $SV_t = 0$ On Schedule or Finished on Time
- $SV_t > 0$ Ahead of Schedule or Finished Early



Schedule Variance-Time

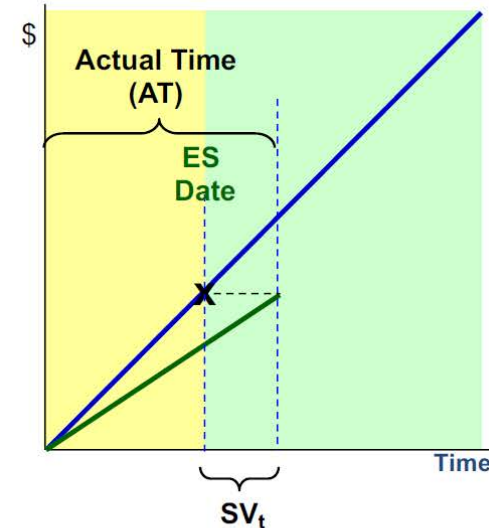
$$(SV_t)$$

Traditional Performance
(Measured in Dollars)



$$SV = BCWP - BCWS$$

Earned Schedule
(Measured in Time)



$$SV_t = ES \text{ Date} - \text{Actual Time}$$



Relevant in all Conditions

<p>Slow and Late</p> <p>$SPI_t = .6$ $SV_t = -9$ days</p>	<p>Fast and Late</p> <p>$SPI_t = 1.3$ $SV_t = -9$ days</p>	<p>On Pace and Late</p> <p>$SPI_t = 1.0$ $SV_t = -9$ days</p>
<p>Slow and Early</p> <p>$SPI_t = .6$ $SV_t = +7$ days</p>	<p>Fast and Early</p> <p>$SPI_t = 1.3$ $SV_t = +7$ days</p>	<p>On Pace and Early</p> <p>$SPI_t = 1.0$ $SV_t = +7$ days</p>
<p>Slow and On Time</p> <p>$SPI_t = .6$ $SV_t = 0$ days</p>	<p>Fast and On Time</p> <p>$SPI_t = 1.3$ $SV_t = 0$ days</p>	<p>On Pace and On Time</p> <p>$SPI_t = 1.0$ $SV_t = 0$ days</p>
<p>$SPI = 1.0$ $SV = \\$0$</p>		

Schedule Performance Index – Time (SPI_t)

SPI_t – schedule efficiency (in periods)
demonstrated to date

- EVM Counterpart: CPI, SPI
- $SPI_t < 1.0$ Behind Schedule or Finished Late
- $SPI_t = 1.0$ On Schedule or Finished on Time
- $SPI_t > 1.0$ Ahead of Schedule or Finished Early

$$SPI_t = ES / AT$$

Additional Metrics

PDWR – Planned Duration of Work Remaining
(EVM Counterpart: BCWR)

- Portion of the project duration not yet EARNED
- From ES Date to Planned Completion Date

EDWR – Estimated Duration of Work Remaining
(EVM Counterpart: ETC)

- Duration forecasted to complete the remaining ETC scope
- From Time Now to Estimated Completion Date

To Complete Indicators

$TSPI_{BCWS}$ – To-Complete Schedule Performance Index - Baseline

- Schedule efficiency needed to achieve the Baseline completion date
- EVM Counterpart: $TCPI_{BAC}$

$$TSPI_{BCWS} = (PD - ES) / (PD - AT)$$

To Complete Indicators (continued)

$TSPI_{ETC}$ – To-Complete Schedule Performance Index - Forecast

- Schedule efficiency needed to achieve Forecast completion date
- EVM Counterpart: $TCPI_{EAC}$

$$TSPI_{ETC} = (PD - ES) / (ED - AT)$$

EVM, including Earned Schedule

$$SV_t = ES - AT$$

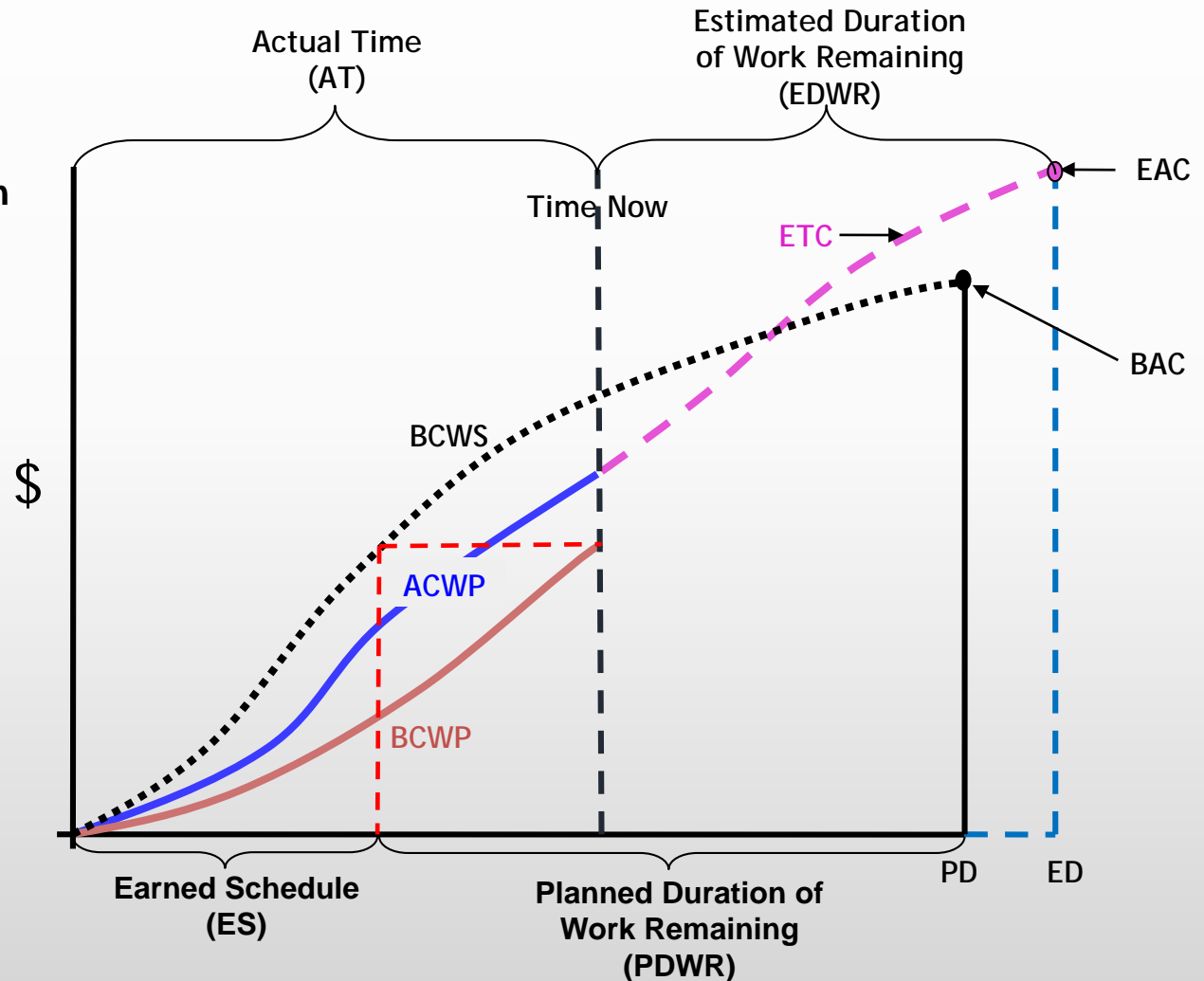
- Schedule Slip Duration

$$SPI_t = \frac{ES}{AT}$$

- Schedule efficiency demonstrated to date

$$TSPI_{ETC} = \frac{PDWR}{EDWR}$$

- Future schedule efficiency needed to make the Estimated completion date



Earned Schedule Example

$$SV_t = 22 - 28 = -6$$

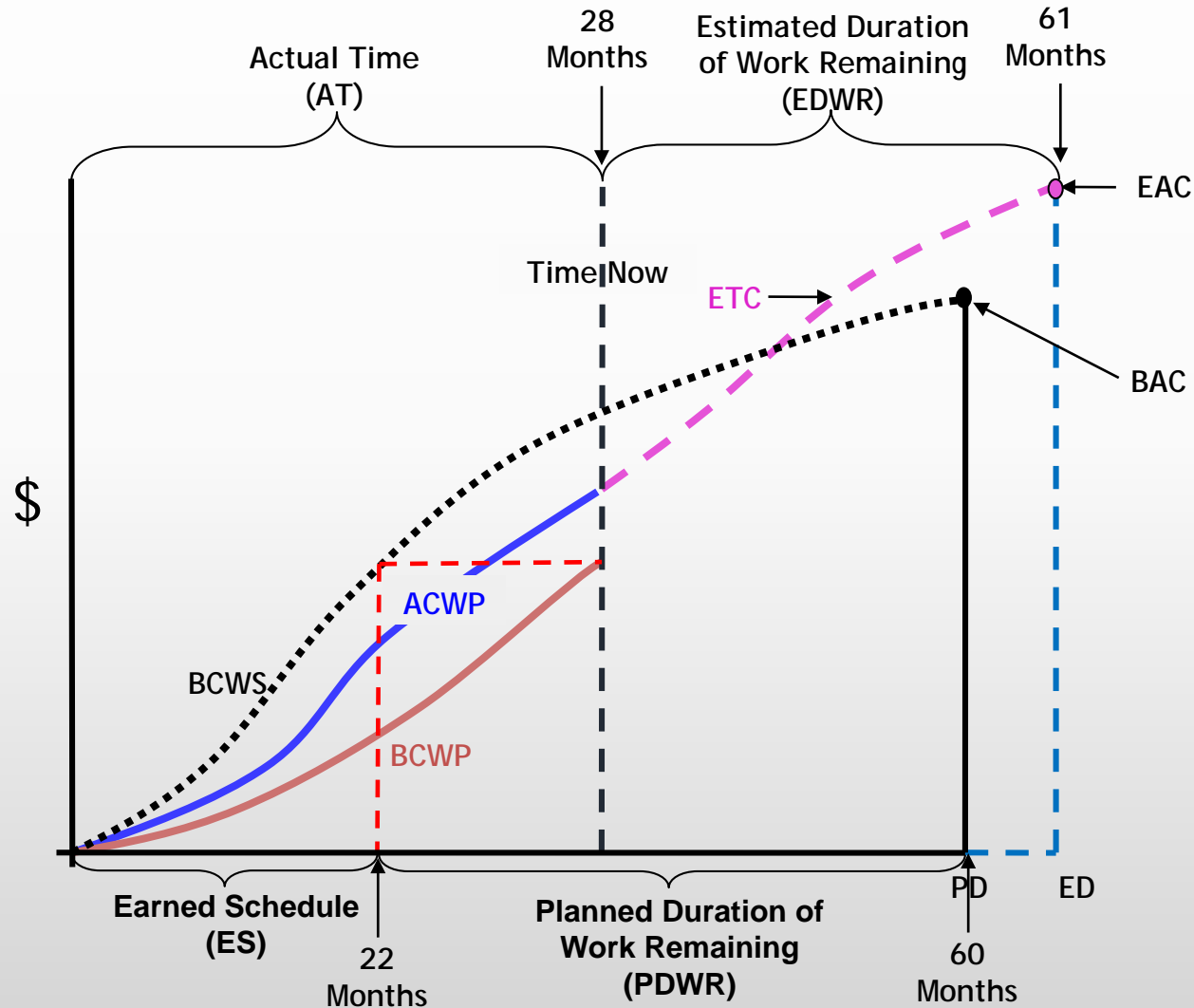
- The current BCWP was planned 6 months ago

$$SPI_t = \frac{ES}{AT} = \frac{22}{28} = .79$$

- For every month of work planned, only .79 of the month has been earned

$$TSPI_{ETC} = \frac{PDWR}{EDWR} = \frac{38}{33} = 1.15$$

- To hit the ED, must earn 1.15 per month going forward



Can the project be completed as Planned? Or as Forecasted?

TSPI_t Value:

Predicted Outcome:

≤ 1.00

Probably Achievable

$> 1.00 - < 1.10$

Might Be Achievable

> 1.10

Unlikely to be Achievable

Independent Estimate Completion Date

- $IECD_t$
 - Predict completion dates, to compare against planned dates
 - EVM Counterpart: IEAC used to predict final cost
 - Result displayed in Periods (weekly, monthly)

$$IECD_t = PD / SPI_t$$

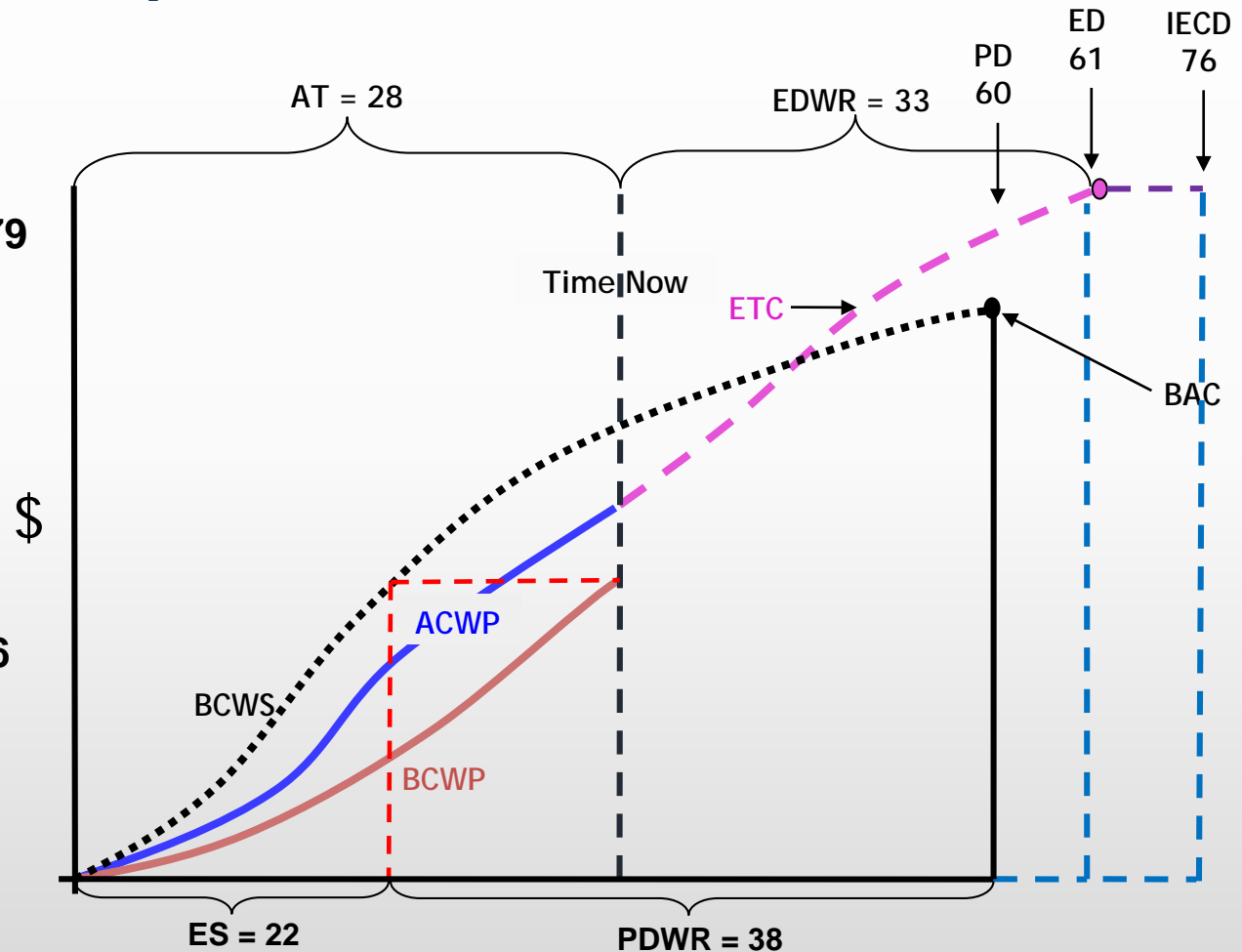
Independent Estimate Completion Date Example

$$SPI_t = \frac{ES}{AT} = \frac{22}{28} = .79$$

- For every month of work planned, only .79 of the month has been earned

$$IECD_t = \frac{PD}{SPI_t} = \frac{60}{.79} = 76$$

- If the Project earns as it has, it will complete in Month 76



Earned Schedule Formulas

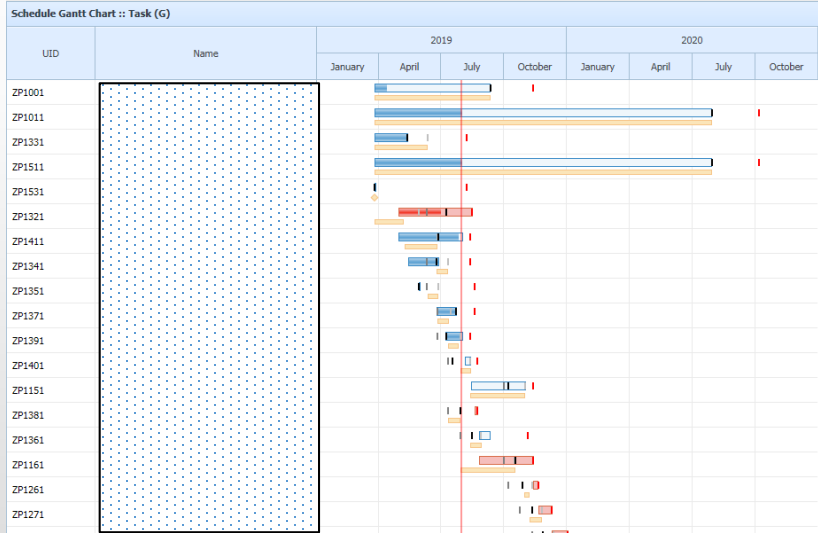
Metrics	Earned Schedule	ES	$ES = ES \text{ Date} - \text{Baseline Start}$
	Actual Time	AT	$AT = \text{number of periods executed}$
	Planned Duration of Work Remaining	PDWR	$PDWR = PD - ES$
	Estimated Duration of Work Remaining	EDWR	$EDWR = ED - AT$
Indicators	Schedule Variance	SV_t	$SV_t = ES - AT$
	Schedule Performance Index	SPI_t	$SPI_t = ES / AT$
	To Complete Schedule Performance Index	TSPI	$TSP_{I_{BCWS}} = (PD - ES) / (PD - AT)$ $TSP_{I_{ETC}} = (PD - ES) / (ED - AT)$
Predictors	Independent Estimate Completion Dates	$IECD_t$	$IECD_t = PD / SPI_t$ $IECD_t = AT + (PD - ES) / PF_t$

Project Analysis Tool

- Web-based project analytics tool calculates Earned Schedule, presents results in periods
- Added Custom Fields to convert Earned Schedule Periods to Dates
 - $IPCD_t$ – Provides Independent Planned Completion Date
 - $IPCD_{SPI_t}$ – Provides Independent Planned Completion Date based on SPI_t
 - $IECD_t$ – Provides Independent Estimate Completion Date
 - $IECD_{SPI_t}$ – Provides Independent Estimate Completion Date based on SPI_t

Sample Earned Schedule Dashboard

LL	HIER	WBS	DESCRIPTION	ElemType	LVL	BCWS	BCWP	ACWP	BAC	EAC	BL Finish	IPCD(t)	IPCD(SPI)	FC Finish	IECD(t)	IECD(SPI)	LastAorE	PD	ED	ES	IEAc(t)	SV(t)	SPI	SPI(t)	TspiEtc	TspiBcws
				Proj																						
11111	C.U.03.01.03			Proj	5	441,065	430,937	345,429	2,999,754	2,999,754	2020-09-29	2020-10-04	2020-10-17	2020-09-30	2020-10-05	2020-10-17	2020-09-30	18	18	3.803	18.197	-0.197	0.977	0.951	1.014	1.014
11111	C.U.03.04.01			Proj	5	1,639,090	1,170,665	815,711	8,205,727	8,132,390	2021-02-23	2021-03-22	2021-06-27	2021-03-01	2021-03-28	2021-07-30	2021-04-18	29	30	8.072	29.928	-0.928	0.714	0.897	0.997	1.046
11111	C.U.03.01.01			Proj	5	716,103	676,587	301,006	4,977,806	4,977,806	2020-09-21	2020-10-01	2020-11-09	2020-10-02	2020-10-12	2020-12-11	2020-10-25	18	19	3.660	18.340	-0.340	0.945	0.915	0.956	1.024
11111	C.M.13.10.04			Proj	5	3,786,898	3,750,322	3,517,892	3,826,730	3,612,800	2019-08-15	2019-10-14	2019-12-02	2019-08-14	2019-10-13	2020-01-03	2019-09-30	35	36	31.000	37.000	-2.000	0.990	0.939	1.333	2.000
11111	C.M.13.20.05			Proj	5	2,856,436	2,091,473	2,010,199	7,788,642	7,788,624	2020-12-24	2021-02-22	2021-05-28	2021-02-03	2021-04-04	2021-06-29	2021-02-21	52	53	31.000	54.000	-2.000	0.732	0.939	1.050	1.105
11111	C.M.13.20.04			Proj	5	304,223	226,027	209,279	1,241,238	1,239,517	2020-01-06	2020-02-24	2020-04-23	2020-03-25	2020-05-13	2020-08-07	2020-04-19	17	20	9.348	18.652	-1.652	0.743	0.850	0.850	1.275



ITEM	APR 19	MAY 19	JUN 19	JUL 19
AT (Actual Time)	1	2	3	4
ES (Earned Schedule)	0.00	1.95	2.42	3.66
PD (Planned Duration)	18	18	18	18
PDWR (PD Work Rem)	18.00	16.05	15.58	14.34
ED (Estimated Duration)	18	18	18	19
EDWR (ED Work Rem)	17	16	15	15
SV\$	-23,183	-6,349	-79,979	-39,516
SV(t)	-1.00	-0.05	-0.58	-0.34
BEI	1.00	1.00	1.00	0.63
CEI	1.00	1.00	0.33	0.33
SPI(t)	0.00	0.98	0.81	0.92
CPI Cum	58.57	1.53	1.88	2.25
SPI Cum	0.93	0.99	0.87	0.94
TCPI BAC	0.94	0.97	0.95	0.92
TCPI EAC	0.99	0.96	0.95	0.92
TSPI(bcws)	1.06	1.00	1.04	1.02
TSPI(etc)	1.06	1.00	1.04	0.96
% Schedule	6.57	9.28	12.05	14.39

Earned Schedule Metrics

	IPCD(t)	IPCD(SPIt)	FC Finish	IECD(t)	IECD(SPIt)	LastAorE	PD	ED	ES	IEac(t)	SV(t)	SPI	SPI(t)	TspiEtc	TspiBcws
29	2020-10-04	2020-10-17	2020-09-30	2020-10-05	2020-10-17	2020-09-30	18	18	3.803	18.197	-0.197	0.977	0.951	1.014	1.014
23	2021-03-22	2021-06-27	2021-03-01	2021-03-28	2021-07-30	2021-04-18	29	30	8.072	29.928	-0.928	0.714	0.897	0.997	1.046
21	2020-10-01	2020-11-09	2020-10-02	2020-10-12	2020-12-11	2020-10-25	18	19	3.660	18.340	-0.340	0.945	0.915	0.956	1.024
15	2020-10-01	2020-10-02	2020-09-30	2020-10-01	2020-01-01	2020-09-30	25	25	21.000	22.000	1.000	0.888	0.888	1.000	2.000

Earned Schedule 12 Period Summary

Earned Schedule 12 Period Summary Report

ITEM	APR 19	MAY 19	JUN 19	JUL 19
AT (Actual Time)	1	2	3	4
ES (Earned Schedule)	0.00	1.95	2.42	3.66
PD (Planned Duration)	18	18	18	18
PDWR (PD Work Rem)	18.00	16.05	15.58	14.34
ED (Estimated Duration)	18	18	18	19
EDWR (ED Work Rem)	17	16	15	15
SV\$	-23,183	-6,349	-79,979	-39,516
SV(t)	-1.00	-0.05	-0.58	-0.34
BEI	1.00	1.00	1.00	0.63
CEI	1.00	1.00	0.33	0.33
SPI(t)	0.00	0.98	0.81	0.92
CPI Cum	58.57	1.53	1.88	2.25
SPI Cum	0.93	0.99	0.87	0.94
TCPI BAC	0.94	0.97	0.95	0.92
TCPI EAC	0.99	0.96	0.95	0.92
TSPI(bcws)	1.06	1.00	1.04	1.02
TSPI(etc)	1.06	1.00	1.04	0.96
% Schedule	6.57	9.28	12.05	14.39

Monthly Project Controls Reviews

- Project Analysis Tool used for Project Controls Reviews
 - AI Narrative Report
 - EVMS metrics
 - BEI/CEI Trends
 - CPI/SPI Trends
 - IEACs
- Added Earned Schedule to the Project Controls Reviews
 - Earned Schedule Periods
 - IECDs

Things to Consider...

- Earned Schedule should not be used as a standalone indicator
- LOE can skew indicators
- Use Earned Schedule in conjunction with Critical Path Analysis
- Avoid making definitive conclusions, since past performance may not be indicative of future performance

Key Takeaways

- Earned Schedule is an extension to EVM that allows cost metrics to be transformed to Time
- Similar to EV schedule metrics
 - Negative values are “under performing”
 - It’s measured against the “time” axis – not dollars
- Provides time-based schedule indicators
- Indicators do not fail late in the project
- Schedule analysis tool connected to EVM data

Questions?

