Earned Value Analysis Exercise

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Author: Adolfo Villafiorita
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Given the following project plan:

ID	Task	Immediate Predecessor (*)	Expected Duration (days)	Budget ($)
A	Meet with client		5	500
B	Write SW	A	20	10000
C	Debug SW	B	5	1500
D	Prepare draft manual	B	5	1000
E	Meet with clients	D	5	1000
F	Test SW	C, E	20	2000
G	Make modifications	F	10	8000
H	Finalize manual	G	10	5000
I	Advertise	C, E	20	8000

(*) all dependencies are assumed to be FS – Finish to Start

And the following progress status:

ID	Task	Status	Actual Start (days)	Actual Duration (days)	Actual costs ($)
A	Meet with client	100%			1500
B	Write SW	100%	+5 days	+10 days	9000
C	Debug SW	100%	+15 days	+5 days	2500
D	Prepare draft manual	100%	As per other delays		1000
E	Meet with clients	100%	As per other delays		1000
F	Test SW	100%	As per other delays		750
G	Make modifications	0%	As per other delays		0
H	Finalize manual	0%	As per other delays		0
I	Advertise	10%	+5 on top of other delays		1000

Perform an analysis of the project status at week 13, using EVA. Use the CPI and SPI to determine project efficiency.

Solution

Earned Value Analysis is discussed in: http://www.spmbook.com/downloads/slides/pdf/C03-08-09-ExecutionMonitoringControl.key.pdf

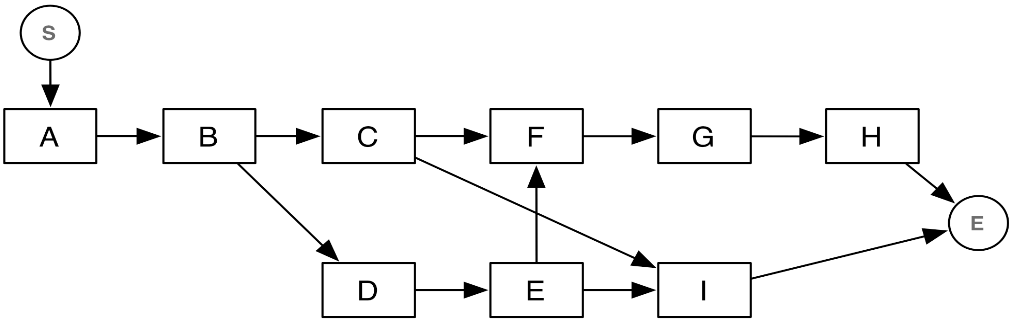
We organize the solution as follows:

1. Drawing the Gantt chart of the plan
2. Drawing the Gantt chart of the actual plan (progress status)
3. Perform the analysis (plot PV, AC, EV, CPI, SPI)

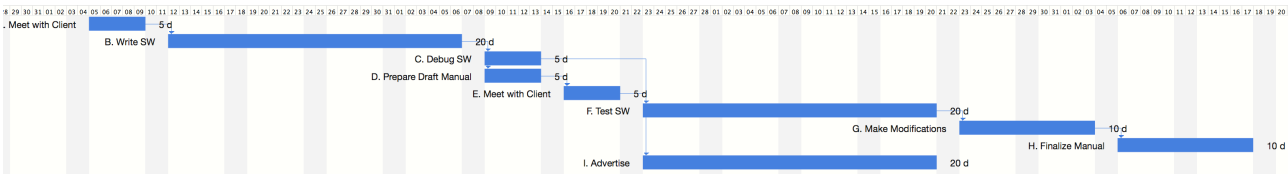
1. Drawing the Gantt chart of the plan

We start by drawing the network diagram using the information about immediate predecessors. (This is not stritcly necessary: the Gantt chart can be drawn directly, if you manage to take into account dependencies and durations at the same time, which should not be too complex.)

This is shown in the following figure, where we use the AON (Activity on Node) notation:



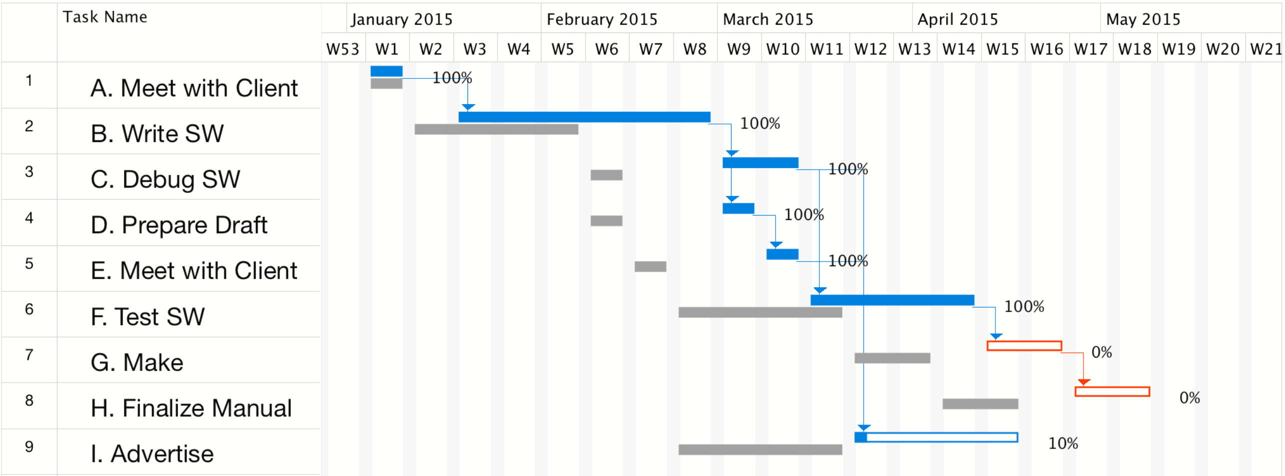
The Gantt chart can now be easily drawn, by taking into account the expected duration of each activity. The result is shown in the following diagram (notice that we are assuming the duration to be expressed in working-days and that we are using a “standard” calendar, in which saturday and sunday are non-working time):



2. Drawing the Gantt chart of the actual plan (progress status)

The actual Gantt chart can be drawn by taking into account the information about delays, variations in duration, and actual completion. The main point of attention (when doing this work manually), is taking into account the constraints. Gantt charting tools, fortunately, can do this for us automatically.

The following figure shows the two plans, the baseline (or initial) plan, shown in the lower part of each activity and the actual plan, shown in the upper part of each activity:



As it can ben seen, the delay on activity B delays all other activities in the plan. The activities marked in red are in the critical path.

3. Perform the analysis (plot PV, AC, EV, CPI, SPI)

To perform the assessment, we start by computing and plotting PV, AC, and EV.

PV is the sum of planned costs. It is computed by determining for each reporting period, the cost associated to each activity and by summing and cumulating them over time.

The following table summarizes the planned costs over time. It is computed as follows:

- Each column of the table represents one week (we show only the first 13 weeks)
- The planned costs of each activity is taken from the first table of the question
- For each activity, we compute the weekly cost (activity cost / duration in weeks) and accrue the cost for each week in which the activity lasts. For instance B has a total planned cost of 10000 and a duration of four weeks, from W2 to W5. Therefore we accrue 2500 in weeks W2 to W5 for B.
- We then compute the cumulative costs, by summing planned expenditure week by week.

		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	Total
A	Meet with client	500													500
B	Write SW		2500	2500	2500	2500									10000
C	Debug SW						1500								1500
D	Prepare draft manual						1000								1000
E	Meet with clients							1000							1000
F	Test SW								500	500	500	500			2000
G	Make modifications												4000	4000	8000
H	Finalize manual														0
I	Advertise								2000	2000	2000	2000			8000
	Total	500	2500	2500	2500	2500	2500	1000	2500	2500	2500	2500	4000	4000	
	Planned Value	500	3000	5500	8000	10500	13000	14000	16500	19000	21500	24000	28000	32000	

AC is the sum of the actual costs incurred into. It is computed by looking at the actual costs when they took place. Similar to the previous case:

- For each activity, we look at its actual costs (second table of the question) and split them evenly for the actual duration of the activity, **<u>up to the monitoring date</u>** (that is, the date in which the analysis is performed)

The result is shown in the following table:

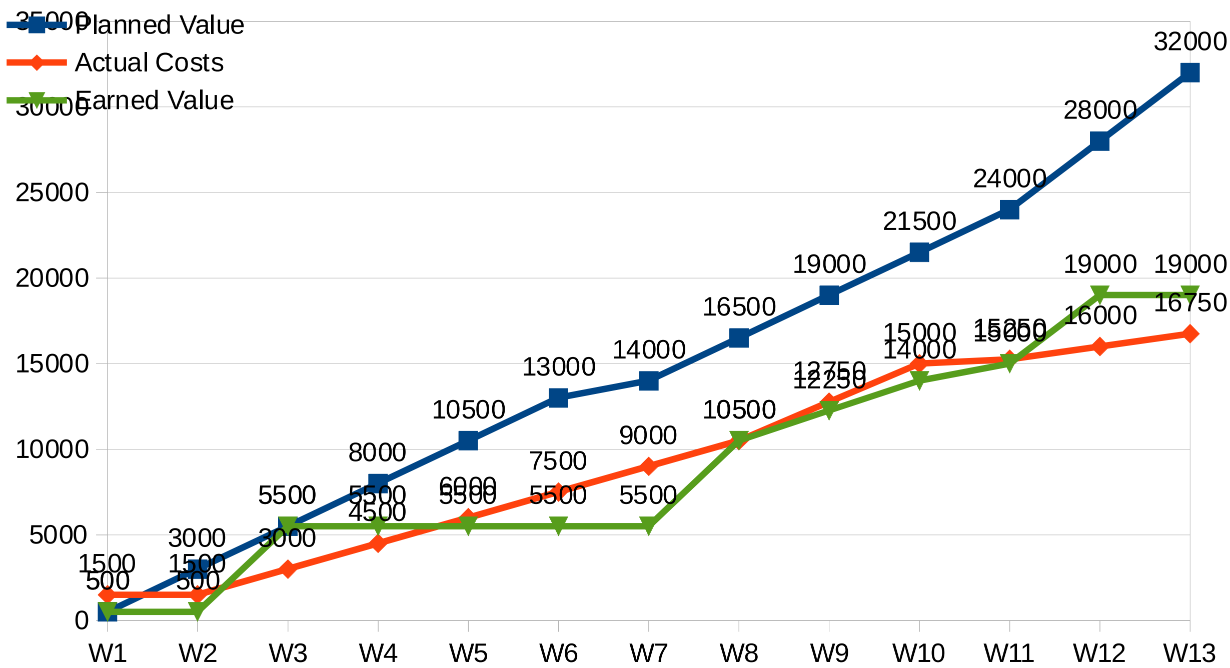
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	Total
A	Meet with client	1500													1500
B	Write SW			1500	1500	1500	1500	1500	1500						9000
C	Debug SW									1250	1250				2500
D	Prepare draft manual									1000					1000
E	Meet with clients										1000				1000
F	Test SW											250	250	250	750
G	Make modifications														0
H	Finalize manual														0
I	Advertise												500	500	1000
	Total	1500	0	1500	1500	1500	1500	1500	1500	2250	2250	250	750	750	
	Planned Value	1500	1500	3000	4500	6000	7500	9000	10500	12750	15000	15250	16000	16750	

EV is the sum of the planned costs on the actual schedule. There are different rules for computing EV. We use 50%-50% (50% of planned costs when an activity starts, the remaining 50%, when the activity ends.

The result is shown in the following table:

		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	Total
A	Meet with client	500													500
B	Write SW			5000	0	0	0	0	5000						10000
C	Debug SW									750	750				1500
D	Prepare draft manual									1000					1000
E	Meet with clients										1000				1000
F	Test SW											1000	0	0	1000
G	Make modifications														0
H	Finalize manual														0
I	Advertise												4000	0	4000
	Total	500	0	5000	0	0	0	0	5000	1750	1750	1000	4000	0	
	Earned Value	500	500	5500	5500	5500	5500	5500	10500	12250	14000	15000	19000	19000	

We can now plot all three values together. The result is shown in the following diagram:



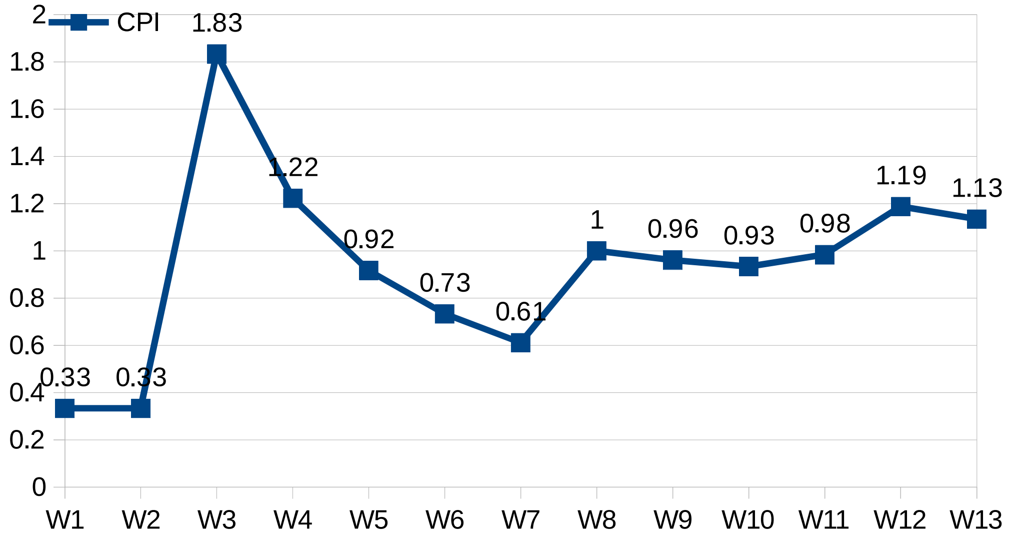
From the data at W13 we can observe the following:

- PV > AC indicates that the project is under budget. However, it might be under budget because of two reasons: it is, in fact, efficient or, alas, it is late (the expenditure has not yet occurred, because activities did not start).
- EV < PV indicates that the project is late. At W13, in fact, the value we currently produced is the one we should have had at W9.

For more precise analyses about the project efficiency, we can compute CPI and SPI, which measure cost efficiency and schedule efficiency.

More in details: **CPI = EV/AC**, that is, how many dollars we produce (EV) for each dollar we spend (AC). Clearly CPI > 1 is a good sign, while CPI < 1 indicates that the project is inefficient and will probably end over budget.

The following graphs shows the behaviour of CPI over time. If we do not consider some noise (due to the 50%-50% rule, which causes, for instance, the peak at W3), we can see that CPI is getting close to 1, indicating that the project should end on budget, if the trend is confirmed.



The SPI index measure the schedule: SPI = EV/PV and indicates how much we produce (EV) with respect to what we thought we would produce. Also in this case SPI > 1 is a good sign (ahead of schedule), while SPI < 1 indicates that the project is late. In our example we should expect SPI to be < 1, as it is, in fact, shown by the following diagram, which plots SPI over time: