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Projects, Programs & Portfolio

Earned Value Management

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Earned Value Management

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Earned value management is a project management technique for measuring project performance and progress. It has the ability to combine measurements of the project management triangle:

- Scope
- Schedule, and
- Costs

In a single integrated system, Earned Value Management is able to provide accurate forecasts of project performance problems, which is an important contribution for project management.

Essential features of any EVM implementation include:

- a project plan that identifies work to be accomplished,
- a valuation of planned work, called Planned Value (PV) and,
- pre-defined "earning rules" (also called metrics) to quantify the accomplishment of work, called Earned Value (EV)
- Current expenditure on project, called Actual Cost (AC).

EVM and ITM Platform

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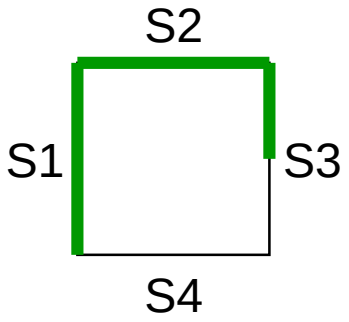
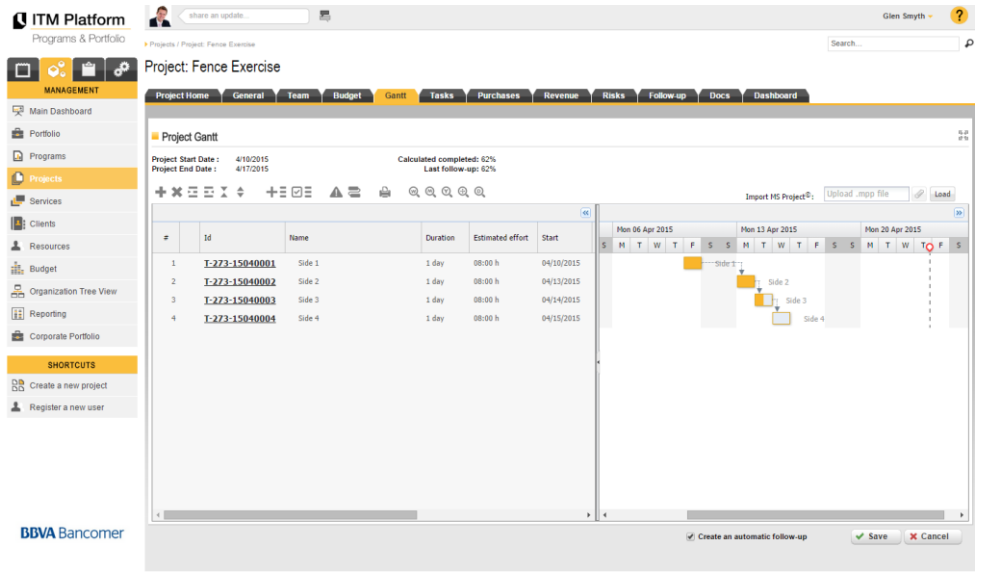
- You hire a bricklayer to build a 4 side fence in your backyard. Each side is built in sequence, one after the other. He charges by the hour, 200€ a day. Each side takes him one day of work. He starts working on 12/09/2011. You budgeted 800€.
- At the end of the 3rd day (14/09/2011):
  - He has completed side 1 (cost 200€)
  - and side 2 (cost 275€)
  - Side 3 is 50% complete (cost 200€)
- How much are you going to pay in the end?





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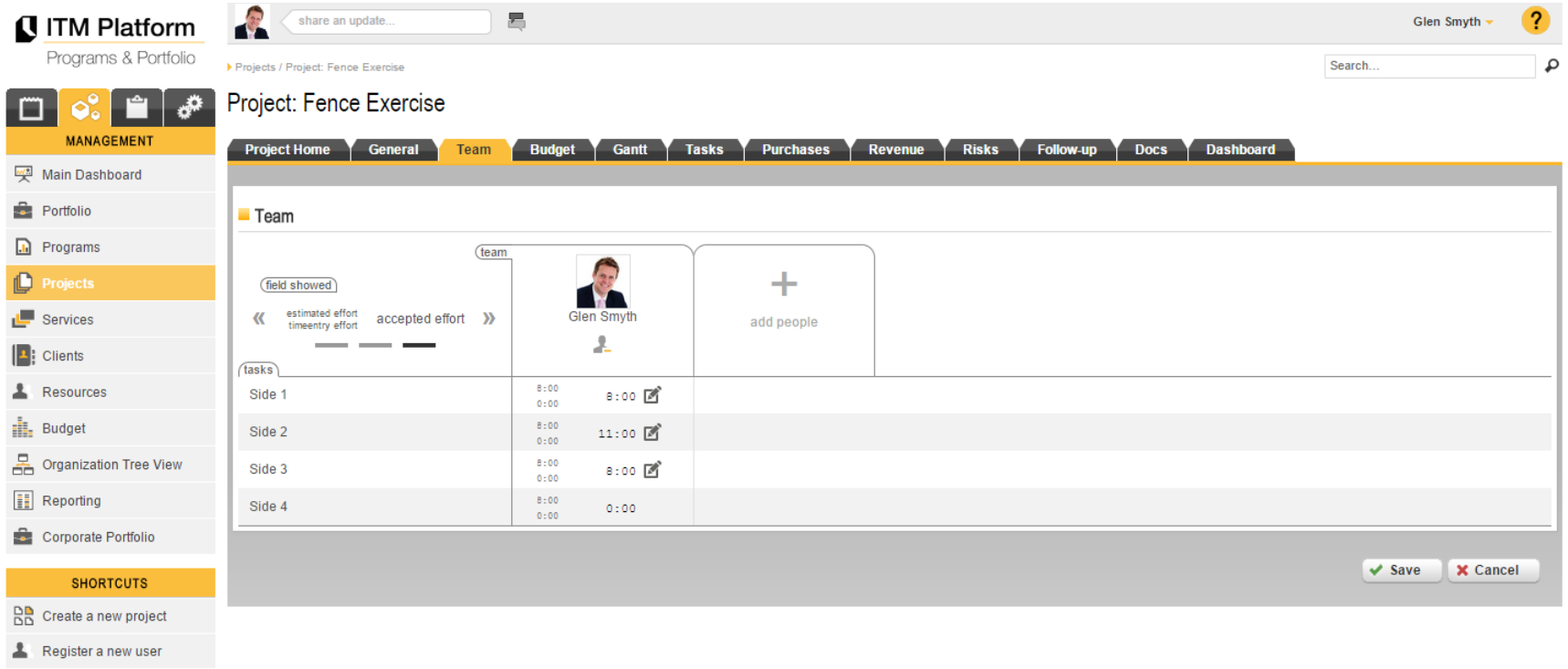
- You can see EVM data in view Follow-up Tab, table Earned Value
- Before that, you need to:
  - Assign resources to tasks
  - Enter standard rates for each resource
  - Register Actual Work + update pending Work for each task



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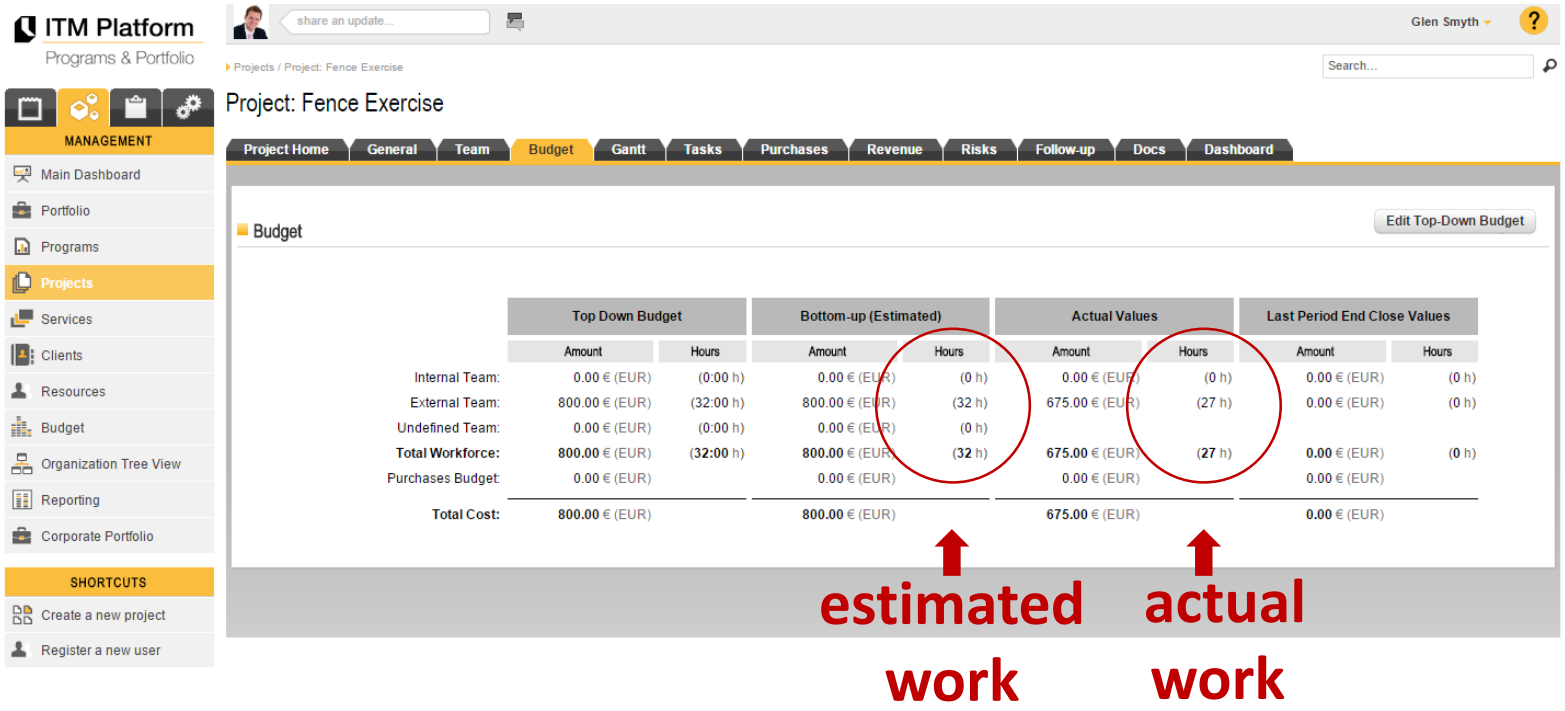
Estimated vs Actual



- Estimated Work = Planned hours for a resource/task (ongoing re-planning)
- Changing Work means re-planning: How many hours do we need to complete? When?
- Tasks are by default effort driven: Project will tend to keep the effort constant (person-hours)
- Estimated Cost = Work * Category Rate
- Actual Work = data entry
- Actual Cost = Actual Work * Category Rate

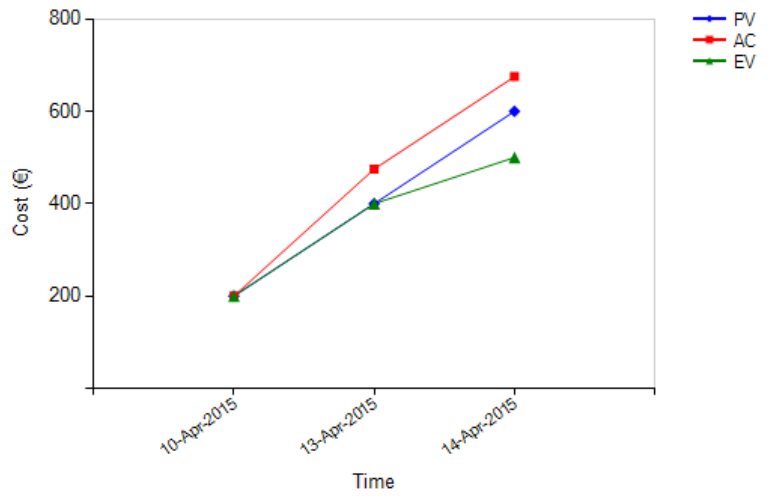
EVM and ITM Platform

ITM Platform calculates for us Earned Value Management variables, and also variations and indexes.

Earned Value

The **Earned Value** metrics provide indicators to measure project progress by analyzing variations in cost and scheduling, ascertaining whether costs and deadlines deviate from the plans.

Values at 4/14/2015		Hours	Cost
Budgeted Cost of Work Completed (BCWC)	BCWC	32:00	800.00 €
Budgeted Cost of Work Scheduled (BCWS)	BCWS	24:00	600.00 €
Actual Cost of Work Performed (ACWP)	ACWP	27:00	675.00 €
Budgeted Cost of Work Performed (BCWP)	BCWP	20:00	500.00 €
Cost Variation (CV)	CV	-07:00	-175.00 €
Schedule Variation (SV)	SV	-04:00	-100.00 €
Cost Performance Index (CPI)	CPI		0.74
Program Performance Index (PPI)	PPI		0.83



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The project value projections indicate how the main budget variables will be affected by considering three different scenarios.

Prediction: continuity scenario		Hours	Cost
Budgeted Cost on Conclusion (BCC)	BCC	32:00	800.00 €
Cost Performance Index (CPI)	CPI		0.74
Estimated Cost on Conclusion (ECC)	ECC		1,080.00 €

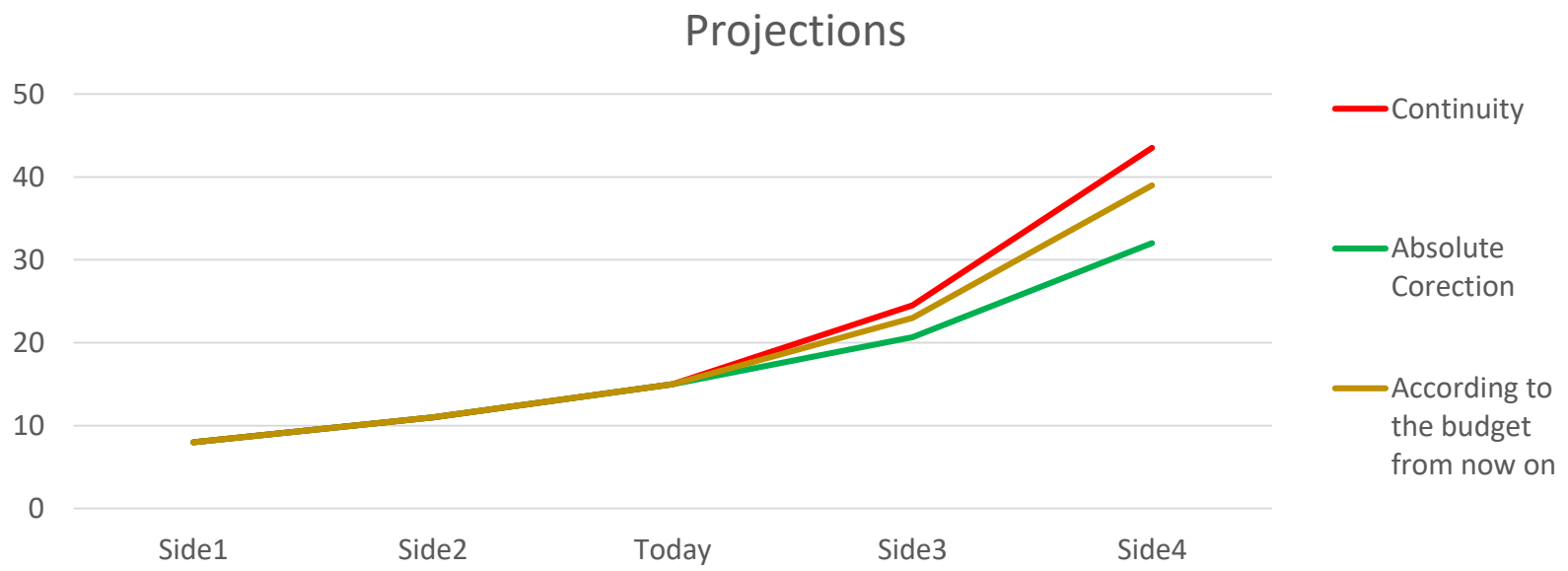
The "continuity" scenario assumes that there will be no variations in performance and performs a cost and deadline estimate based on the current situation.

Prediction: absolute correction		Hours	Cost
Budgeted Cost on Conclusion (BCC)	BCC		800.00 €
Cost Performance Index (CPI)	CPI		2.40
Estimated Cost on Conclusion (ECC)	ECC		800.00 €

The "absolute correction" scenario takes into consideration the performance required to fulfill the planned values, correcting where necessary the deviation which has occurred to date.

Prediction: according to the budget from now		Hours	Cost
Budgeted Cost on Conclusion (BCC)	BCC		800.00 €
Cost Performance Index (CPI)	CPI		1.00
Estimated Cost on Conclusion (ECC)	ECC		975.00 €

The "as per budget from now" scenario considers the performance required in order to fulfill the planned performance from this point onwards.



How is the project going?

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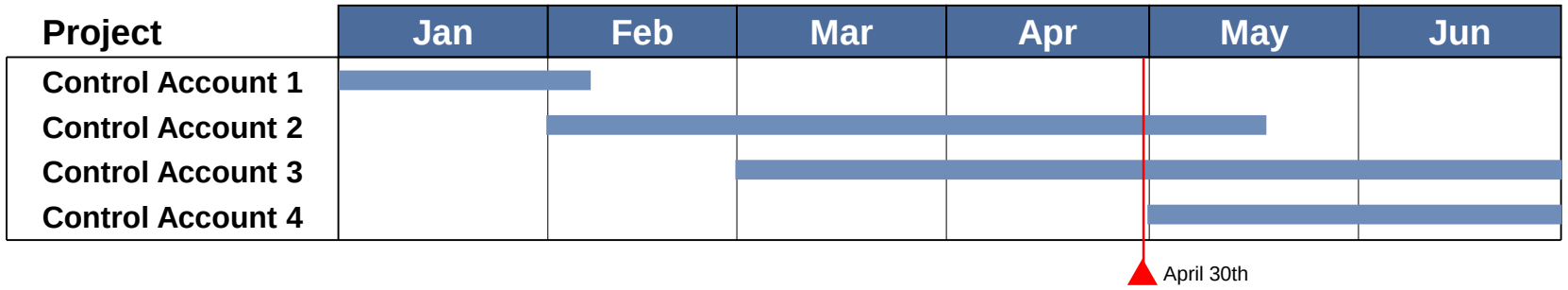
Good Practice: Control and Monitor cost at the Control Account level

A very simple case:

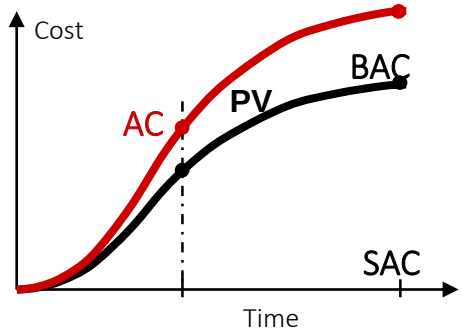
- 6 months duration project (4 control accounts)
- follow-up meeting on April the 30th



Data date April the 30th means nothing…

How is the project going?

Since the beginning, you have planned durations and costs estimations (if you prefer, you can manage working hours as your cost magnitude)
Since the beginning, you can have a representation of BAC over time
During execution, you can register actual work



Case:

- BAC= 6000 h (1500 + 1500 + 2000 + 1000)
- Work Scheduled by end of April = 4000 h (1500 + 1500 + 1000 + 0)
- Actual Work by end of April = 3700 h (1200 + 1000 + 1500 + 0)

Project	Jan	Feb	Mar	Apr	May	Jun	6000 / 4000 / 3700 (*)
Control Account 1							1500 / 1500 / 1200
Control Account 2							1500 / 1500 / 1000
Control Account 3							2000 / 1000 / 1500
Control Account 4							1000 / 0 / 0

(*) BAC / Planned Work / Actual Work

April 30th

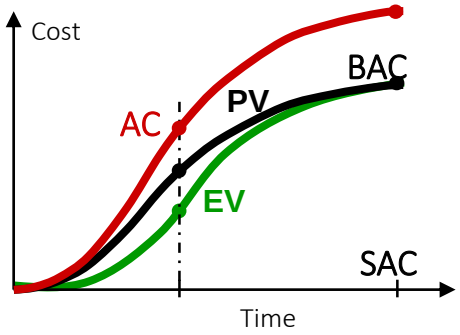
We have spent 300 hours less than planned.
Seems good… but you don't know yet

How is the project going?

For each Control Account, you register the % of work completed

The 3 points Planned / Actual / Complete is all what you need to get:

- Variance at this point
- Variance forecast in the end



Case:

Status report (58% completed):

- 3% of over budget (200 hours)
- 8% of delay (10 days)

Forecast report:

- 6% of over budget (343 hours)
- 14% of delay (17 days)

Project	Jan	Feb	Mar	Apr	May	Jun	6000 / 4000 / 3700 / 3500 (*)
Control Account 1							1.500 / 1.500 / 1.200 / 1.500 (100%)
Control Account 2							1.500 / 1.500 / 1.000 / 500 (33%)
Control Account 3							2.000 / 1.000 / 1.500 / 1.500 (75%)
Control Account 4							1.000 / 0 / 0 / 0 (0%)

April 30th

Planned-Actual-Complete tell us how is the project going and how is going to end
EVM is the accepted standard method (ANSI 748) to quantify project performance

EVM (standard ANSI 748)

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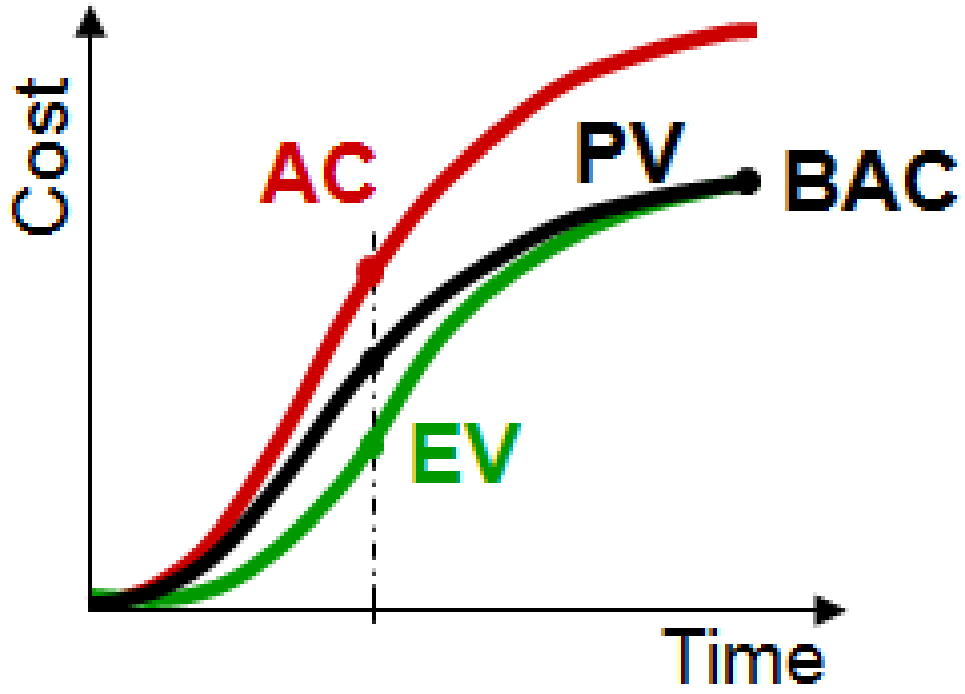
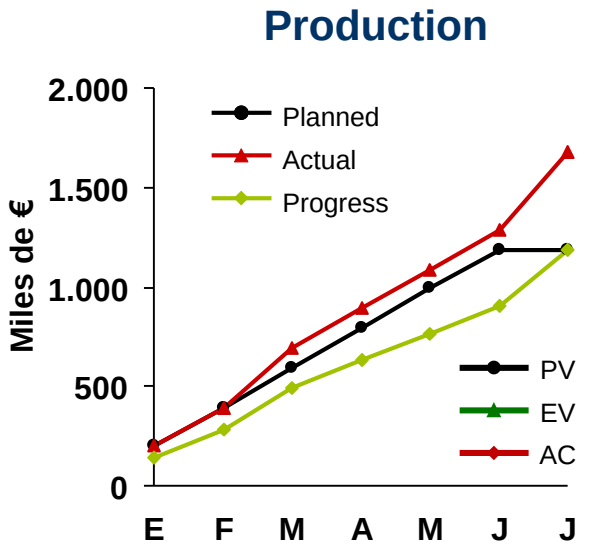


Earned Value Management

EVM it's a objective method used to measure executing progress. Combines three aspects of major importance in Project execution: technique (compliance of planned work), costs (if spend more tan planned) and Schedule (if project is delayed or ahead).



1. Detailed Project planning shows what and when to do, as how it will cost (staff and material effort). All this data is know as **Planned Value**, or the work scheduled.
2. On the other hand, based on planned tasks completion at Project's beginning calculated in each moment. This will result in what we know as **Earned Value**, or actual work developed.
3. Finally, at each moment we know **Actual Costs.**

Schedule and cost deviations on EVM

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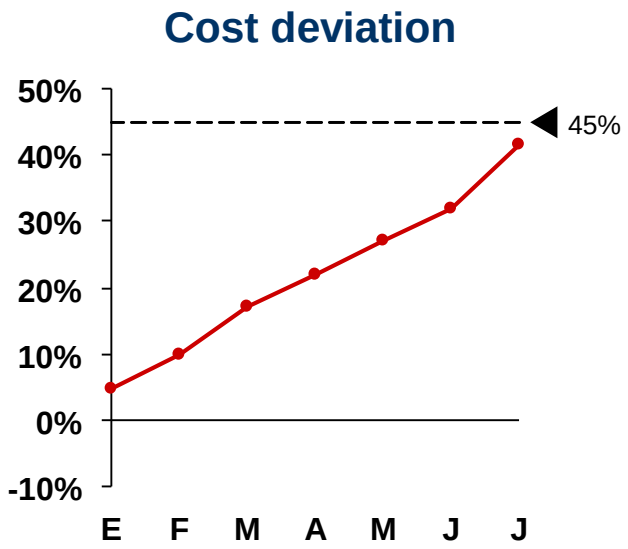
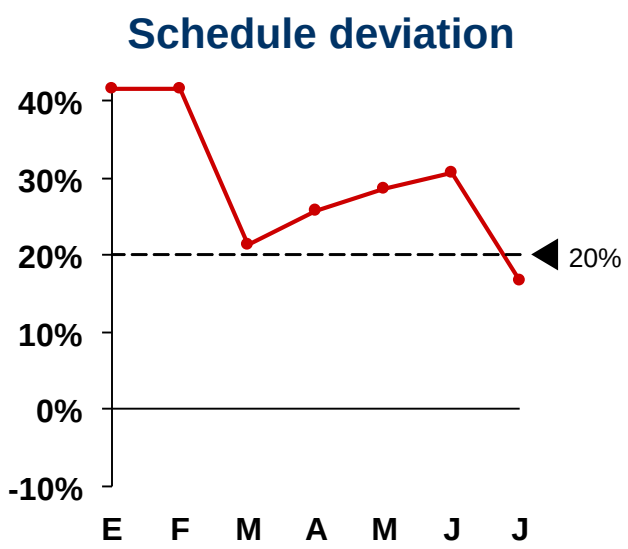
Earned Value Management technique is useful not only to report actual return of a Project, as well as estimate future Schedule and cost deviations.





EVM Breakthrough

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- EVM is already a standard in international projects related to defense and aeronautics and space sector.
- It was introduced by the US DoD to control internally or contracted projects efficiently.
- Later it spread throughout the American administration for acquisitions, control and monitoring of projects.
- Since 1998 ANSI 748 standard.

EVM Formulas

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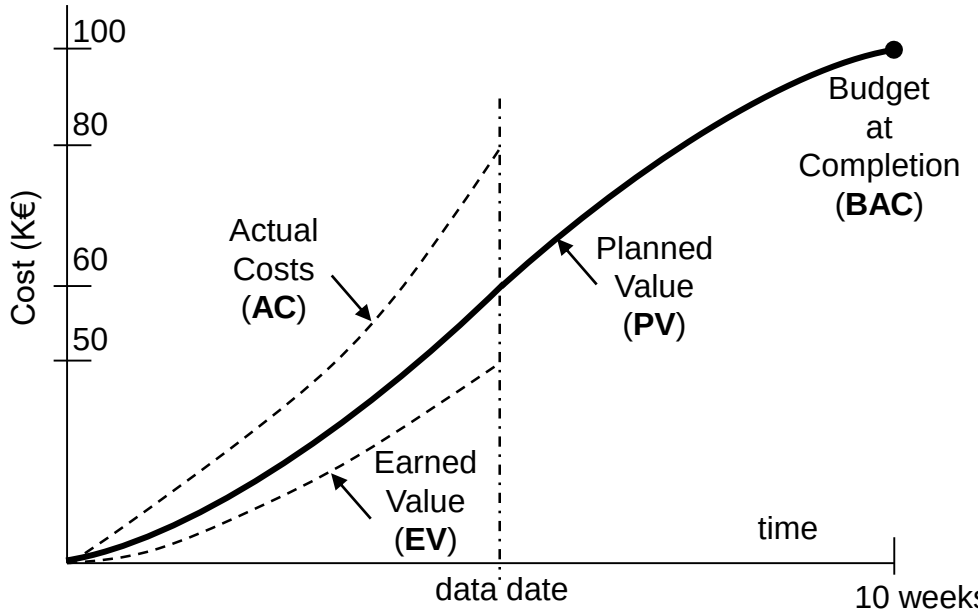
	Term		Formula	Value	Calculation	Interpretation
baseline	BAC	Budget At Completion		6000		We budget 6000 person-hours for the total project effort
	SAC	Schedule At Completion		120		We schedule 120 days for the total project effort
	PV	Planned Value		4000	= 1500+1500+1000	As of today, the estimated value of the work planned to be done was 4000
status	EV	Earned Value		3500	= 1500+1500*33%+2000*75%	As of today, the estimated value of the work actually accomplished has been of 3500
	AC	Actual Cost		3700	= 1200+1000+1500	As of today, the actual cost incurred for the work accomplished has been of 3700
	CV	Cost Variance	EV-AC	-200	= 3500-3700	Negative is over budget; positive is under budget
	SV	Schedule Variance	EV-PV	-500	= 3500-4000	Negative is behind schedule; positive is ahead of schedule
	TV	Time Variance	SV / (BAC/SAC)	-10	= -500/(6000/120)	We have a cummulated delay of 10 days
	CPI	Cost Performance Index	EV/AC	0.95	= 3500/3700	We are getting 95 cents out of every euro spent. Funds are not being used efficiently
	SPI	Schedule Performance Index	EV/PV	0.88	= 3500/4000	We are only progressing at 88% of the rate originally planned
	POC	Percentage of Completion	EV/BAC = AC/EAC	58%	= 3500/6000 = 3700/6343	We have completed 58% of the work so far
	TCPI	To Complete Performance Index	(BAC-EV) / (BAC-AC)	1.09	= (6000-3500)/(6000-3700)	We need to produce 1,09€ for each euro invested in order to end on budget
forecast	EAC	Estimate At Completion	BAC/CPI = AC+ETC	6343	= 6000/0.95 = 3700+2643	We currently expect a total cost of 6343 person-hours
	ETC	Estimate To Complete	(BAC-EV)/CPI = EAC-AC	2643	= (6000-3500)/0.95 = 6343-3700	From this point on, we expect it to cost 2643 person-hours more to finish the project
	VAC	Variance At Completion	BAC-EAC	-343	= 6000-6343	As of today, we expect to be 343 person-hours over budget at the end of the project
	TEAC	Time Estimate At Completion	SAC/SPI	137	= 120/0.88	We currently expect a total duration of 137 days
	TVAC	Time Variance At Completion	SAC-TEAC	-17	= 120-137	As of today, we expect to be 17 days behind schedule at the end of the project

PV, EV, AC defined

Former names

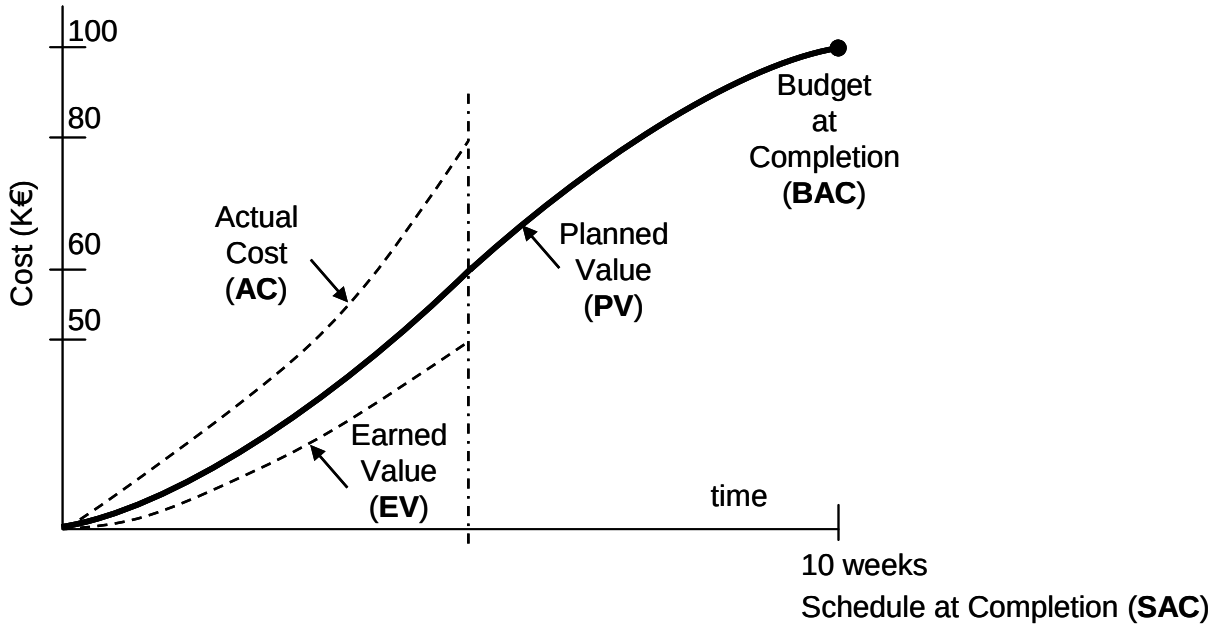
PV = **BCWS** = Budget Cost of Work Scheduled
EV = **BCWP** = Budget Cost of Work Performed
AC = **ACWP** = Actual Cost of Work Performed



Planned Value (PV)	PV is the budgeted cost for the work scheduled to be completed on an activity or WBS component up to a given point in time.
Earned Value (EV)	EV is the budgeted amount for the work actually completed on the schedule activity or WBS component during a given time period.
Actual Cost (AC)	AC is the total cost incurred in accomplishing work on the schedule activity or WBS component during a given time period. This AC must correspond in definition and coverage to whatever was budgeted for the PV and the EV (e.g., direct hours only, direct costs only, or all costs including indirect costs).

Project duration 10 weeks, budget 100 k€. In follow-up meeting PV=60 k€, AC=80 k€, EV=50 k€

- Cost Variance CV= EV-AC=50-80= -30 k€ (negative meaning over budget 30 k€)
- Schedule Variance SV= EV-PV=50-60= -10 k€ (negative meaning behind schedule). In the end SV=0
- Cost Performance Index CPI = EV/AC = 0.63 (minor than 1 meaning over budget: 1€ invested produces 63c)
- Schedule Performance Index SPI = EV/PV = 0.83 (minor than 1 meaning behind schedule). In the end SPI=1



Earned Value Management Variances

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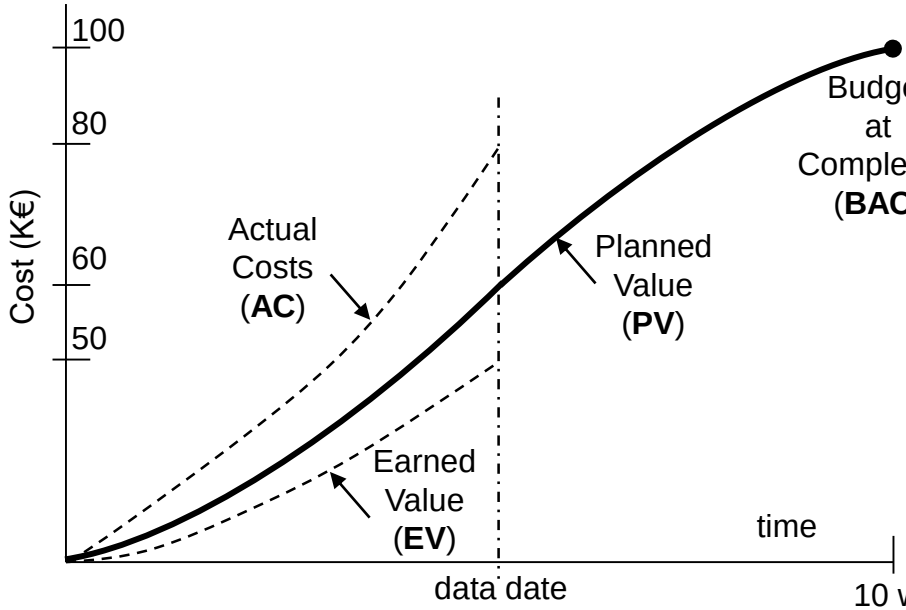
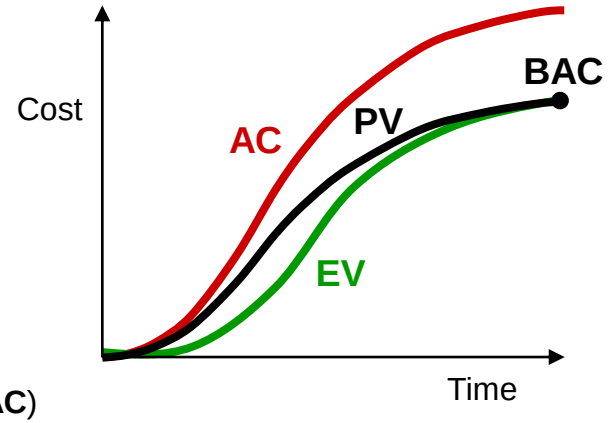
- CV at the end of the project will be the difference between the budget at completion (BAC) and the actual amount spent.
- SV will ultimately equal zero when the project is completed because all of the planned values will have been earned.

CV	Cost Variance	EV – AC
SV	Schedule Variance	EV – PV
PVR	Planned Value rate	BAC / SAC
TV	Time Variance	SV / PVR
CVP	Cost Variance Percent	CV / EV
SVP	Schedule Variance Percent	SV / EV

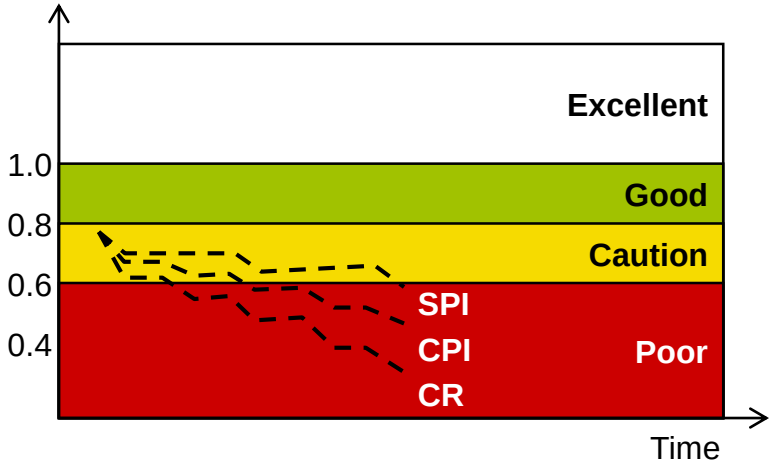


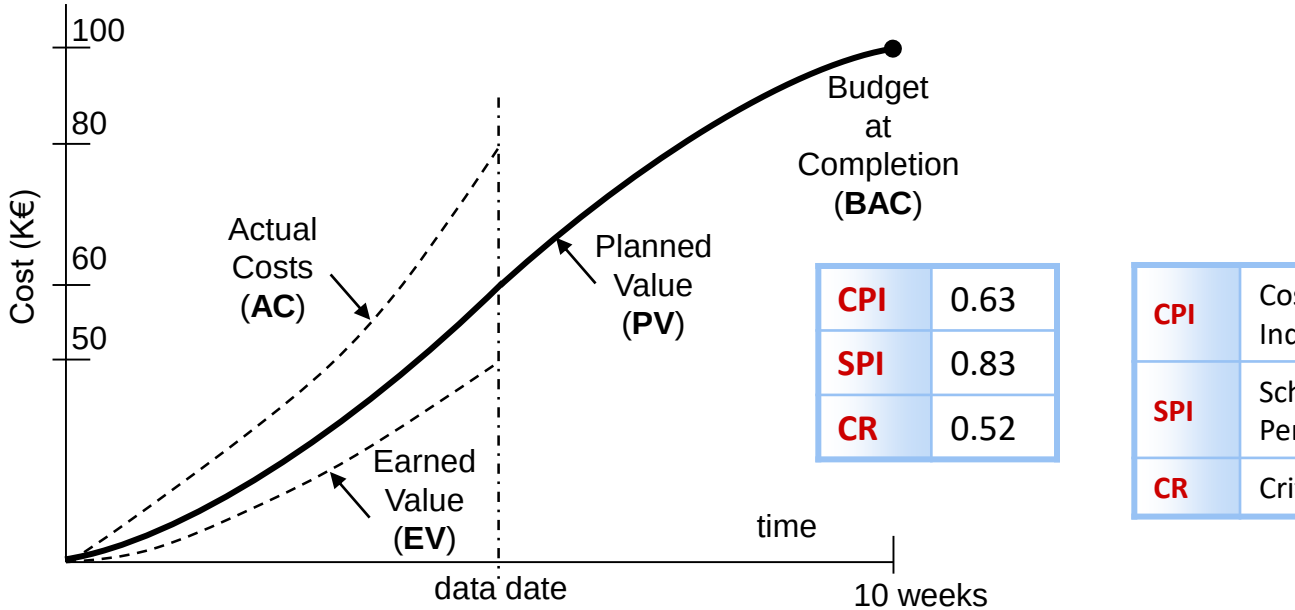
CV	-30 K€
SV	-10 K€
TV	-1 week
CVP	-60%
SVP	-20%



Performance Indexes

- CPI < 1.0 indicates cost overrun
- SPI < 1.0 indicates schedule slippage
- CR > 1.0 indicates good global performance

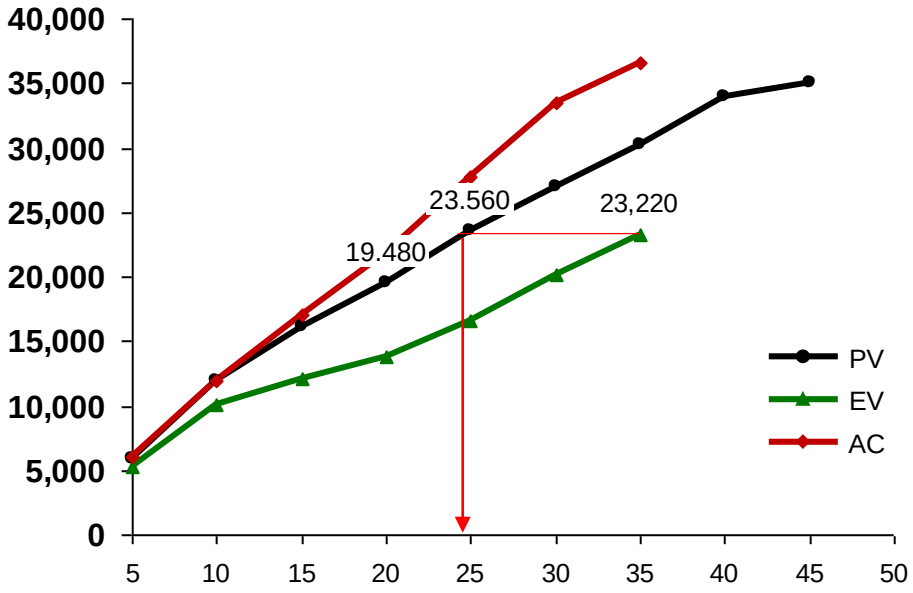


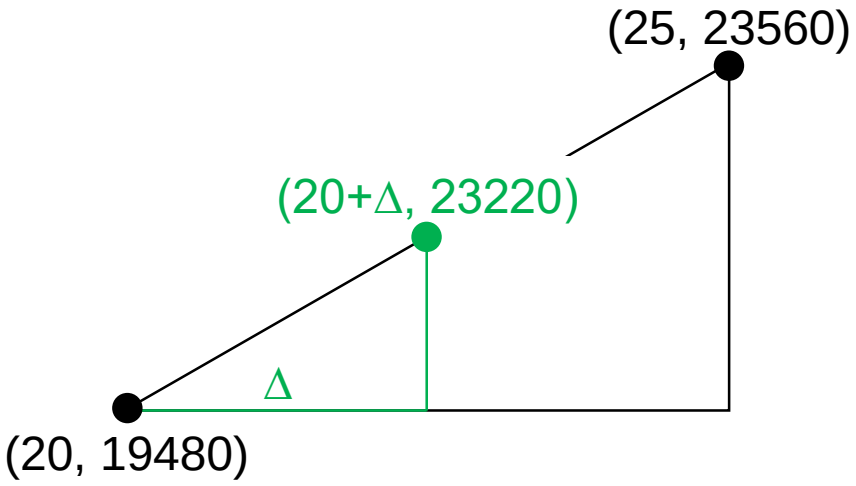


CPI	0.63
SPI	0.83
CR	0.52

CPI	Cost Performance Index	CPI = EV / AC
SPI	Schedule Performance Index	SPI = EV / PV
CR	Critical Ratio	CR = SPI x CPI

Earned Schedule (ES)





SV(t)

ES **AT**

$$\frac{23220 - 19480}{\Delta} = \frac{23560 - 19480}{25\text{-}20}$$

ES = 20 + Δ = 24.58 days

SV(t) = Schedule Variance in units of time = ES- Actual Time = 24.58-35 = -10.42 days

Forecasting

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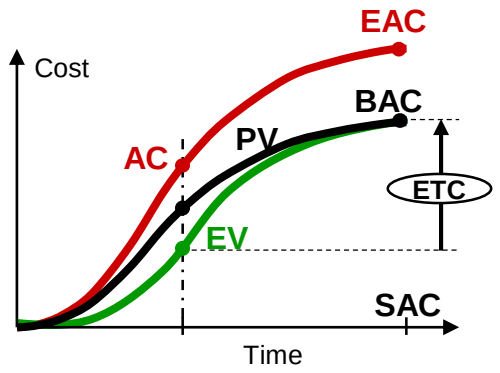
- Estimate At Completion EAC is always equal to Actual Cost plus Estimated to Complete
- EAC = AC + ETC
- What it takes to complete the project (ETC) will depend on the situation. Four typical scenarios are:
  - When the assumptions are incorrect: **new estimate for the remaining work**
  - When the current variances are not typical -> **remaining budget**: ETC = BAC - EV



EAC = BAC/ CPI

  - When the current variances are expected to remain the same:
    - remaining budget affected by cost performance factor: ETC = (BAC - EV) / CPI
    - remaining budget affected by cost and schedule performance factors : ETC = (BAC - EV) / (CPI * SPI)

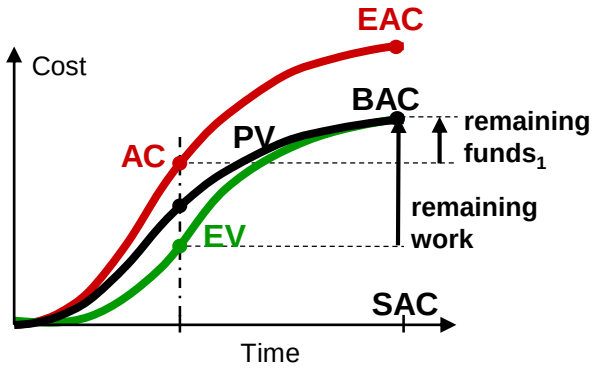
Forecasting

- The ratio To Complete Performance Index (TCPI) is remaining work / remaining funds
- It means how much work should be get out of each unit invested
- Two scenarios:
  - If cost limit is Budget at Completion (BAC):
    - $TCPI_1$ = (BAC-EV) / (BAC-AC)
  - If cost limit is Estimated at completion (EAC):
    - $TCPI_2$ = (BAC-EV) / (EAC-AC)

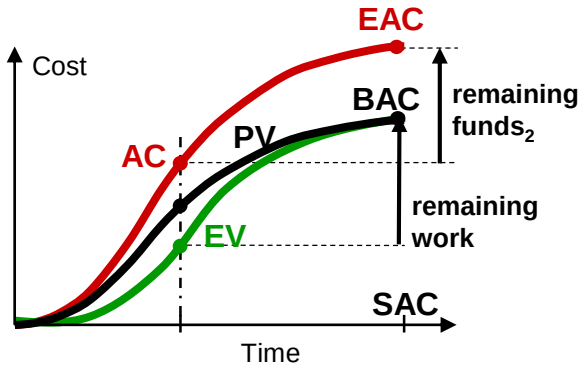
TCPI = 1.09
We need to produce 1,09€ for each euro invested in order to end on budget

CPI = 0.95
We are getting 95 cents out of every euro spent

$TCPI_1$



$TCPI_2$



Using EVM in corporate reports

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- Budget 100 M€, duration 5 years (60 months)
- At the end of year 4, actual cost 90 M€, planned cost 80 M€
- Progress 75% (Earned Value 75 M€)

- EV = 75 M€; AC = 90 M€; PV = 80 M€
- CPI = 75 / 90 = 0.83
- CV = 75 - 90 = **-15 M€**
- ETC = (100 - 75)/ 0.83 = 30 M€
- EAC = 90 + 30 = 100 / 0.83 =120 M€
- VAC = 100 - 120 = **-20 M€**

- SPI= 75 / 80 = 0.94
- SV = 75 - 80 = -5 M€
- TV = (75 - 80) / (100/60) = **-3 months**
- TEAC = 60 / 0.94 = 64 months
- TVAC = 60 - 64 = **-4 months**

Current over budget of 15 M€
Expected final over budget of 20 M€
Current delay of 3 months
Expected final delay of 4 months

Sarbanes-Oxley
material financial issues

Using EVM in our previous case

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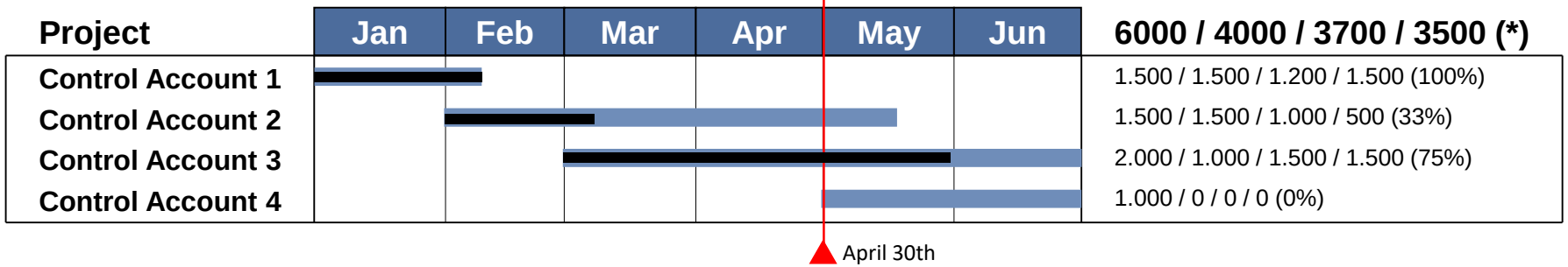
Status report (58% completed):

- 3% over budget (200 hours)
- 8% of delay (10 days)

Forecast report:

- 6% over budget (343 hours)
- 14% of delay (17 days)



Data:

- BAC = 6000
- SAC = 6 *20 = 120
- PV = 4000
- AC = 3700
- EV = 3500

Status report:

- POC = EV / BAC = 3500 / 6000 = 58%
- CV= 3500-3700 = -200
- SV = 3500-4000 = -500
- TV= SV / (SAC/BAC) = -500/(6000/120) = -10
- CPI = 3500 / 3700 = 0.945
- SPI = 3500 / 4000 = 0.875

Forecast report:

- EAC = BAC / CPI = 6000 / 0.945 = 6343
- VAC = BAC – EAC = 6000 - 6343 = -343
- TEAC = SAC / SPI = 120 / 0.875 = 137
- TVAC = SAC - TEAC = -17

Using EVM in the management language

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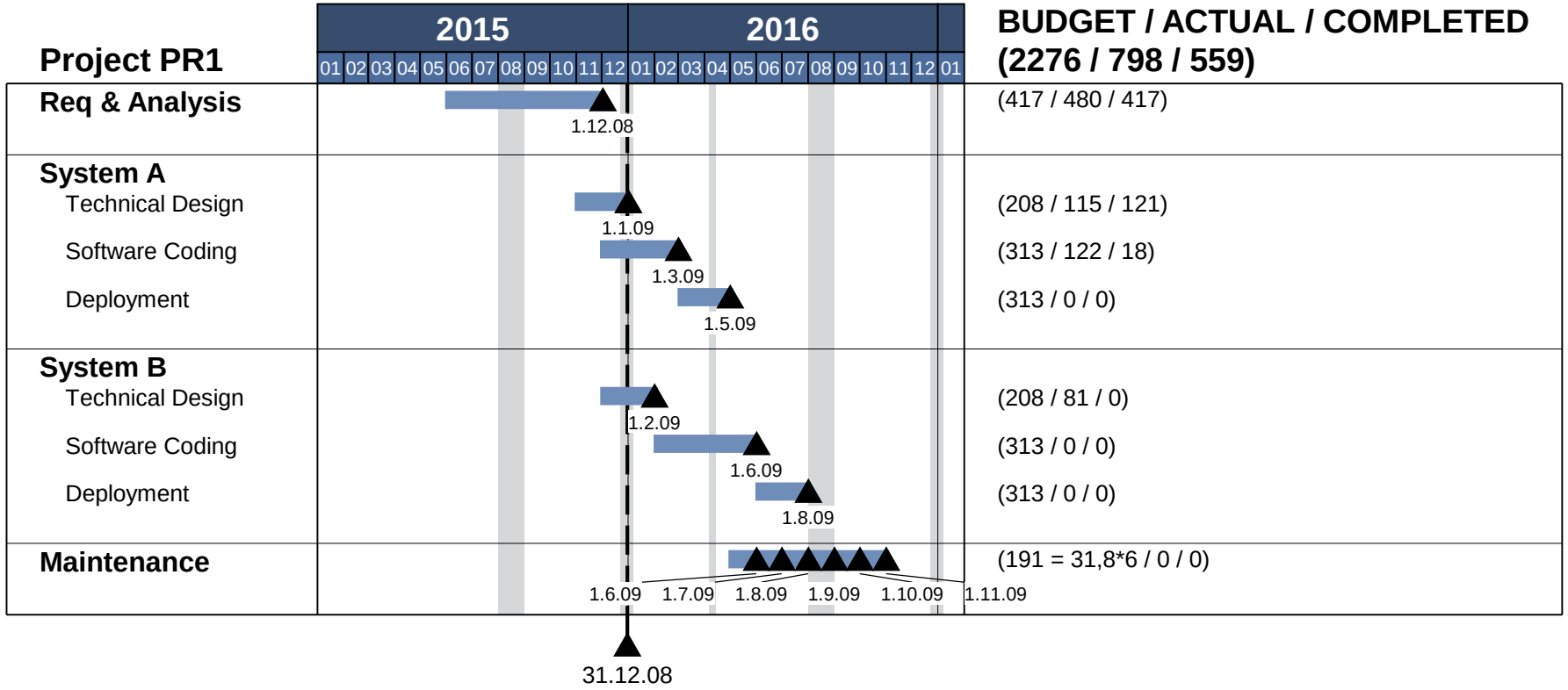
Planned 758 k€; Actual 798 k€; Completed 559 k€; ETC **2.178 k€**

Status Report: Over budget **239 k€**; Slippage **1.3 months**

Forecast Report: Over budget **891 k€** (**43%**); Slippage **5 months**



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