3 UNIT

Project Monitori and Contr

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- Dimensions of Project Monitoring and Control
- Earned Value Analysis
- Earned Value Indicators
- Budgeted Cost for Work Scheduled (BCWS)
- Cost Variance (CV)
- Schedule Variance (SV)
- Cost Performance Index (CPI)
- Schedule Performance Index (SPI)
- Interpretation of Earned Value Indicators

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PART-1

Dimensions of Project Monitoring and Control, Earned Value Analysis, Earned Value Indicators : Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI) and Interpretation of Earned Value Indicators.

CONCEPT OUTLINE : PART-1

- Earned value analysis looks at three basic parameters :
  a. Planned value
  b. Earned value
  c. Actual cost
- BCWP is the budgeted cost of work that has actually been performed in carrying out a scheduled task during specific time period.
- BCWS is approved budget that has been allocated to complete a scheduled task during specific time period.
- ACWP is actual cost that has been spent, rather than budgeted cost.
- Cost variance represents the algebraic difference between earned value of project and actual cost of project.
- Schedule variance is used by project management personnel to determine schedule performance during or after the completion of project.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 3.1. What do you mean by project monitoring and control process ? Explain. How these process affect the project schedule ? Discuss. **UPTU 2012-13, Marks 10**

Answer

1. The purpose of project planning is to identify the scope of the project, estimate the work involved, and create a project schedule.
2. The main goal of monitoring for project managers is to get visibility into the project execution so that they can determine whether any action needs to be taken to ensure that the project goals are met.

3. Different types of monitoring might be done for a project.
4. The three main levels of monitoring are activity level, status reporting, and milestone analysis.
5. Measurements taken on the project are employed for monitoring.
6. Activity-level monitoring ensures that each activity in the detailed schedule has been done properly and within time.
7. This type of monitoring may be done daily in project team meetings or by the project manager checking the status of all the tasks scheduled to be completed on that day.
8. A completed task is often marked as 100 % complete in detailed schedule, this is used by tools like the Microsoft project to track the percentage completion of the overall project or a higher level task.
9. Status reports are often prepared weekly to take stock of what has happened and what needs to be done.
10. Status reports typically contain a summary of the activities successfully completed since the last status report, any activities that have been delayed, any issues in the project that need attention, and if everything is in place for the next week.
11. The milestone analysis is done at each milestone or every few weeks, if milestones are too far apart.
12. If there is some deviation from planned activity then task of control start.
13. So, the project must complete within time and cost limit.
14. The project control and monitoring activity can be represented as shown in Fig. 3.1.1.

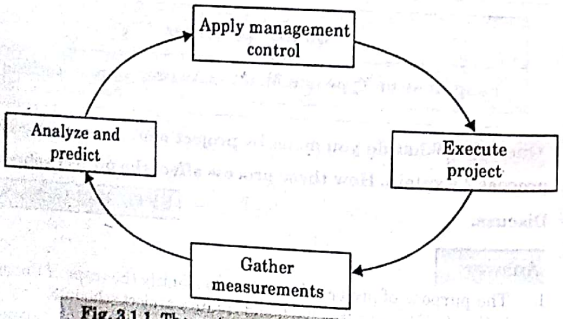

Fig. 3.1.1. The project monitoring and control cycle

Project monitoring and control process affect the project schedule :

15. Monitoring and control process are used to :
    a. Monitor the progress of projects.

    b. Assess the risk of slippage.
    c. Visualize and assess the state of project.
    d. Revise targets to correct or counter act drift.
    e. Control changes to a project's requirements.

Progress assessment will be made on the basis of information collected at regular intervals or when specific event occurs. This information will be objective and tangible. Progress assessment will have to rely on the judgment of the team members who are carrying out project activities.

Que 3.2. Why project monitoring and control is needed for successful implementation of a software project ?

Answer

1. Creating and maintaining the project plan is an important part of project leadership. However, constantly monitoring a project's "health" and regularly controlling a project's overall status is vital for ensuring the successful implementation of the project plan.
2. There are three major reasons for this :
    a. Many project managers are only trained in project planning and simply lack the skill or at least the "awareness" that monitoring and controlling is at least as important as planning.
    b. Project monitoring and controlling involve some additional effort not everyone is committed to invest.
    c. Most project management software packages only support the planning phase, but provide little additional value for project monitoring or controlling.
3. Nevertheless, constantly monitoring a project is important. And it is even more important to define a simple controlling cycle.
4. When the project's performance deviates significantly from the plan so that appropriate corrective actions and preventive actions will be taken.
5. Project activity monitoring is an aspect of project management that is performed throughout the project. Controlling is the aspect of the project in which corrective and preventive actions are taken.
6. It falls to the project manager to ensure that the combined monitor and control process is effectively executed. Effective execution of the project monitoring and controlling process leads to successful project delivery.

Que 3.3. What do you understand by earned value analysis and management ? Explain with example. Why many individuals and firms have failed to adapt the methods under earned value analysis and management ? Discuss. **UPTU 2012-13, Marks 10**

Answer

Earned value analysis :

1. Earned Value Analysis (EVA) was developed by the US Department of Defense to determine the performance of large military procurement contracts.
2. Its techniques can still be applied to the smaller projects currently in use today.
3. EVA looks at three basic parameters :
   a. How much work did you plan to complete ? (Planned Value)
   b. How much work did you actually complete ? (Earned Value)
   c. How much did it cost to complete the work ? (Actual Cost)
5. By comparing these parameters, an objective assessment of cost and schedule performance can be gained.
6. Instead of simply concentrating on how much time has been taken to achieve progress, earned value looks at how much value has been achieved so far.

Earned value management :

1. Earned Value Management (EVM) has proven itself to be one of the most effective performance measurement and feedback tools for managing projects.
2. It enables managers to close the loop in the plan-do-check-act management cycle.
3. If the application of EVM to a project reveals that the project is behind schedule or over budget, the project manager can use the EVM methodology to help identify :
   a. Where problems are occurring.
   b. Whether the problems are critical or not.
   c. What it will take to get the project back on track.
4. EVM provides organizations with the methodology needed to integrate the management of project scope, schedule, and cost.
5. EVM can play a crucial role in answering management questions that are critical to the success of every project, such as :
   a. Are we ahead of or behind schedule ?
   b. How efficiently are we using our time ?
   c. When is the project likely to be completed ?
   d. Are we currently under or over our budget ?
   e. How efficiently are we using our resources ?
   f. What is the remaining work likely to cost ?

   g. What is the entire project likely to cost ?
   h. How much will we be under or over budget at the end ?
6. EVM strategically augments good project management to facilitate the planning and control of cost and schedule performance.
7. The key practices of EVM include :
   a. Establish a performance measurement baseline (PMB)
      i. Decompose work scope to a manageable level.
      ii. Assign unambiguous management responsibility.
      iii. Develop a time-phased budget for each work task.
      iv. Select EV measurement techniques for all tasks.
      v. Maintain integrity of PMB throughout the project.
   b. Measure and analyze performance against the baseline
      i. Record resource usage during project execution.
      ii. Objectively measure the physical work progress.
      iii. Credit EV according to EV techniques.
      iv. Analyze and forecast cost/schedule performance.
      v. Report performance problems and/or take action.

Many individuals and firms have failed to adapt the methods under earned value analysis and management because :

a. The first stage in setting up an earned value analysis is to create the baseline budget.
b. The baseline budget is based on the project plan and shows the forecast growth in earned value through time.
c. Earned value may be measured in monetary values but, in case of staff-intensive projects such as software development, it is common to measure earned value in person-hours or work days.

Que 3.4. What are the essentials of EVM ?

Answer

The essentials of EVM are as follows :

1. A clear set of well defined, accomplishable and measurable deliverables.
2. A clear set of standards to judge whether a deliverable has been accomplished.
3. An ability to know when and how work can be divided among multiple persons.
4. A method of determining parallel and serial deliverable accomplishment efforts.
5. An ability to know all the different staff and skills necessary for deliverable accomplishment.

6. A clear set of well defined, accomplishable, and measurable tasks that result in accomplished deliverables.
7. A clear set of staff hour, unit-effort-based, allocations to accomplish deliverables via tasks.
8. A strategy to assess staff and quantify the velocity at which they work in order to accomplish deliverables.
9. An enumeration of work environment factors that affect the rate of deliverable accomplishment.
10. A strategy to quantify and assign work environment factors to individual deliverable accomplishments.

Que 3.5. Show the relationship among earned value key parameters, earned value performance measures and earned value forecasting indicators.

Answer

Fig. 3.5.1 shows the relationship among earned value key parameters, earned value performance measures and earned value forecasting indicators.

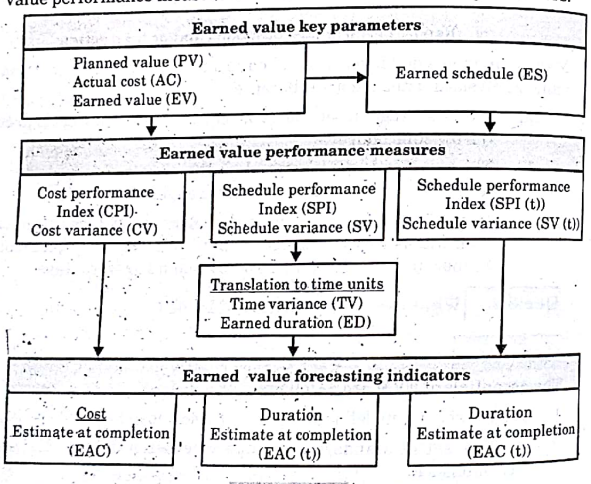

Fig. 3.5.1.

Que 3.6. What do you mean by earned value analysis and earned value indicators ? Discuss various earned value indicators with examples. **UPTU-2014-15, Marks 05**

Answer

Earned value analysis : Refer Q. 3.3, Page 93C, Unit-3.

Earned value indicators : Earned value indicators are the indicators which defines something about the performance compared to the plan.

Various earned value indicators are :

1. **Budgeted Cost of Work Performed (BCWP) :** Budgeted cost of work performed (BCWP) or "Earned Value" (EV), in project management is the budgeted cost of work that has actually been performed in carrying out a scheduled task during a specific time period.
2. **Budgeted Cost of Work Scheduled (BCWS) :** It is the approved budget that has been allocated to complete a scheduled task during a specific time period.
3. **Actual Cost of Work Performed (ACWP) :** It is the actual cost that has been spent, rather than the budgeted cost.
4. **Cost Variance (CV) :**
   a. The term cost variance, also known by the abbreviation of CV, refers specifically to the true measurement of cost performance on a particular project.
   b. The cost variance represents the algebraic difference between the earned value of a project (also known by the abbreviation of EV), and the actual cost of the project (also known by the abbreviation AC).

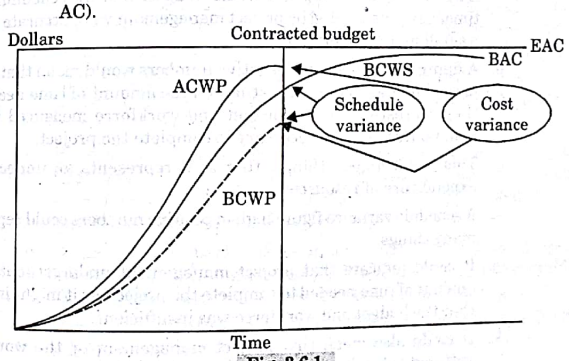

Fig. 3.6.1.

   c. The equation to determine the cost variance would be broken down as follows : CV = EV minus AC.
   d. If the resulting value for the cost variance is a number greater than zero (or "positive value"), then it is considered to be a favourable cost variance condition.

e. A value that is less than zero (or a resulting "negative" value) represents a cost variance that is considered less than favourable.

f. Because the cost variance is so dependent on the earned value and the actual cost, in order to maintain a favourable cost variance, it is advantageous for the project to minimize actual costs to the extent possible.

CV = BCWP – ACWP and CV = EV – AC

5. **Schedule Variance (SV) :**

a. Schedule variance is a quantitative measure used by project management personnel to determine schedule performance during or after the completion of a project.

b. It is calculated using a simple algebraic equation where the earned value (EV) represents the actual amount of time taken to either complete the project or progress to the project's current stage.

c. The planned value (PV) represents the amount of time which reaching the project's current progress should have taken to achieve according to the project management's schedule.

d. Schedule variance (SV) is found by subtracting PV from EV. (EV – PV = SV).

e. Schedule variance and its exact number may indicate many possible things to project management.

f. A number approaching zero would indicate that the scheduling and timeframes generated by project management were accurate within a small margin of error.

g. A figure that is well into negative numbers would mean that either project management overestimated the amount of time needed or they overestimated the budget and workforce measured in raw man hours that was necessary to complete the project.

h. This is not a good thing either as it represents an unnecessary expenditure of resources.

i. A schedule variance figure high in positive numbers could represent many things.

j. It could indicate that project management underestimated the amount of time needed to complete the project, or it might indicate that the budget and workforce was insufficient.

k. It could also mean that project management or the workforce suffered setbacks, foreseen or otherwise, which may or may not have been avoidable. It is given by formula

SV= EV – PV

6. **Cost Performance Index :**

a. The cost performance index, also referred by the abbreviation (CPI), refers specifically to a method, chart, or other instrument that is

implemented for the purposes of determining/measuring the actual cost efficiency of a project.

b. The cost performance index is determined by measuring the ratio of earned value (also known by the abbreviation of EV) to actual costs (also known by the abbreviation of AC).

c. The equation to determine the cost performance index can be derived by the following equation : CPI = EV divided by AC.

d. If the resulting value is greater than one indicates that the conditions of cost efficiency for the project are considered to be favourable.

e. A resulting value that is less than one indicates that the conditions of cost efficiency for the project are considered to be less than favourable.

f. The cost performance index can change over the life of a project depending on the ways in which the earned values and actual cost have changed.

g. This can also be shown by a simple formula,

CPI = EV/ACWP

7. **Schedule Performance Index (SPI) :**

a. The schedule performance index is a measure of project efficiency given by project management to gauge the progress and efficiency.

b. A schedule performance index score of 1 or greater is an optimum goal since it shows the project management that the project is on track and has favourable conditions of meeting the required goals.

c. However, a schedule performance index less than 1 is to be avoided since that shows the project is not meeting goals and is showing unfavourable conditions that could lead to project failure if the current course of action is allowed to continue.

d. If the schedule performance index showing a trend that is at or approaching 1, the project management will reevaluate the current conditions of the project and begin an analysis of the current project trends and begin corrective actions.

e. If the schedule performance index trend is rising, the project management will analyze the goals and the current favourable conditions to possibly re-assess the project's short term goals.

f. The schedule performance index is a ratio of Earned Value (EV) to the Planned Value (PV).

g. Earned Value is the value of the project at its current timeframe. Planned Value is the overall projected value of the project at the same time as the Earned Value.

h. To determine the project's schedule performance index the project management divides the EV by the PV. This can also be shown by a simple formula :

SPI = EV/PV.

Que 3.7. **Suppose you are managing a software development project. The project is expected to be completed in 8 months at a cost of $10000 per month. After 2 months, you realize that the project is 30% completed at a cost of $40,000. You need to determine whether the project is on-time and on-budget after 2 months. Let's see how healthy the project is by calculating the cost variance and schedule variance.**

Answer

We can solve the problem in two steps as follows :

Step1 : Calculate the Planned Value and Earned Value

From the scenario :

1. Budget at Completion (BAC) = $ 10,000 * 8 = $ 80,000
2. Actual Cost (AC) = $ 40,000
3. Planned Completion = 2/8 = 25 %
4. Actual Completion = 30 %
5. Therefore,
   a. Planned Value = Planned Completion (%) * BAC = 25% * $ 80,000 = $ 20,000
   b. Earned Value = Actual Completion (%) * BAC = 30 % * $ 80,000 = $ 24,000

Step 2 : Compute the earned value management cost and schedule variances :

1. Cost Variance = EV – AC = $ 24,000 – $ 40,000 = – $ 16,000
2. Schedule Variance = EV – PV = $ 24,000 – $ 20,000 = $ 4,000

Que 3.8. **Differentiate between Cost Variance (CV) and Schedule Variance (SV).** **UPTU 2014-15, Marks 05**

Answer

Cost variance (CV) : Refer Q. 3.6, Page 96C, Unit-3.

Schedule variance (SV) : Refer Q. 3.6, Page 96C, Unit-3.

Que 3.9. **What do you understand by 'Earned Value Analysis' ? Discuss the following indicators :**

1. Cost Variance (CV)

2. Schedule Performance Index (SPI)

3. Cost Performance Index (CPI) **UPTU 2013-14, Marks 10**

Answer

Refer Q. 3.6, Page 96C, Unit-3.

PART-2

Error Tracking, Software Reviews, Types of Review : Inspections, Deskchecks, Walkthrough, Code Reviews and Pair Programming.

CONCEPT OUTLINE : PART-2

- Software review is an effective way of filtering error in a software product.
- Inspections improve the reliability, availability, and maintainability of a software product.
- Code inspection is a process of examining the code of program for identification of certain errors.
- Code review is a phase in the software development process in which the authors of code, peer reviewers, and perhaps quality assurance testers get together to review code.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 3.10. **What do you mean by software technical reviews ?**

Answer

1. Software review is an effective way of filtering errors in a software product.
2. Software review is used as a filter at various points of software development.
3. Reviews conducted at each of these phases, analysis, design, coding, and testing reveal areas of improvement in the product.
4. Reviews also indicate those areas that do not need any improvement.
5. We can use software reviews to achieve consistency and uniformity across products.
6. Reviews also make the task of product creation more manageable.
7. Some of the most common software review techniques, practiced across software organizations include :
   a. Inspection
   b. Walkthrough
   c. Formal technical reviews
   d. Code reviews
   e. Pair programming

Que 3.11. **What is software review and formal technical review?**

OR

Explain formal technical review (Peer reviews).

Answer

Software review :

1. The software review are filter or software engineering process i.e., review are applied at various points during software development and serve to uncover errors and defects that can then be removed.
2. Software review "Purifies" the software engineering activities that we have called analysis, design and coding.
3. Many different type of reviews can be conducted as a part of software engineering. Each has its place.
4. An informal meeting around the coffee machine is a form of review, if technical problems are discusses.
5. A formal presentation of software design to an audience of customer's managements and technical staff is also a form of review.

FTR :

a. A formal technical review is software quality assurance activity performed by software engineers (and others).

b. A Formal Technical Review (FTR) is known as walkthrough or an inspection.

c. The objectives of FTR are :
   1. To uncover errors in function, logic or implementation for representation of software.
   2. To verify that software under review meets its requirements.
   3. To ensure that the software has been represented according to predefined standards.
   4. To achieve software that is developed in a uniform manner.
   5. To make projects more manageable.

d. In addition, the FTR serves as a training ground, enabling junior engineers to observe different approach to software analysis, design and implementation.

e. The FTR also serves to promote backup and continuity because a number of people became familiar with parts of the software that they may not have otherwise seen.

Que 3.13. **What do you mean by inspection ?**

Answer

1. Inspections improve the reliability, availability, and maintainability of a software product.
2. Anything readable that is produced during software development can be inspected.
3. Inspections can be combined with structured, systematic testing to provide a powerful tool for creating defect-free programs.
4. The inspection activity follows a specified process and the participants play well-defined roles.
5. An inspection team consists of three to eight members who play the roles of moderator, author, reader, recorder, and inspector.
6. It also helps to have a client representative participate in requirements specification inspections.
7. Group inspections enable team members to exchange knowledge and ideas during an inspection session.
8. Moderator leads the inspection, schedules meetings, controls meetings, reports inspection results, and follows up on rework issues.
9. Author creates or maintains the work product being inspected.
10. Reader describes the sections of the work product to the team as they proceed through inspection.
11. Recorder classifies and records defects and issues raised during the inspection.
12. All participants play the role of inspectors. However, good inspectors are those who have created the specification for the work product being inspected.
13. For example, the designer can act as an inspector during code inspection while a quality assurance representative can act as standard enforcer.

An error checklist for inspections :

1. An important part of the inspection process is the use of a checklist to examine the program for common errors.
2. The checklist is largely language independent, meaning that most of the errors can occur with any programming language.
3. We may wish to supplement this list with errors peculiar to our programming language.
4. The errors may be
   a. Data Reference errors
   b. Data-Declaration errors
   c. Computation errors
   d. Comparison errors

e. Control-Flow errors
f. Interface errors
g. Input-Output errors

Que 3.14. What do you mean by code inspection ? Which types of errors can be removed by code inspection ?

Answer

1. Code inspection is done to find out some common types of errors caused due to misunderstanding and improper programming.
2. In other words, code inspection is a process of examining the code of program for identification of certain errors which are not identifiable by code walkthrough.
3. In an inspection, in contrast to a walkthrough, the meeting and the procedure are much more formal.
4. The inspection of a work product is done by a group of peers, who first inspect the product privately and then get together in a formal meeting to discuss potential defects found by individuals and to detect more defects.
5. An inspection can be held for any technical product, which may include requirements specifications, system design document, detailed design, code, and test plan.
6. During identifying errors through code inspection, the standard of coding is also checked.

There are three reasons for having review or inspections :

a. Defect removal.
b. Productivity increase.
c. Provide information for project monitoring.

For code review, the inspection package can consist of the following :

a. Program source listing.
b. Pertinent portions of design or specification document.
c. Pertinent parts of common definitions (e.g., macros and data structures) that are used by the code.
d. Any system constraints.
e. Blank copies of all forms and reports.
f. Checklists to be used for review.

There is a list of some classical programming errors which can be checked during code inspection as given below :

a. Use of un-initialized variables.
b. Jumps within loop (use of transfer control statements (goto) to transfer execution control of program in between the loop *i.e.*, for-loop, while-loop, do-while loop etc).

c. Non-terminating loops (condition for completion of loop is not given).
d. Mismatched assignment.
e. Array indices out of bounds (size of array is not initialized).
f. Improper storage allocation and de-allocation.

Que 3.15. What is desk checking ?

Answer

1. A third human error-detection process is the older practice of desk checking.
2. A desk check can be viewed as a one-person inspection or walkthrough : a person reads a program, checks it with respect to an error list, and/or walks test data through it.
3. Desk checking is relatively unproductive. It is a completely undisciplined process.
4. It runs counter to a testing principle that people are generally ineffective in testing their own programs.
5. For this reason, you could deduce that desk checking is best performed by a person other than the author of the program (e.g., two programmers might swap programs rather than desk check their own programs), but even this is less effective than the walkthrough or inspection process.
6. Desk checking may be more valuable than doing nothing at all, but it is much less effective than the inspection or walkthrough.

Que 3.16. Write a short note on walkthroughs.

OR

What is walkthrough ? When we can perform the walkthrough and what are the objectives of walkthrough ?

Answer

1. In a walkthrough, author describes and explains the work product in an informal meeting to his peers or supervisor to get feedback.
2. Here validity of the proposed solution for work product is checked.
3. Structured walkthrough technique is very useful technique to analyze a product for its effectiveness.
4. In design phase of the product, the purpose of walkthrough is to find out as many possible problems in product design while the design is on paper.
5. It is cheaper to make changes when the design is on paper rather than at the time of conversion.
6. Generally walkthrough can be done at any stage of product development as given below :

a. At the time of deciding schedule for different phases
b. At the time of problem specification
c. Designing data structure
d. Program designing
e. Preparing documentation and user manual
f. Coding
g. Test plan, data and result
h. Maintenance changes

7. So, the walkthrough can start in early stage of software development as design and planning, long before the testing begins.
8. It is a static method of quality assurance. Walkthrough are informal meetings but with purpose.
9. **Objectives of walkthrough :** It is one of the methods of review whose purpose is to ensure high quality. Its main objectives are to find :
   a. Bugs, misinterpretation, errors, inconsistencies, and anything that is unclear.
   b. Anything that is complex and difficult to modify.
   c. Any deviation from standard.
10. The purpose of walkthrough is to only find out the problem not to correct them, the correction is the field of developer.
11. Different authorities give different recommendation for optimum number of participant in walkthrough.
12. Generally four participants are taken for walkthrough. This is because the more people there are the more passivity of waste of time due to difference of options.
13. Now who will attend the walkthrough ? Again there is difference in opinion but generally this is decided on the basis of work product being walkthrough.
14. There is general agreement that author of the product, a maintenance expert and a member of quality assurance group should attend the walkthrough.
15. Users can attend specification walkthrough, testing walkthrough, design walkthrough but not the code walkthrough.
16. User involvement in walkthrough may help system developer.

Que 3.17. Write short notes on code review.

UPTU 2012-13, Marks 05

Answer

a. Code review is a phase in the software development process in which the authors of code, peer reviewers, and perhaps quality assurance (QA) testers get together to review code.
b. Finding and correcting errors at this stage is relatively inexpensive and tends to reduce the more expensive process of handling, locating, and fixing bugs during later stages of development or after programs are delivered to users.
c. Reviewers read the code line by line to check for :
   1. Flaws or potential flaws.
   2. Consistency with the overall program design.
   3. The quality of comments.
   4. Adherence to coding standards.
d. Code review may be especially productive for identifying security vulnerabilities. Specialized application programs are available that can help with this process.
e. Automated code reviewing facilitates systematic testing of source code for potential trouble such as buffer overflows, race conditions, memory leakage, size violations, and duplicate statements.
f. Code review is also commonly done to test the quality of patches.

Steps in code review are as follows :

1. Obtain print-outs of the specification and design documents, and of the code. Write comments neatly on the print-outs, with name, date and other relevant details.
2. Read through the specification and design documents to get an understanding of the purpose of the code and how it achieves this purpose.
3. Compare the class hierarchy and/or function call-tree from the design document with the actual code. Note any discrepancies.
4. Identify the important data structures from the design document. Check this against the actual code. Note any discrepancies.
5. Check for adherence to the project's coding standard.
6. Check the style and correctness of each of the following :
   a. each file
   b. each class
   c. each function/method
7. Check the handling of exceptions and errors.
8. Check the user interaction.
9. Look for common errors.

10. Read the test plan. Verify that it checks the software limits.

Que 3.18. **What do you mean by 'Code Review' ? Also, discuss the difference between code inspection and code walkthrough.**

UPTU 2013-14, Marks 10

Answer

Code review : Refer Q. 3.17, Page 106C, Unit-3.

S.No.	Code Inspection	Code Walkthrough
1.	Formal.	Informal.
2.	Initiated by the project team.	Initiated by the author.
3.	Planned meeting with fixed roles assigned to all the members involved.	Unplanned.
4.	Reader reads the product code. Everyone inspects it and comes up with defects.	Author reads the product code and his team mate comes up with defects or suggestions.
5.	Recorder records the defects.	Author makes a note of defects and suggestions offered by team mate.
6.	Moderator has a role in making sure that the discussions proceed on the productive lines.	Informal, so there is no moderator.

Que 3.19. **Write short note on pair programming.**

UPTU 2012-13, Marks 05

Answer

1. All code to be sent into production is created by two people working together at a single computer. Pair programming increases software quality without impacting time to deliver.
2. It is natural, two people working at a single computer will add as much functionality as two working separately except that it will be much higher in quality.
3. With increased quality, comes big savings later in the project. The best way to pair program is to just sit side by side in front of the monitor.

4. Slide the keyboard and mouse back and forth. Both programmers concentrate on the code being written.
5. Pair programming is a social skill that takes time to learn. You are striving for a co-operative way to work that includes give and take from both partners regardless of corporate status.
6. The best pair programmers know when to say "let's try your idea first". Do not expect people to be good at it from the start.
7. It helps if you have someone on your team with experience to show everyone what it should feel like.

The advantages of pair programming are as follows :

1. **Flexibility :** If you pair on everything, then you can contribute to anything. This is a huge advantage.
2. **Code ownership :** If you worked on each piece of the application, then you bear some responsibility when it breaks. If you spread this across the team, problems get solved very quickly.
3. **Collaboration :** Nothing builds team unity like solving problems together. You also get the benefit of gaining your co-workers expertise when you code with them.

Disadvantages of pair programming are :

1. **It ties up two programmers :** It would appear that you are wasting at least one person's time. One of the programmer is not actually programming.
2. **It's inconvenient and reduces flexibility :** Sometimes it is inconvenient. I really enjoy working on something until it is completed. If I have to switch pairs and tasks, it really bugs me that the other task was not finished first. You also have fewer pairs than people, which mean fewer tasks being worked on at the same time.

VERY IMPORTANT QUESTIONS

Following questions are very important. These questions may be asked in your SESSIONALS as well as UNIVERSITY EXAMINATION.

Q. 1. What do you mean by project monitoring and control ?
Ans: Refer Q. 3.1

Q. 2. Discuss earned value analysis.
Ans: Refer Q. 3.3