CHAPTER 9

MONITORING AND CONTROL

EXAMPLE 1

Sipho is the project leader and his duty is to make sure the project is finished in time. The other members and their job specifics are:

- Nomsa – Analyse existing systems (2 weeks)
- Bennie – Obtain user requirements (3 weeks)
- Maggie – Plan office layout (3½ weeks)
- Alice – Finalise office layout (4 weeks)
- Arthur – Issue tender (4½ weeks)

(Note: the weeks in brackets denote the scheduled time within which each person's part of the project is to be completed. The longest time, i.e. 4½ weeks is the scheduled time for the completion of the whole project).

After the first week Nomsa is delayed by a week, but she finished by the end of the 3rd week. By the end of the 4th week Bennie has finished but Maggie was delayed for a week. This was the last delay in the project.

Name and describe four ways that a manager can use to visualise this data. Present this data visually in all four ways. Accept that each activity, allocated to a specific person, starts at the same time.

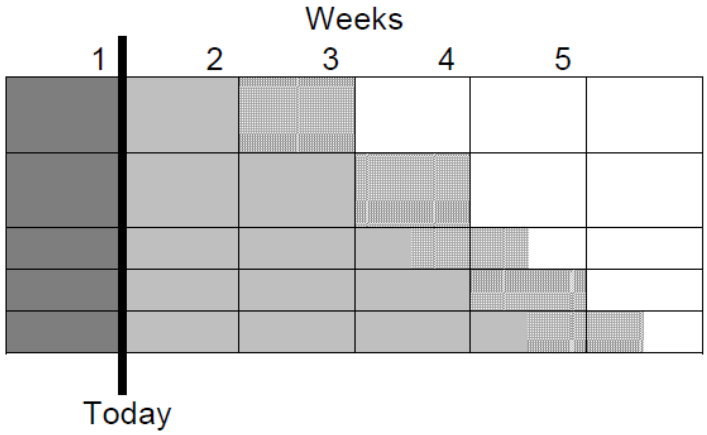
SOLUTION 1:

THE GANTT CHART (5)

This chart is used to indicate scheduled activity dates and durations frequently associated with activity floats. The Gantt chart can visually indicate if a project is ahead or behind schedule. One disadvantage is that this chart is very difficult to keep up to date. The Gantt is given in two diagrams, one for the project after the first week, the second for after week 4.

After week 1:

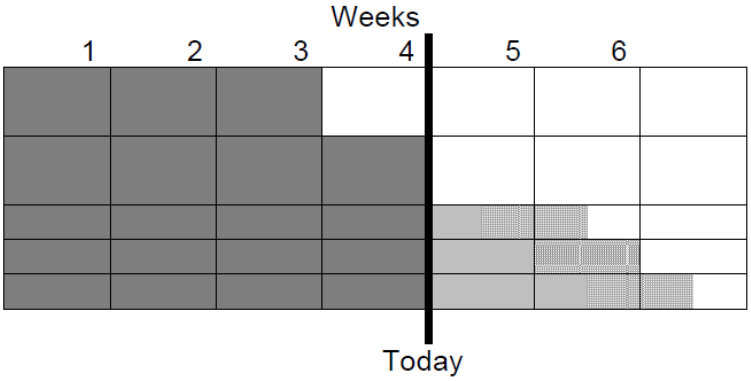
Nomsa	Analyse existing systems
Bennie	Obtain user requirements
Maggie	Plan office layout
Alice	Finalise office layout
Arthur	Issue tender



Note that after the first delay, all the other tasks are also delayed by one week because Nomsa was delayed by one week.

After week 4:

Nomsa	Analyse existing systems
Bennie	Obtain user requirements
Maggie	Plan office layout
Alice	Finalise office layout
Arthur	Issue tender



After week 4, the last 3 tasks were all delayed for another week because Maggie was delayed.

Legend:

completed

scheduled

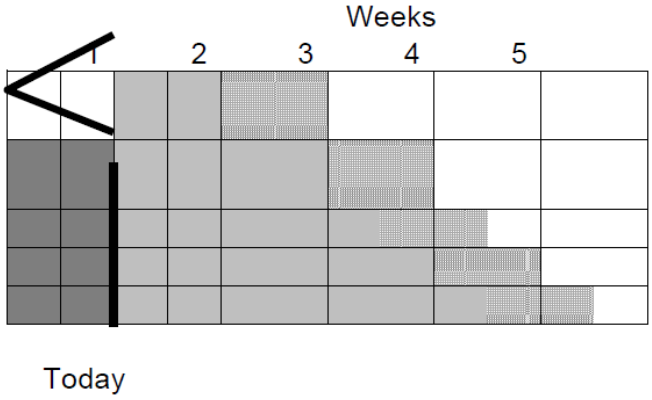
delayed

THE SLIP CHART (5)

The slip chart is a more striking visual indication of the progressing of activities than the Gantt chart. The slip chart has a slip line that indicates the variation from the plan. The more the slip line bends the greater the variation. The project manager can then decide to reschedule some activities if the chart has a very jagged slip line.

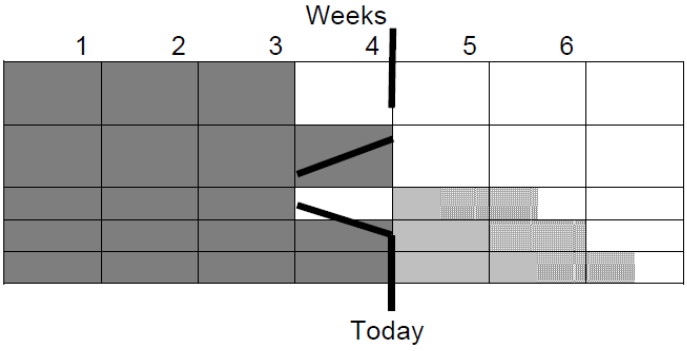
After week 1:

Nomsa	Analyse existing systems
Bennie	Obtain user requirements
Maggie	Plan office layout
Alice	Finalise office layout
Arthur	Issue tender



After week 4:

Nomsa	Analyse existing systems
Bennie	Obtain user requirements
Maggie	Plan office layout
Alice	Finalise office layout
Arthur	Issue tender



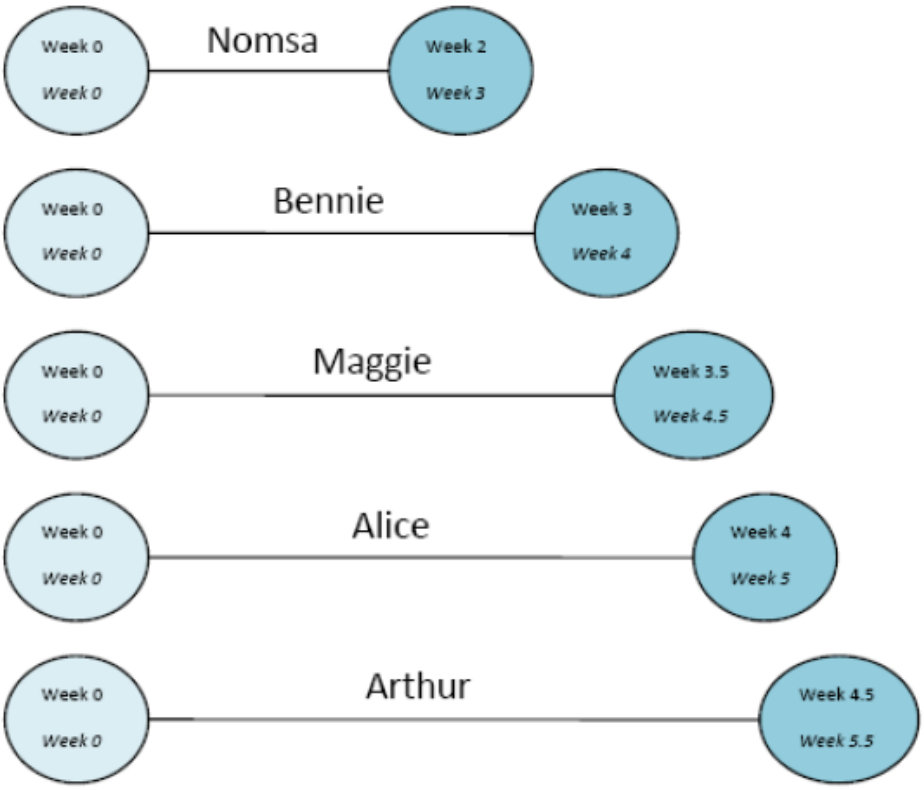
After week 4, Maggie is delayed for another week, delaying Alice and Arthur as well for another week.

Please note, this diagram is not the same as in the textbook on page 220, it is simpler as we do not have the actual start dates of the activities and we do not know if it is ahead of schedule or not. We only know the two activities that were delayed in week 1 and 4 respectively, causing the other activities to be delayed in a ripple effect.

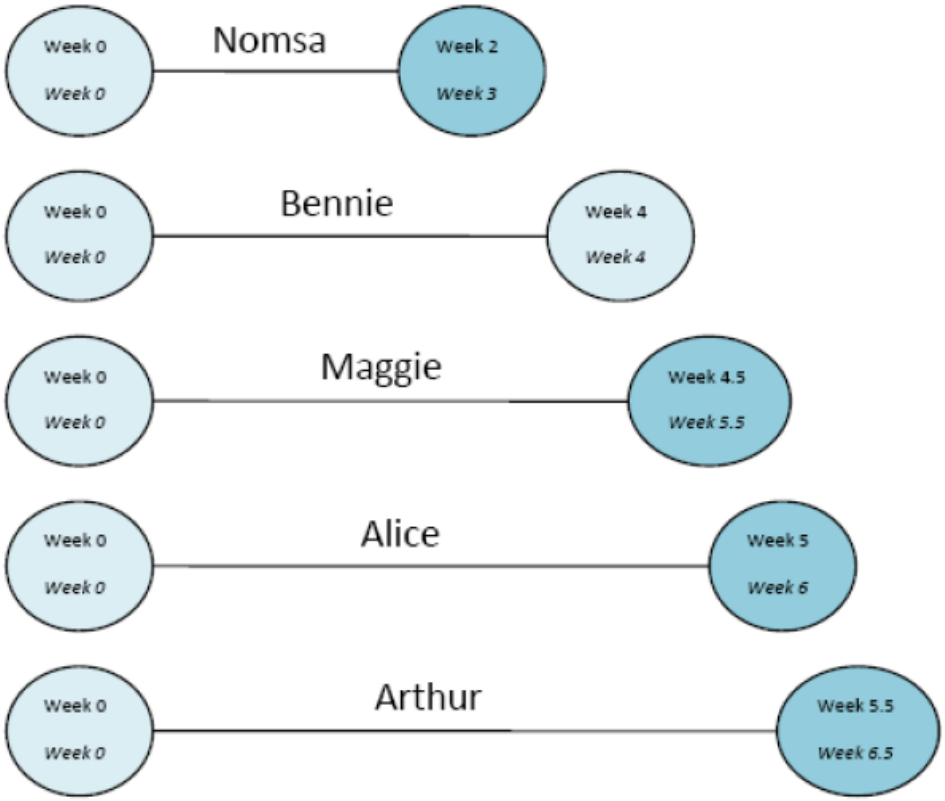
BALL CHARTS (5)

Another way to visualise the progress of activities is with a ball chart. This chart uses circles and colours to indicate whether an activity is ahead or behind schedule. If the activity is ahead of schedule the circle for that activity is coloured light grey and if an activity is late the circle is coloured dark grey. The original scheduled date is the top date in the circle, the most recent or the actual date is in italics in the bottom. One advantage of this chart is that it is very easy for a project manager to keep it up to date.

After week 1:



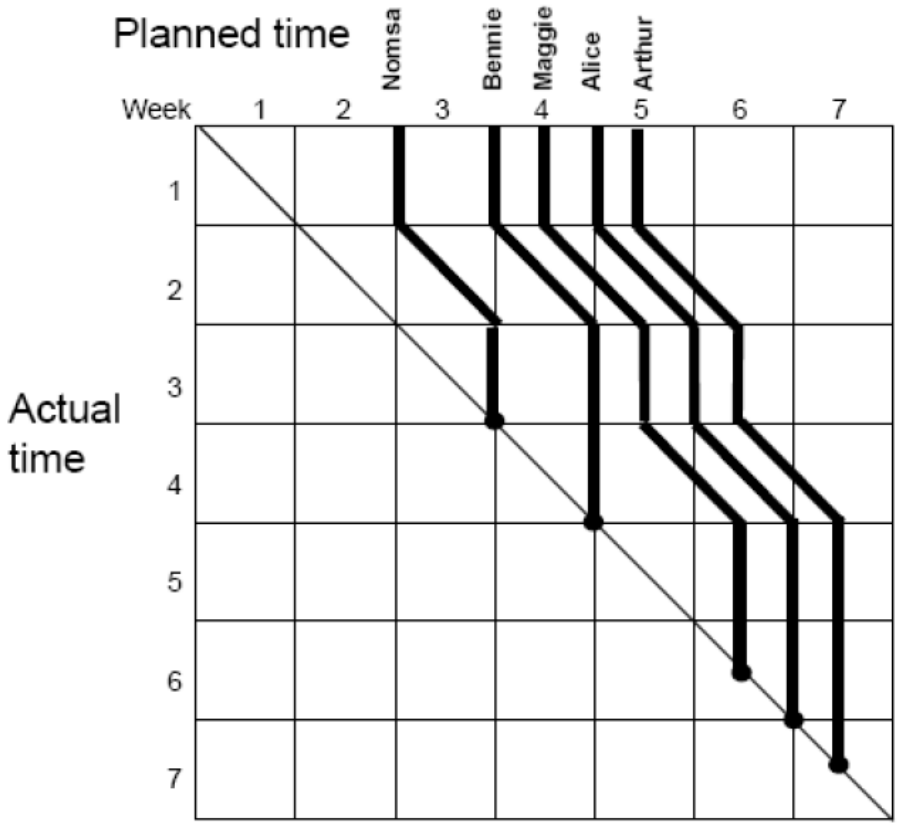
After week 4:



After week 4, Bennie is on schedule, therefore the lighter coloured ball, but Maggie is delayed by 1 week, delaying Alice and Arthur as well by 1 week. We assume that after the initial delay, he activities were rescheduled, resulting in the Week 4 scheduled date for Bennie.

THE TIMELINE CHART (5)

The timeline chart indicates the delayed finishing date of the project. (5)



The timeline chart illustrates the way in which targets have changed through-out the duration of a project. Planned time is shown along the horizontal axis and actual time along the vertical axis. In the ideal situation (no delays), the Planned Time and the Actual Time will correspond on the diagonal.

When one part of a project is delayed for a number of days, the completion time for the whole project is delayed with the same number of days. On a timeline chart a delay in one part of the project has an effect on all the other uncompleted parts of the project in that each of the uncompleted parts shows the same delay. Keep in mind that a time line chart shows planned and actual times of completion of parts of a project as well as of the whole project and not dependencies of parts of a project on each other. On a timeline chart each part of a project's time is measured from the beginning of the project.
In the chart above the ● indicates the final completion of each person's activity.

Remember, that the diagonal line shows the completion of each activity.
Nomsa and Bennie had one delay after the second week and therefore this delay is indicated with a diagonal line across week 2 with the amount of days delayed (= 1 week). Also remember that the delay of one activity is reflected on all the activities to the right. That means in the second week Maggie, Alice and Arthur had been delayed due to the delay by Nomsa. Maggie has also had one delay and therefore has a diagonal line to the right with the number of days delayed. Once again Alice and Arthur are delayed with a week due to the delay by Maggie. There were no further delays and the other activities ends when their activity lines reach the diagonal line. This is the end of the project and the project manager can visually see the delay in the target date.

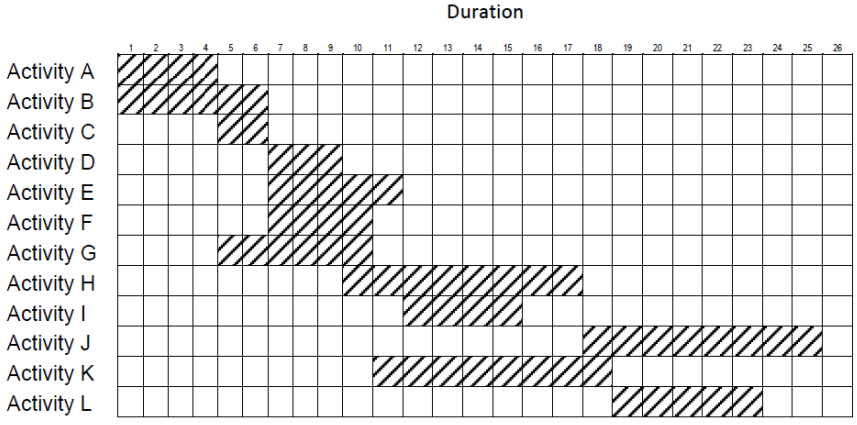
To make sure you understand this question, also do Exercise 9.2 on page 222 in the prescribed book.

EXAMPLE 2

Consider the following list of tasks with dependencies and estimated durations reflected in the table below.

Task / Activity	Precedents	Duration
A	None	4
B	None	6
C	A	2
D	B	3
E	B	5
F	B	4
G	A	6
H	C, D	8
I	E	4
J	G, H	8
K	F	8
L	I, K	5

A Gantt chart is another tool to present project activities. Draw a Gantt chart of the original activities and durations as given above.



EXAMPLE 3

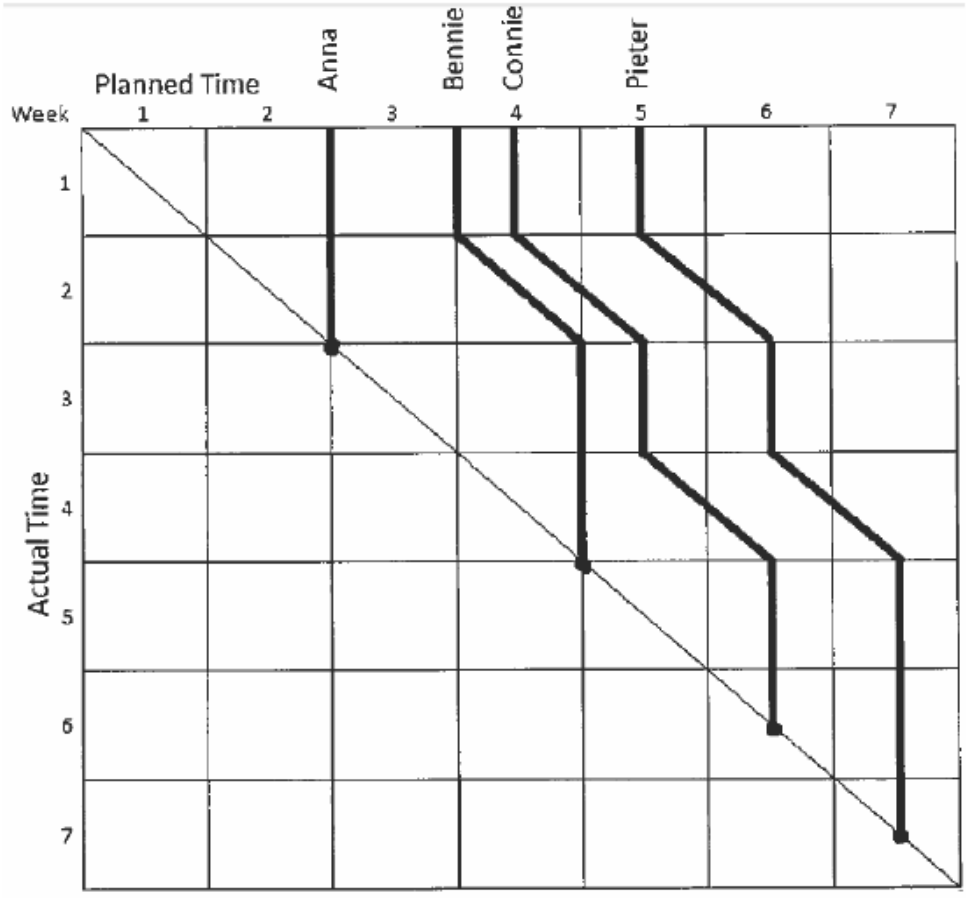
The timeline chart is useful both during the execution of a project and as part of the post-implementation review. John is the project leader and his duty is to make sure the project is finished in time. The other members and their job specifics are:

Anna – Analyse existing systems (2 weeks)
Bennie – Obtain user requirements (3 weeks)
Connie – Plan office layout (3,5 weeks)
Pieter – Issue tender (4,5 weeks)

(Note: the weeks in brackets are the scheduled time for the project to be completed.) After the second week Anna is on schedule with her work but Bennie is delayed with a week. At the end of the third week Bennie did not experience further delays. By the end of the fourth week Bennie is finished but now Connie is delayed with a whole week. This was the last delay in the project.

Draw a timeline chart, based on the information provided above. (8)

SOLUTION:



NOTES: EARNED VALUE ANALYSIS

Definition:
Earned value analysis is a method of performance measurement. Earned value integrates cost, schedule and scope and can be used to forecast future performance and project completion dates. It allows projects to be managed better – on time, on budget.

3 quantities form the basis for cost performance measurement using Earned Value Management. They are

1. Budgeted Cost of Work Scheduled (BCWS) or Planned Value (PV)
2. Budgeted Cost of Work Performed (BCWP) or Earned Value (EV) and
3. Actual Cost of Work Performed (ACWP) or Actual Cost (AC).

- **The value assigned to the task (activity) is known as** (BCWS) or (PV)
- **The total value credited to the project at any point is known as** (BCWP) or (EV)
  This value (project BCWP or EV) can be represented as:
  - A money value,
  - An amount of staff time or
  - A percentage of the PV.

  So, EV is analogous to the agreed price to be paid to the contractor once the work is completed.

The above quantities are defined below.

• **Budgeted Cost of Work Scheduled (BCWS)** or **Planned Value (PV)**
– The sum of budgets for all work packages scheduled to be accomplished within a given time period.
• **Budgeted Cost of Work Performed (BCWP)** or **Earned Value (EV)**
– The sum of budgets for completed work packages and completed portions of open work packages.
• **Actual Cost of Work Performed (ACWP)** or **Actual Cost (AC)**
– The actual cost incurred in accomplishing the work performed within a given time period. For equitable comparison, ACWP is only recorded for the work performed to date against tasks for which a BCWP is also reported.

When tasks are started but not yet completed there are some common methods in SW projects that can be applied:

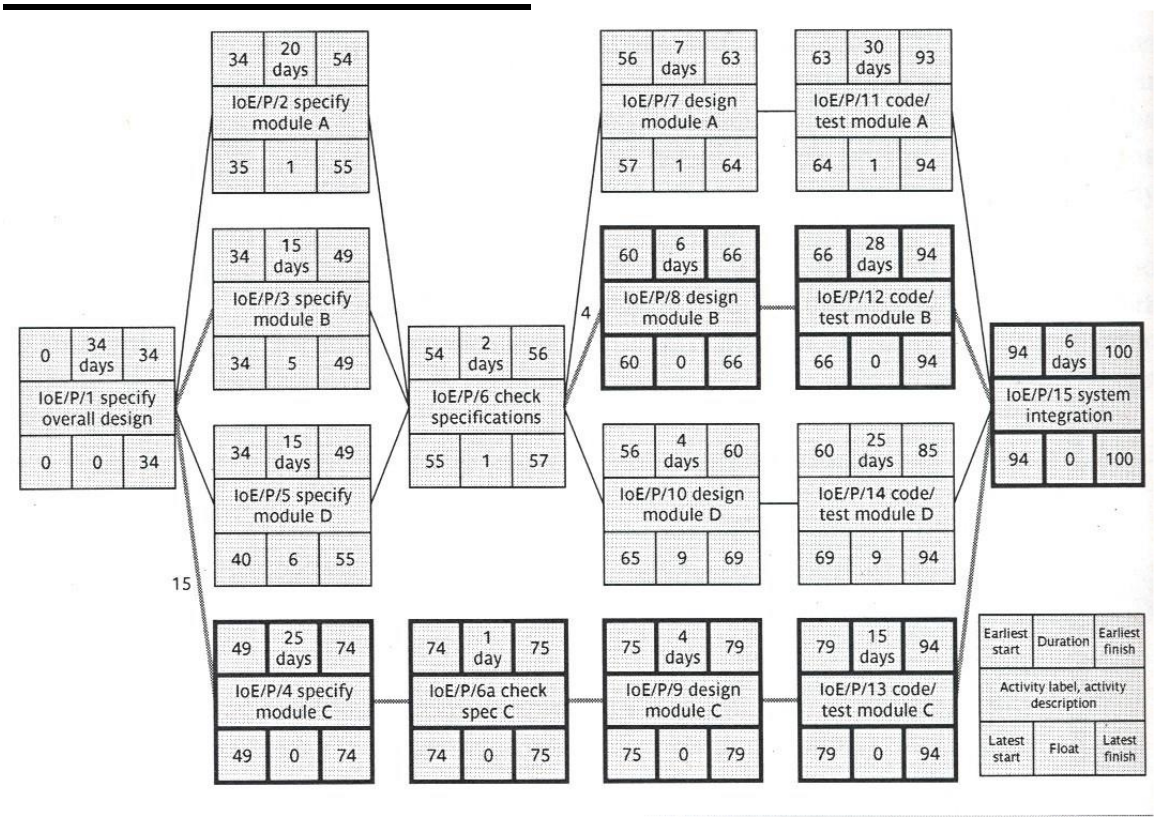
- **The 0/100 technique.** 0 till it is completed then 100% of the budgeted value.
- **The 50/50 technique.** 50% on start, then 50% on successful completion.
- **The 75/25 technique.** 75% then 25% on completion.
- **The milestone technique.** Values based on milestones achieved.
- **The percentage complete technique.** Values based on the percentage completed.

SETTING UP AN EARNED VALUE ANALYSIS

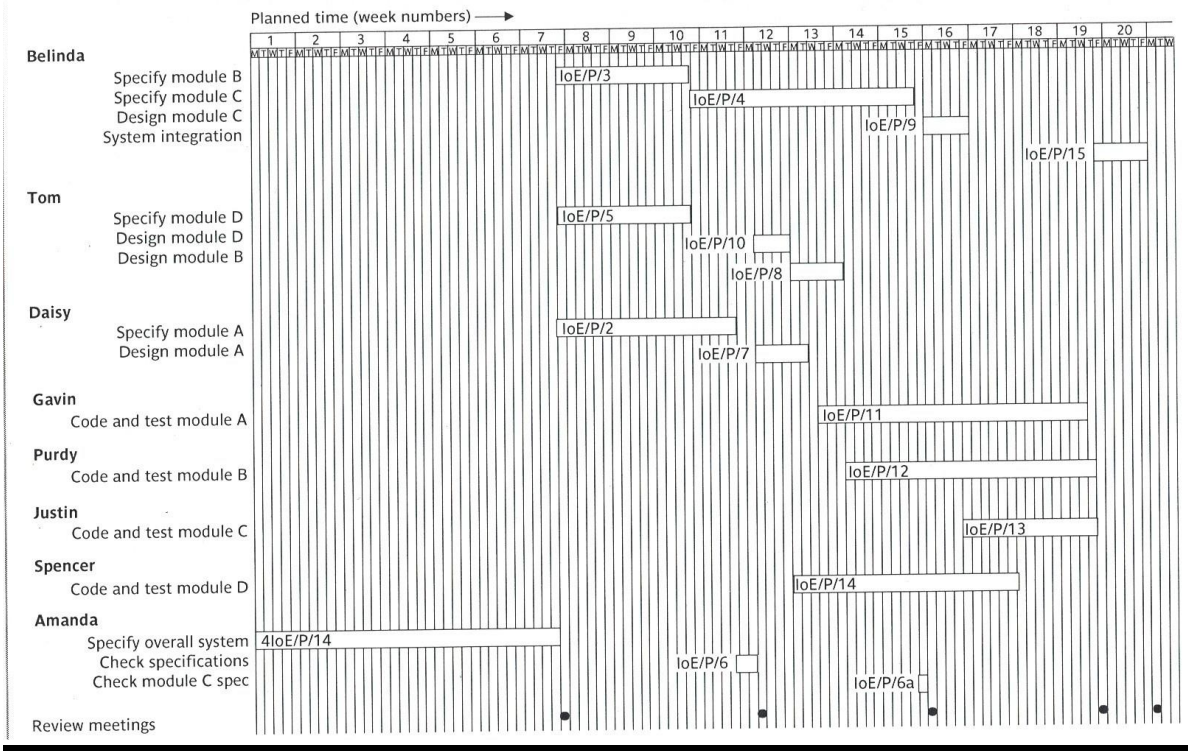
1. THE BASELINE BUDGET

- The first stage in setting up an earned value analysis is to: create a baseline budget.
- **The baseline budget is based on:**
  - The project plan
- **It shows:**
  - The forecast growth in earned value through time.
- EV can be measured in monetary values.
- In staff intensive projects such as “software development” it is common to measure EV in:
  - person-hours or
  - workdays

Precedence Network



The Baseline Budget Work schedule

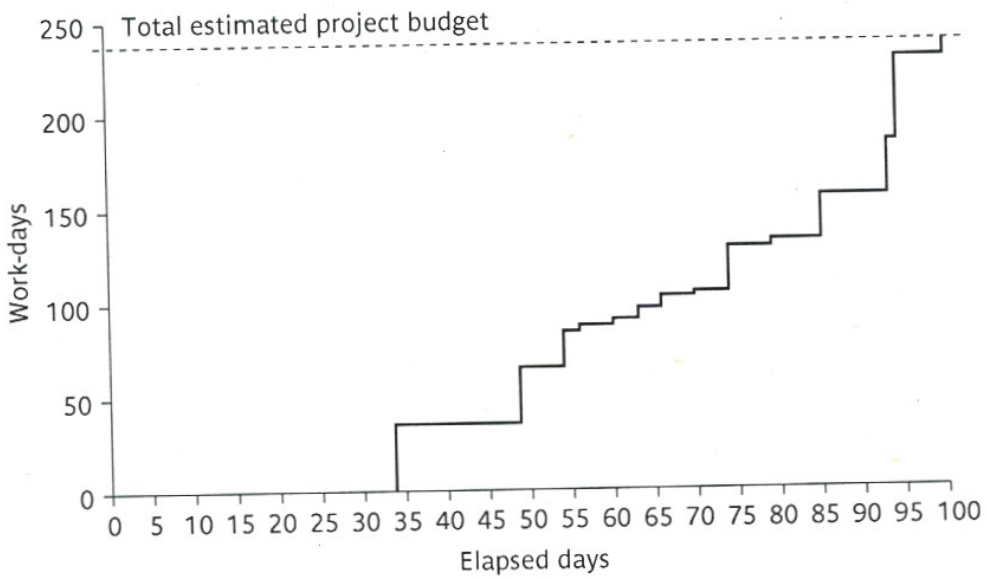


The Baseline Budget Calculation

Task	Budgeted workdays	Scheduled completion	Cumulative workdays	% cumulative earned value
Specify overall system	34	34	34	14.35
Specify module B	15	49	64	27.00
Specify module D	15	49		
Specify module A	20	54	84	35.44
Check specifications	2	56	86	36.28
Design module D	4	60	90	37.97
Design module A	7	63	97	40.93
Design module B	6	66	103	43.46
Specify module C	25	74	128	54.01
Check module C spec	1	75	129	54.43
Design module C	4	79	133	56.12
Code and test module D	25	85	158	66.67
Code and test module A	30	93	188	79.32
Code and test module B	28	94	231	97.47
Code and test module C	15	94		
System integration	6	100	237	100.00

In the previous table:

- The budgeted workdays or the Planned value equals to the Activity assigned duration.
- The scheduled completion is the EF “Earliest Finish” for the activity.
- The cumulative workdays is the summation of the Budgeted workdays.
- % cumulative earned value = The cumulative workdays/237
- 237 is the largest number at the end of the cumulative workdays column.



Elapsed days is the “scheduled completion (EF)” and the work-days is the cumulative workdays.

2. MONITORING EARNED VALUE

After creating the baseline budget, the next step is to:

- Monitor the earned value as the project progresses.

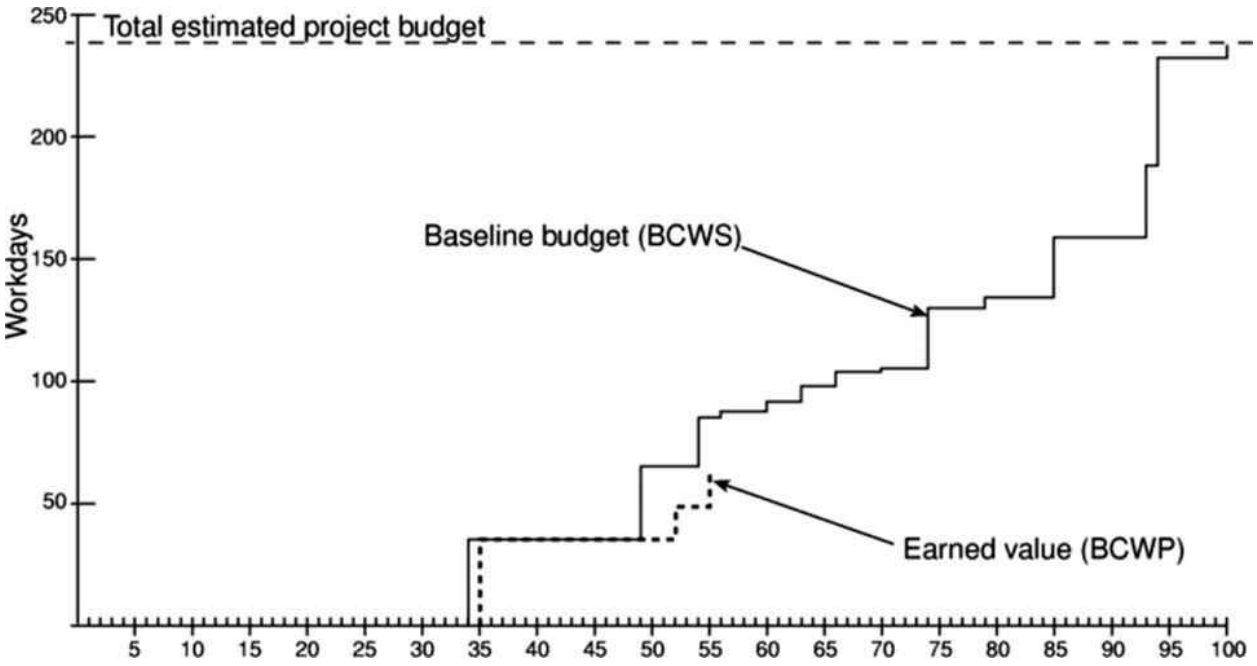
This is done by monitoring:

- The completion of tasks or
- Activity starts,
- Milestone achievements.
- The monitoring is based on the crediting technique used.

- **On the earned value tracking chart:**
  - As well as recording the EV,
  - The actual cost of each task can be collected as:
    Actual cost (AC) also known as Actual cost of work performed (ACWP).

EXERCISE

Consider the following chart: the chart at slide 30 is modified to add the EV. Both the PV and EV are measured in work-days and the 0/100 technique is applied. The chart shows the earned value analysis.



1. **What is the status of the project (on, behind or ahead of) schedule?**
   behind schedule

2. **Can you describe what could possibly go wrong?**
   The initial activity “specify overall system” has slipped a day instead of taking “34” days it took “35” days.

PERFORMANCE STATISTICS

There are some performance statistics that can be shown directly or derived from the earned value chart:

1. The schedule variance (SV).
2. The time variance (TV).
3. The cost variance (CV).
4. Performance ratios:
   (a)Cost performance index: CPI
   (b)Schedule performance index: SPI

1. The Schedule Variance

- **The schedule variance SV** is measured in cost terms.
- SV= ***EV-PV***
- SV indicates the degree to which the value of completed work differs from that planned.

Example:

If work with a **PV of $40,000** should have been completed **by now**, but some of that work has not been done so the **EV is only $35,000.**

The **SV = 35,000 – 40, 000 = -$5000**, a negative value means the project is behind schedule.

2. The Time Variance

The time variance is:

- The difference between the time when the achievement of the current earned value was **planned to occur** and the time **now**.

Example:

If the current **EV** should have been achieved by the **9th** month and the **time now** is the end of month **11**, The **TV is 9-11= -2** months.

3. The Cost Variance

- CV is calculated as ***EV – AC***
- It indicates the difference between the earned and the actual
- cost of completed work.

Example:

- Consider that the Earned value **EV** at one point which was $35,000, has an actual cost **AC** of $55,000. so you had to spend $55,000 to get that amount of **EV**.
- **CV** = 35,000 – 55,000 = -20,000
- **A negative value for CV indicates that the project is over cost.**
- **CV can also be an indicator of the accuracy of the original cost estimate.**

4. Performance ratios

- **COST PERFORMANCE INDEX (CPI)**

CPI = EV / AC
CPI = 35,000 / 55,000 = 0.64

- **SCHEDULE PERFORMANCE INDEX(SPI)**

SPI = EV / PV
SPI = 35,000 / 40,000 = 0.88
A CPI/SPI value greater than "1":
indicates that work is being completed better than planned.
A CPI/SPI value less than "1":
indicates that work is costing more than or proceeding more slowly than planned.

CPI can be used to produce a revised estimate for the project as follows. If the Budget at completion **(BAC) was $100,000**,

- Budget at completion is the currently projected budget for the project.
- The estimate at completion **(EAC)= BAC/CPI**
- **(EAC)** will be 100,000/0.64= $156,250

Similarly, SPI can be used to produce a projected possible duration for the project. If the planned total duration of the project is 23 month.

- Schedule at completion **(SAC)= 23 months.**
- Schedule at completion is the planned total duration for the project.
- The time estimate at completion **(TEAC) =SAC/SPI**
- **TEAC =** 23/0.88 =26.14

GETTING THE PROJECT BACK TO TARGET

- **Shorten the critical path**
  - Adding resources – especially staff
  - Increase use of current resources
  - Reallocate staff to critical activities
  - Reduce scope
  - Reduce quality
- **Reconsider the precedence requirements**

Summary of the Earned Value Management Formula:

NAME	FORMULA
• Cost Variance (CV)	EV – AC
• Schedule Variance (SV)	EV – PV
• Time Variance (TV)	Difference between the time when the achievement of the current earned value was planned to occur and the time now
• Cost Performance Index (CPI)	EV / AC
• Schedule Performance Index (SPI)	EV / PV