



# Software Project Management

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# Candidate work products for review

- All interim and final work products are usually candidates for review.
- Usually, the work products considered to be suitable candidates for review are as follows.
  - Requirements specification documents
  - User interface specification and design documents
  - Architectural, high-level, and detailed design documents
  - **Source code**
  - Test plan and the designed test cases
  - Project management plan and configuration management plan



# Code Review

- Review is a very effective technique to remove defects from **source code**.
- In fact, review has been acknowledged to be more cost-effective in removing defects as compared to testing.
- Over the years, review techniques have become extremely popular and have been generalised for use with other work products.

# Code Review cont...

- Code review for a module is undertaken after the module successfully compiles, i.e. all the syntax errors have been eliminated from the module.
- Obviously, code review **does not target to design syntax errors in a program**, but is designed **to detect logical, algorithmic, and programming errors**.
- Code review has been recognised as an extremely cost-effective strategy for eliminating coding errors and for producing high quality code.

# Code Review cont...

- The reason behind why code review is a much more cost-effective strategy to eliminate errors from code compared to testing is that *reviews directly detect errors*.
- On the other hand, testing only helps detect failures and significant effort is needed to locate the error during debugging.

# Code Review cont...

- The rationale behind the above statement is explained as follows. Eliminating an error from code involves three main activities—testing, debugging, and then correcting the errors.
- Testing is carried out to detect if the system fails to work satisfactorily for certain types of inputs and under certain circumstances. Once a failure is detected, debugging is carried out to locate the error that is causing the failure and to remove it.

# Code Review cont...

- Of the three testing activities, debugging is possibly the most laborious and time consuming activity.
- In code inspection (which is a type of review), errors are directly detected, thereby saving the significant effort that would have been required to locate the error.



# Code Review cont...

Normally, the following two types of reviews are carried out on the code of a module:

- Code walkthrough.
- Code inspection.

# Code inspection and code walk through

- After a module has been coded,
  - code inspection and code walk through are carried out
  - ensures that coding standards are followed
  - help detect as many errors as possible before testing.

# Code inspection and code walk through cont...

- Detect as many errors as possible during inspection and walkthrough:
  - detected errors require less effort for correction
    - much higher effort needed if errors were to be detected during integration or system testing.

# Code Walk Through

- An informal code analysis technique.
  - undertaken after the coding of a module is complete.
- A few members of the development team select some test cases:
  - simulate execution of the code by hand using these test cases, i.e. the members mentally trace the execution through different statements and functions of the code.

# Code Walk Through cont...

- The members note down their findings of their code walk through and discuss those in a walkthrough meeting.
- Even though it is an informal technique:
  - several guidelines have evolved over the years
  - making this naive but useful analysis technique more effective.
  - These guidelines are based on
    - personal experience, common sense, and several subjective factors.

# Code Walk Through cont...

- The guidelines should be considered as examples:
  - rather than accepted as rules to be applied dogmatically.
- The team performing code walk through should not be either too big or too small.
  - Ideally, it should consist of between three to seven members.

# Code Walk Through cont...

- Discussion should focus on discovery of errors:
  - and not on how to fix the discovered errors.
- To foster cooperation:
  - avoid the feeling among engineers that they are being evaluated in the code walk through meeting,
  - managers should not attend the walk through meetings.

# Code Inspection

- In contrast to code walk through,
  - code inspection aims mainly at discovery of the commonly made errors that usually creep into code due to programmer mistakes and oversights .
  - also aims at checking adherence to coding standards.
- During code inspection:
  - the code is examined for the presence of certain kinds of errors,
  - in contrast to the hand simulation of code execution done in code walk through.





# Benefits of code inspection

- Finds the commonly made errors
- Programmer receives feedback on
  - programming style,
  - choice of algorithm, and
  - programming techniques

# Code Inspection

cont...

- For instance, consider:
  - classical error of writing a procedure that modifies a formal parameter
  - while the calling routine calls the procedure with a constant actual parameter.
- It is more likely that such an error will be discovered:
  - by looking for this kind of mistakes in the code,
  - rather than by simply hand simulating execution of the procedure.

# Code Inspection cont...

- Good software development companies:
  - collect statistics of errors committed by their engineers
  - identify the types of errors most frequently committed.
- A list of common errors:
  - can be used during code inspection to look out for possible errors.

# Examples of some commonly made errors

- Use of uninitialized variables.
- Use of incorrect logical operators or incorrect precedence among operators.
- Non-terminating loops.
- Array indices out of bounds.
- Incompatible assignments.
- Improper storage allocation and deallocation.
- Actual and formal parameter mismatch in procedure calls.
- Jumps into loops
- Improper modification of loop variables, etc.

# Cleanroom Technique

- Pioneered at IBM
- The term **cleanroom** was first coined at IBM by drawing analogy to the semi-conductor fabrication units where the defects are avoided by manufacturing in an **ultra-clean atmosphere**.
- Relies heavily on walkthroughs, inspection and formal verification for bug removal
- Programmers are not allowed to test any of their code by executing the code other than doing some syntax testing using a compiler

# Cleanroom Technique cont ...

## Pros:

- This technique reportedly produces documentation & code that are more reliable and maintainable than other development methods relying heavily on code execution based testing.

## Cons:

- The testing effort is increased as walkthroughs, inspection and verification are time consuming for detecting simple errors.
- Some errors might escape during manual inspection. Testing-based error detection techniques may detect these errors.

# Visualizing the Progress of a Project

- Having collected data about project progress, a manager needs some way of presenting that data to greatest effect.
- Some methods of presenting a picture of the project and its future.
  - Methods that provide a static picture, a single snapshot (such as [Gantt charts](#))
  - Methods that try to show how the project has progressed and changed through time (such as [timeline charts](#))

# Gantt chart

- Gantt chart has been named after its developer Henry Gantt.
- A Gantt chart is a form of bar chart.
- The vertical axis lists all the tasks to be performed.
- The bars are drawn along the y-axis, one for each task.
- Gantt charts used in software project management are actually an enhanced version of the standard Gantt charts. In the Gantt, each bar consists of a unshaded part and a shaded part.



# Gantt chart

- The shaded part of the bar shows the length of time each task is estimated to take.
- The unshaded part shows the slack time or lax time.
- The lax time represents the leeway or flexibility available in meeting the latest time by which a task must be finished.



# Gantt chart

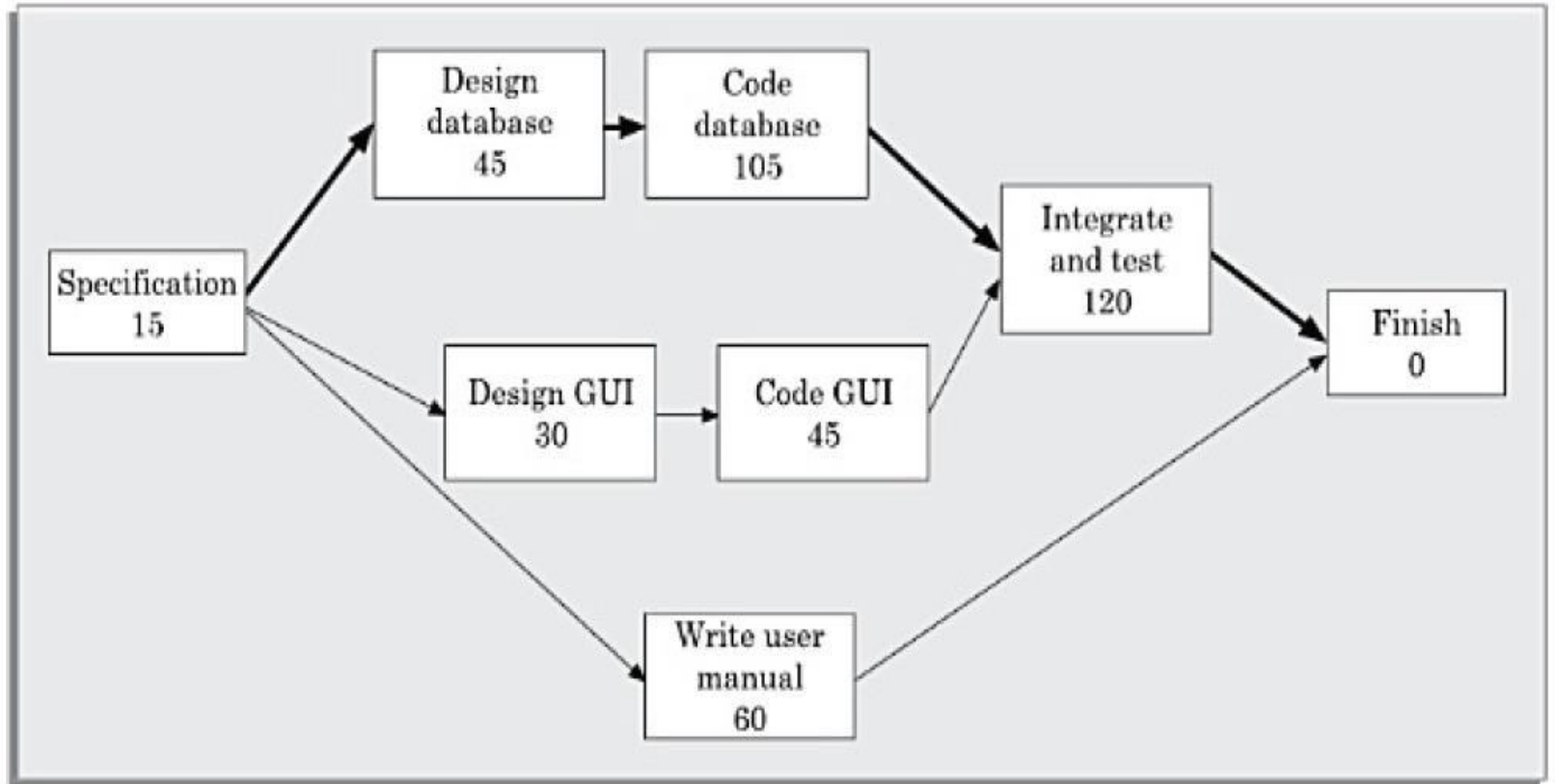
- A Gantt chart is a special type of bar chart where each bar represents an activity. The bars are drawn along a time line. The length of each bar is proportional to the duration of time planned for the corresponding activity.
- Gantt chart representation of a project schedule is helpful in planning the utilisation of resources, while PERT chart is useful for monitoring the timely progress of activities.



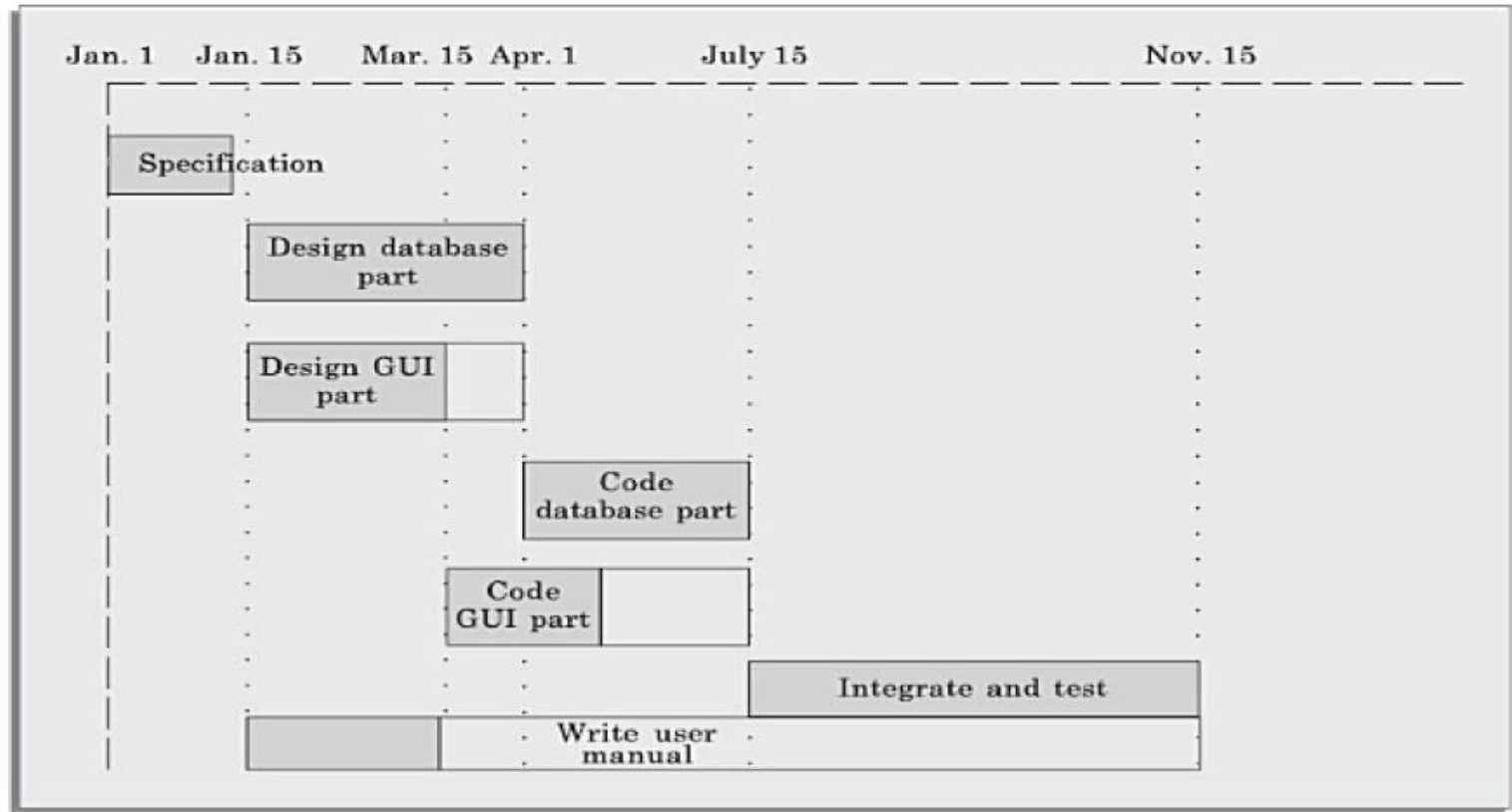
# Gantt chart

- Gantt charts are useful for resource planning (i.e. allocate resources to activities). The different types of resources that need to be allocated to activities include staff, hardware, and software.

# Activity network representation of MIS problem



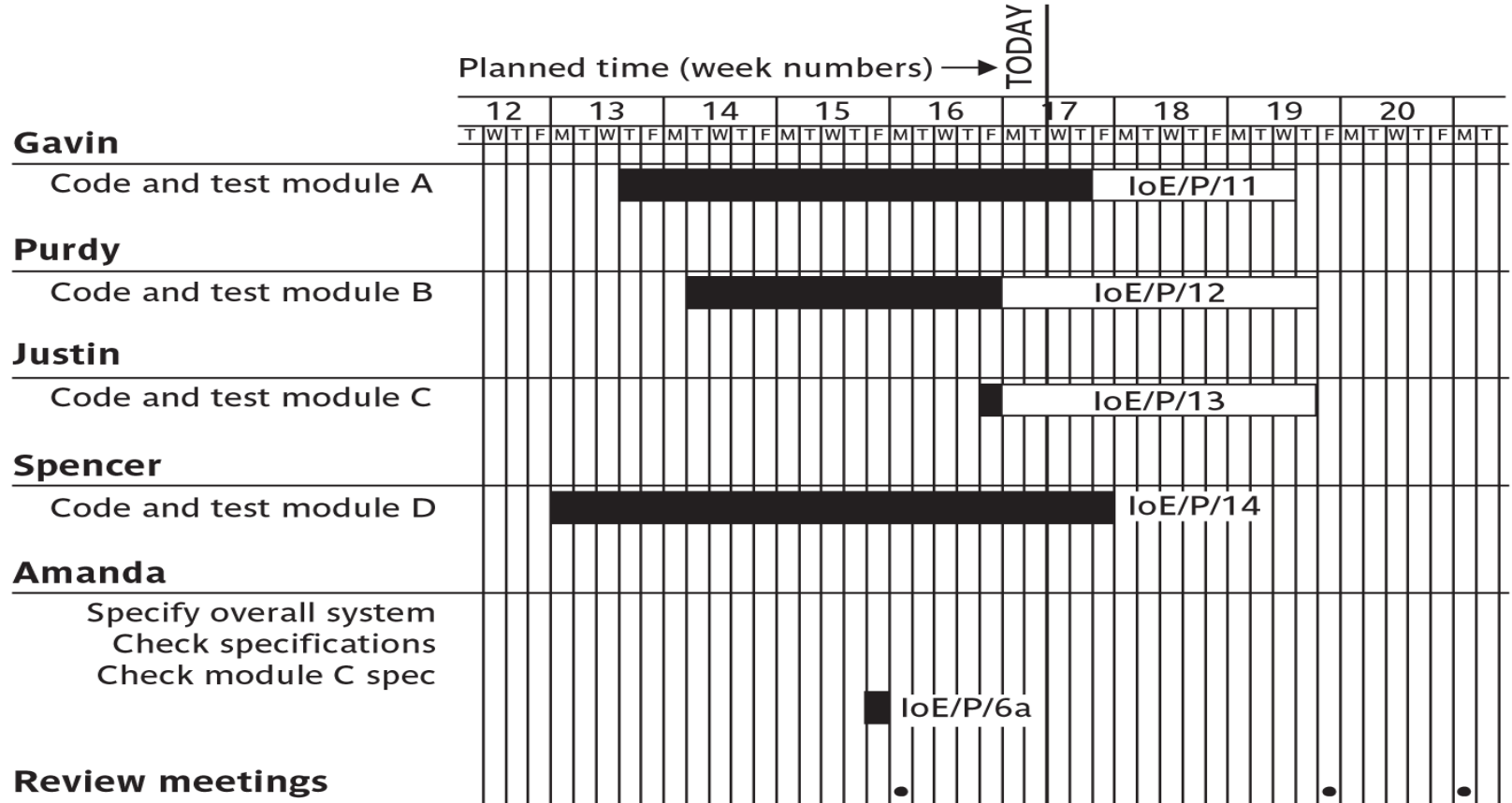
# Gantt chart representation of the MIS problem



# Gantt chart

- One of the simplest and oldest techniques for tracking project progress is the **Gantt chart**.
- This is essentially an activity bar chart indicating scheduled activity dates and durations, frequently augmented with activity floats (Activity float is the time by which an activity may be delayed without affecting any subsequent activity).
- Reported progress is recorded on the chart (normally by shading activity bars) and a 'today cursor' provides an immediate visual indication of which activities are ahead or behind schedule.

# A Sample Gantt chart



## Gantt chart cont ...

- The figure shows a sample Gantt chart as at the end of Tuesday of week 17.
- 'Code and test module D' has been completed ahead of schedule and 'Code and test module A' appears also to be ahead of schedule.
- The coding and testing of the other two modules are behind schedule.



# The slip chart

- A slip chart is a very similar alternative favoured by some project managers who believe
  - it provides a more striking visual indication of those activities that are not progressing according to schedule,
    - the more the slip line bend, the greater the variation from the plan.
- Additional slip lines are added at intervals and, as they build up, the project manager will gain an idea as to whether the project is improving (subsequent slip lines bend less) or not.
- A very jagged slip line indicates a need for rescheduling.



# The slip chart

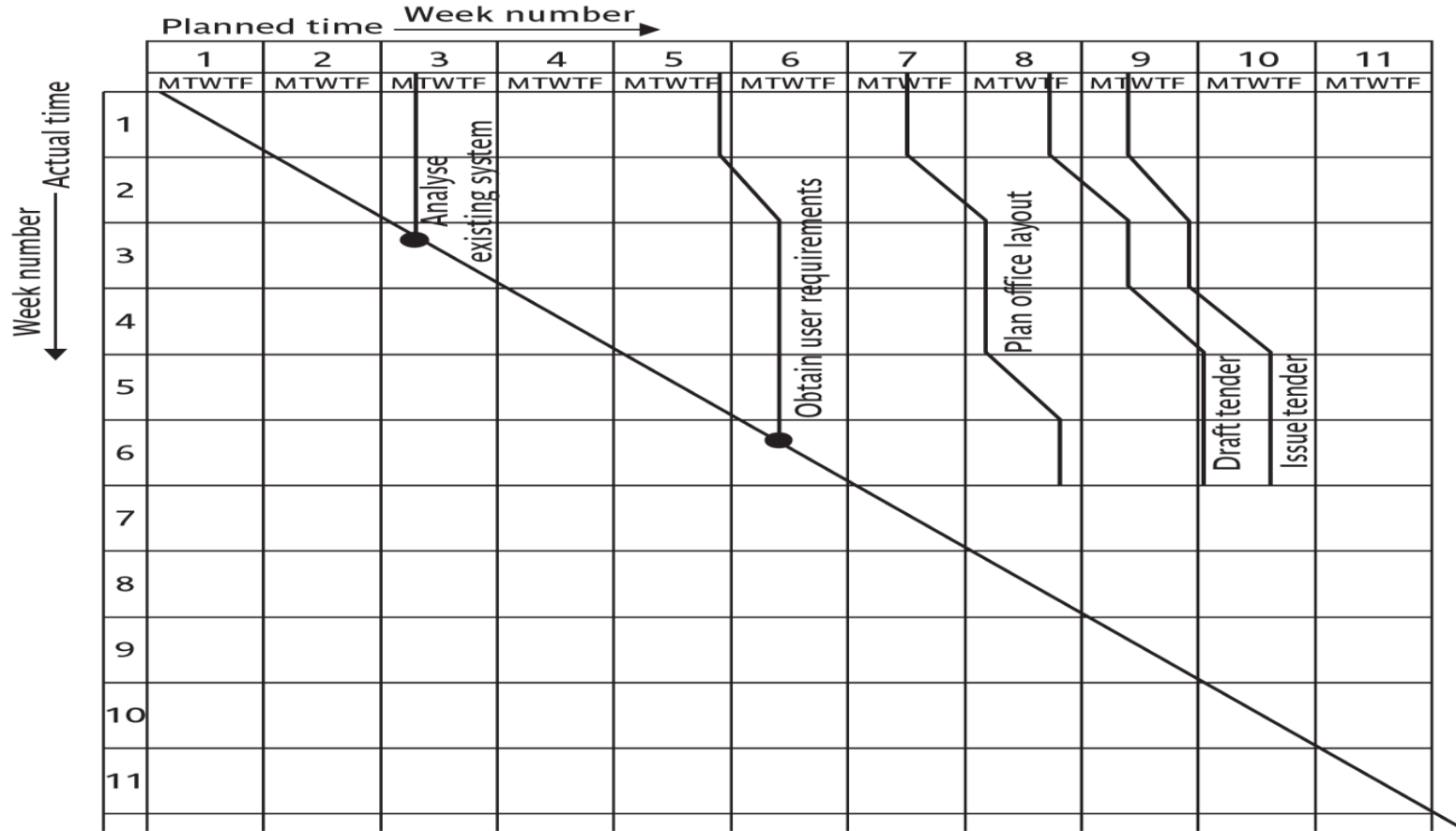
cont ...

- To the left of the line are all the completed activities and to the right those activities that have not been completed.
- The more jagged the line, the more it means that that there are some activities that are lagging to various degrees and some that are ahead of themselves.
- A very jagged line means that there is scope for re-planning to move resources from those activities that are ahead to those that are behind.

# The timeline chart

- One disadvantage of Gantt chart and Slip chart is that they **do not show clearly the slippage of the project completion date through the life of the project.**
- Analysing and understanding trends in the project so far, allows us to predict the future progress of the project.
- For example, if a project is behind schedule because so far productivity has not been as high as assumed at the planning stage, it is likely that the scheduled completion date will be pushed back even further, unless action is taken to compensate for or improve productivity.
- The **timeline chart** is a method of recording and displaying the way in which targets have changed throughout the duration of the project.

# A sample timeline chart



# The timeline chart cont ...

- The figure shows a sample time line chart at the end of the sixth week.
- Planned time is plotted along the horizontal axis and elapsed time down the vertical axis.
- The lines meandering down the chart represent scheduled activity completion dates
  - At the start of the project 'analyse existing system' is scheduled to be completed by the Tuesday of week 3,
  - 'obtain user requirements' by Friday of week 5
  - 'issue tender', the final activity, by Tuesday of week 9, and so on.

# The timeline chart cont ...

- At the end of the first week, the project manager reviews these target dates and leaves them as they are
  - lines are therefore drawn vertically downwards from the target dates to the end of week 1 on the actual time axis.
- At the end of week 2, he decides that 'obtain user requirements' will not be completed until Tuesday of week 6
  - he therefore extends that activity line diagonally to reflect this.
- The other activity completion targets are also delayed correspondingly.

# The timeline chart cont ...

- By the Tuesday of week 3, 'analyse existing system' is completed and the project manager puts a blob on the diagonal timeline to indicate that this has happened.
- At the end of week 3 he decides to keep to the existing targets.
- At the end of week 4 he adds another 3 days to 'issue tender'.
- Note that by the end of week 6, two activities have been completed and three are still unfinished.
- Up to this point she has revised target dates on three occasions and the project as a whole is running almost one week late.





# The timeline chart cont ...

- The timeline chart is useful both during the execution of a project and as part of the post-implementation review.
- Analysis of the timeline chart, and the reasons for the changes, can indicate failures in the estimation process or other errors that might, with that knowledge, be avoided in future.

# Summary

- Discussed two important code review techniques such as code walk through and code inspection.
- Presented a list of some commonly made errors which can be detected by code review.
- Discussed briefly Cleanroom Technique .
- Discussed various ways to visualize the progress of a project such as
  - ✓ Gantt chart,
  - ✓ Slip chart and
  - ✓ Time line chart.



# References :

1. B. Hughes, M. Cotterell, R. Mall, *Software Project Management*, Sixth Edition, McGraw Hill Education (India) Pvt. Ltd., 2018.
2. R. Mall, *Fundamentals of Software Engineering*, Fifth Edition, PHI Learning Pvt. Ltd., 2018.



Thank you