1. Conventional Software Management

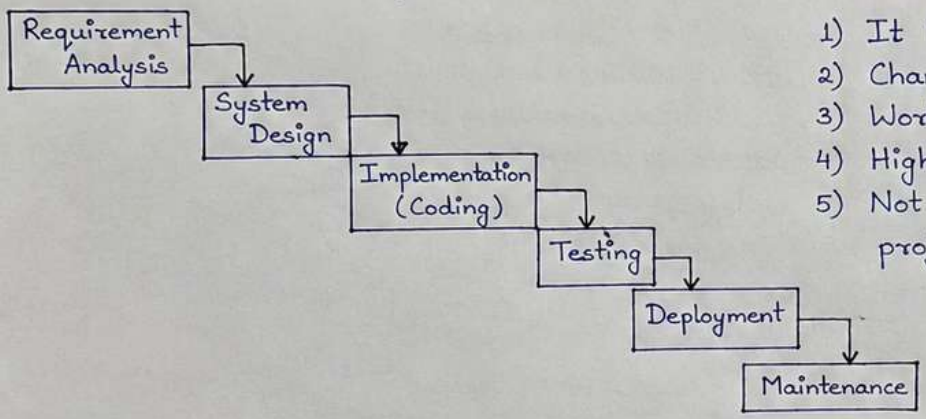
Definition :-

Conventional Software Management refers to the traditional approach used for planning, developing, controlling and maintaining software projects. It mainly follows the Waterfall Model and focuses on completing each phase one after another.

Characteristics :-

1) Follows sequential (linear) flow.
2) Each phase has specific deliverables.
3) Progress is measured phase by phase.
4) Documentation is given high importance.
5) Changes are difficult to implement.

Waterfall-based Management :-



Problems with Conventional Management :-

1) It is rigid and inflexible.
2) Changes in requirements are difficult.
3) Working software is available late.
4) High risk and uncertainty.
5) Not suitable for large and complex projects.

Advantages :-

1) Simple and easy to understand.
2) Clear stages and well defined.
3) Easy to plan and manage.
4) Suitable for small projects with stable requirements.
5) Strong documentation.

Disadvantages :-

1) Inflexible to changes.
2) Real product visible very late.
3) High risk if requirements are wrong.
4) Not suitable for complex and long projects.
5) Customer feedback comes in late stage.

14 Marks Answer (RGPV Exam Style) :-

Conventional Software Management is a traditional approach used for software project management. It mainly follows the Waterfall Model in which the project is divided into different phases and each phase is completed before moving to the next phase. The main phases are Requirement Analysis, System Design, Implementation, Testing, Deployment and Maintenance. It is simple, easy to understand and suitable for small projects where requirements are clear and stable. However, it is rigid, not flexible, changes are difficult and working software is available late. It has high risk and is not suitable for large and complex projects.

2. Evolution of Software Economics

1) Software Crisis :-

Software crisis refers to a period when the demand for software exceeded the ability to design, develop and maintain it using conventional methods.

Problems :-

- Poor quality software
- Cost overruns
- Schedule delays
- Changing requirements
- Lack of skilled manpower
- Difficult maintenance

2) Evolution :-

- 1960s – Manual coding and ad-hoc methods.
- 1970s – Structured programming, SDLC, documentation.
- 1980s – Object oriented concepts, CASE tools.
- 1990s – Component based development, reuse.
- 2000s and beyond – Agile, DevOps, cloud computing, automation, AI tools.

3) Cost Factors :-

- Personnel cost
- Hardware cost
- Software tools cost
- Training cost
- Maintenance cost
- Operational cost
- Cost of quality (errors, rework, testing)

4) Schedule :-

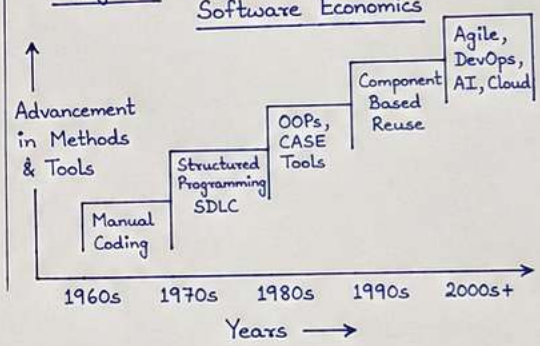
- Software projects often face schedule delays.
- Causes – unrealistic estimation, requirement changes, complexity, resource unavailability.
- Proper planning, estimation and tracking reduces delays.

5) Productivity :-

- Productivity is the measure of output produced per unit input.
- Higher productivity means more work in less time and cost.
- Depends on tools, methods, skills, reuse and automation.
- Measured as –

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}}$$

Diagram :- Evolution of Software Economics



14 Marks Answer (RGPV Exam Style) :-

Software economics is concerned with the economic aspects of software development. It includes cost, schedule, productivity and quality. In earlier years, software industry faced a serious problem called software crisis. During 1960s, the demand for software increased rapidly but the available technologies, tools and skilled manpower were not sufficient to meet this demand. As a result, software projects suffered from poor quality, cost overruns, schedule delays and customer dissatisfaction.

To overcome this crisis, different techniques and tools evolved over the years. In 1970s, structured programming and SDLC were introduced. In 1980s, object oriented concepts and CASE tools improved productivity. In 1990s, component based development and reuse became popular. In 2000s and beyond, agile methods, DevOps, cloud computing and AI tools are used to improve efficiency and reduce cost.

The cost of software depends on various factors such as personnel cost, hardware, software tools, training, maintenance, operational cost and cost of quality. Proper estimation and cost control are necessary for successful projects.

Schedule is another important factor. Delay occurs due to unrealistic estimation, requirement changes, complexity and resource problems. Proper planning, monitoring and tracking help in completing projects on time.

Productivity measures the efficiency of process. It is the ratio of output to input. It can be improved by better tools, automation, reuse, skilled people and standard methods.

Hence, evolution of software economics shows how software development practices improved to produce better quality software in less cost and time.

3. Improving Software Economics

Introduction :-

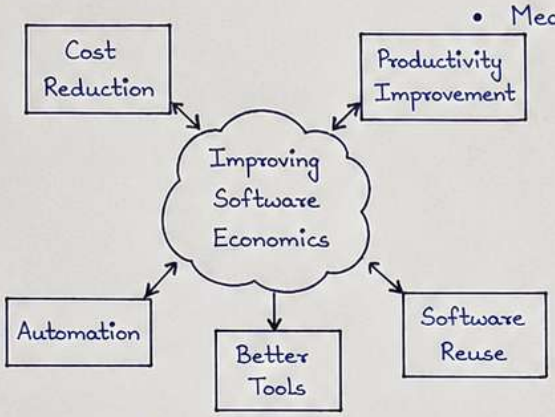
Improving software economics means developing and delivering better software in less cost and less time while maintaining high quality. It can be achieved through cost reduction, productivity improvement, software reuse, better tools and automation.

1) Cost Reduction :-

- Avoid unnecessary features.
- Optimize requirements.
- Improve estimation accuracy.
- Reduce rework and errors.
- Use standard processes.

2) Productivity Improvement :-

- Better planning and tracking.
- Use of skilled manpower.
- Training and motivation.
- Parallel development.
- Measurement and feedback.



3) Software Reuse :-

- Reuse existing modules, components and libraries.
- Saves development time.
- Improves reliability.
- Reduces cost and effort.
- Promotes standardization.

4) Better Tools :-

- Use of CASE tools.
- IDEs, compilers, debuggers.
- Version control tools.
- Testing tools.
- Improves quality and speed.

5) Automation :-

- Automate repetitive tasks.
- Use automated testing.
- Build automation.
- Deployment automation.
- Reduces human errors.
- Saves time and cost.

14 Marks Answer (RGPV Exam Style) :-

Improving software economics is very important in software development. It means delivering high quality software in less cost and less time. It can be achieved through cost reduction, productivity improvement, software reuse, better tools and automation.

Cost reduction can be done by avoiding unnecessary features, optimizing requirements, improving estimation accuracy, reducing rework and using standard processes. Productivity improvement depends on better planning, use of skilled manpower, training, motivation, parallel development and measurement. Software reuse means reusing existing modules, components, libraries and frameworks. It saves development time, improves reliability and reduces cost. Better tools such as CASE tools, IDEs, compilers, debuggers, version control tools and testing tools help in improving quality and speed of development. Automation includes automating repetitive tasks, automated testing, build automation and deployment automation. It reduces human errors, saves time and reduces cost.

By applying these techniques, software projects can be completed with better quality, less cost and less time which improves overall software economics.

4. Reducing Product Size

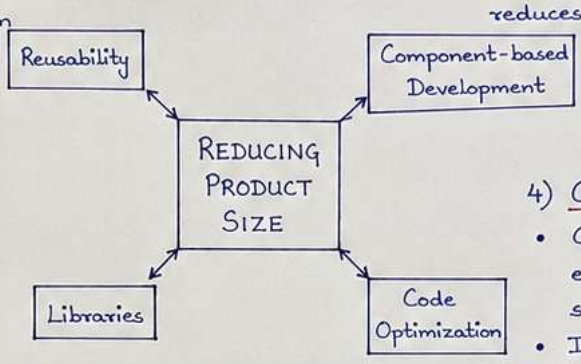
Reducing product size means developing software with less lines of code, less complexity and less resources while maintaining high quality and required functionality. It can be achieved through reusability, component-based development, use of libraries and code optimization.

1) Reusability :-

- Reusability is the ability to use existing software artifacts in new development.
- It reduces development time, cost and effort.
- Types : Code reuse, Design reuse, Test case reuse, Documentation reuse.

2) Component-Based Development :-

- CBD is an approach in which software is built using pre-existing, well-defined components.
- Components are independent, reusable and can be integrated to form a system.
- It improves quality, maintainability and reduces size.



3) Libraries :-

- Libraries are pre-written collections of functions, classes or modules.
- Using libraries avoids writing code from scratch.
- It reduces code size, increases reliability and saves time.
- Examples : STL (C++), .NET Libraries, Java API.

4) Code Optimization :-

- Code optimization means writing efficient code to perform the same task with less resources.
- It reduces memory usage, execution time and code size.
- Techniques : Remove duplicate code, use efficient algorithms, loop optimization, memory optimization, data structure optimization.

Benefits

- Reduces development and maintenance cost.
- Improves reliability and quality.
- Reduces complexity.
- Improves maintainability.
- Faster development and delivery.

14 Marks Answer (RGPV Exam Style) :-

Reducing product size is an important objective in software engineering. It means developing software with minimum code, minimum complexity and minimum resources while maintaining required functionality and quality. Smaller software is easy to develop, test, maintain and enhance. Product size can be reduced through reusability, component-based development, use of libraries and code optimization.

Reusability is the ability to use existing software artifacts in new development. It includes code reuse, design reuse, test case reuse and documentation reuse. It reduces development time, cost and increases reliability.

Component-based development is an approach in which software is built using pre-existing, well-defined components. Components are independent and can be integrated to form a system. It improves quality, maintainability and reduces size.

Libraries are collections of pre-written functions, classes or modules. Using libraries avoids writing code from scratch. It reduces code size, increases reliability and saves time. Examples are STL in C++, .NET libraries and Java API.

Code optimization means writing efficient code to perform the same task with less resources. It reduces memory usage, execution time and code size. Techniques include removing duplicate code, using efficient algorithms, loop optimization, memory optimization and data structure optimization.

By applying these techniques, software product size is reduced which results in less cost, less time, better quality, high reliability and easy maintenance.

Other Techniques To Reduce Size

- Requirement analysis
- Avoid unnecessary features
- Use standard frameworks
- Use simple design
- Remove redundant code
- Use proper coding standards

5. Software Processes

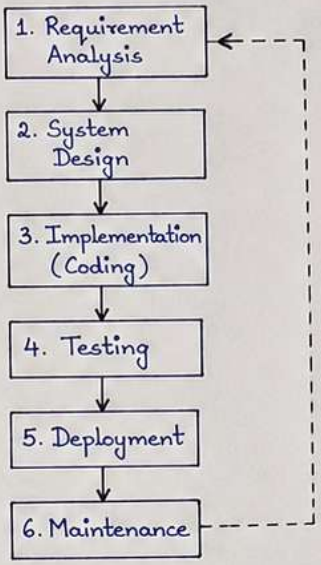
1) Definition :-

A software process is a set of related activities and actions performed to develop, deliver and maintain a software system. It defines the order of activities, deliverables and the roles involved in software development.

2) SDLC (Software Development Life Cycle) :-

SDLC is a framework that describes phases of software development from start to finish. It provides a systematic approach to build high quality software in less time and cost.

SDLC Phases :-



3) Generic Activities :-

These activities occur across all phases of the software process.

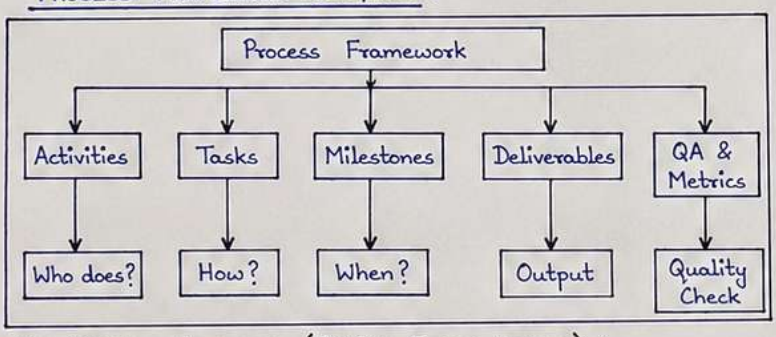
- Communication
- Planning
- Modeling (Analysis & Design)
- Construction (Coding & Testing)
- Deployment

4) Framework (Process Framework) :-

A framework provides the basic structure to manage and control the software process.

- It defines key process activities.
- It defines tasks, milestones, deliverables and quality assurance.
- It can be prescriptive, descriptive or tailored.

Process Framework Diagram :-



5) Advantages of Software Process :-

1. Provides a systematic and disciplined approach.
2. Improves quality of software.
3. Helps in better planning and tracking.
4. Reduces risk and cost.
5. Enhances communication and teamwork.
6. Ensures timely delivery.
7. Easy maintenance and future changes.

14 Marks Answer (RGPV Exam Style) :-

A software process is a set of related activities, methods and practices used to develop, deliver and maintain software systems. It provides a systematic approach to transform user requirements into working software. Software process includes all the activities, deliverables, roles and quality assurance measures required to build a high quality software product.

SDLC (Software Development Life Cycle) is a framework that consists of phases followed in sequence. The main phases are Requirement Analysis, System Design, Implementation (Coding), Testing, Deployment and Maintenance. These phases are shown in the diagram.

Generic activities are the activities that occur throughout the process irrespective of the model used. These are Communication, Planning, Modeling, Construction and Deployment.

A process framework provides the structure to manage the process. It defines the activities, tasks, milestones, deliverables and QA metrics. It can be prescriptive, descriptive or tailored as per the needs of the project.

The advantages of software process are systematic approach, improved quality, better planning, risk reduction, effective communication, timely delivery and easy maintenance.

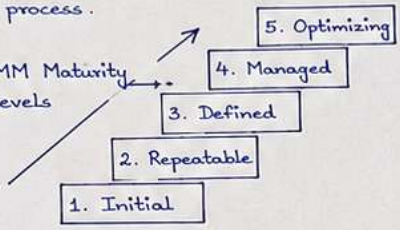
Thus, software processes help in producing quality software in less time and cost by following a disciplined and well-defined approach.

6. Process Improvement

Process improvement means improving the software development process continuously to achieve better quality, higher productivity and customer satisfaction. It can be done using models like CMM, CMMI, ISO standards and continuous improvement techniques like PDCA cycle.

1) CMM (Capability Maturity Model) :-

- Developed by SEI (Software Engineering Institute) in early 1990s.
- It provides a framework to evaluate and improve the software process.
- 5 Maturity Levels :-
  1. Initial
  2. Repeatable
  3. Defined
  4. Managed
  5. Optimizing



2) CMMI (Capability Maturity Model Integration) :-

- CMMI is an improved version of CMM.
- Developed by SEI to integrate different models.
- It supports Process Improvement across multiple domains.
- CMMI has 5 Maturity Levels (same as CMM) :-
  1. Initial
  2. Managed
  3. Defined
  4. Quantitatively Managed
  5. Optimizing

CMMI Features
- Process areas
- Goals and practices
- Continuous improvement
- Can be used in small as well as large organizations.

3) ISO (ISO 9001:2015) :-

- ISO is an international standard for Quality Management System (QMS).
- It is not specific to software but can be applied to software organizations.
- Focuses on customer satisfaction, quality management and continuous improvement.
- Main Principles :-
  1. Customer focus
  2. Leadership
  3. Engagement of people
  4. Process approach
  5. Improvement
  6. Evidence based decision making
  7. Relationship management

ISO 9001 Benefits
- Improves process efficiency
- Enhances customer satisfaction
- Increases quality
- Reduces cost
- Improves global acceptance

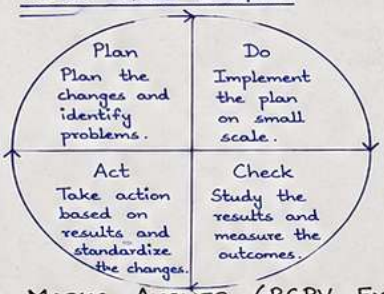
4) Continuous Improvement :-

- It is an ongoing effort to improve products, processes and services.
- Aims at incremental and continuous enhancement.
- Requires commitment from all team members.
- Leads to higher quality and customer satisfaction.

5) PDCA Cycle (Plan-Do-Check-Act Cycle) :-

- PDCA is a continuous improvement model proposed by Deming.
- Used in continuous improvement of processes.
- It is also called Deming Cycle.

PDCA Cycle Diagram



Plan : Identify problems, analyze causes and plan solutions.
Do : Implement the plan.
Check : Check the results with goals.
Act : Take action to improve process and make it standard.

Benefits of Process Improvement
1. Improves software quality.
2. Increases productivity.
3. Reduces cost and time.
4. Improves customer satisfaction.
5. Helps in risk management.
6. Promotes best practices.
7. Ensures continuous growth.

14 Marks Answer (RGPV Exam Style) :-

Process improvement is the systematic approach to enhance the software development process continuously to achieve better quality, productivity and customer satisfaction. It can be achieved using models like CMM, CMMI, ISO and techniques like continuous improvement and PDCA cycle.

CMM (Capability Maturity Model) was developed by SEI. It has five maturity levels : Initial, Repeatable, Defined, Managed and Optimizing. It helps organizations to evaluate their current process and improve it. CMMI (Capability Maturity Model Integration) is an improved version of CMM. It integrates different models and also has five maturity levels : Initial, Managed, Defined, Quantitatively Managed and Optimizing. It includes process areas, goals and practices.

ISO 9001:2015 is an international standard for Quality Management System. It focuses on customer satisfaction, quality, leadership, process approach, improvement and evidence based decision making.

Continuous improvement is an ongoing effort to improve products, processes and services continuously. PDCA cycle is a model for continuous improvement consisting of four steps : Plan, Do, Check and Act. It helps in identifying problems, implementing solutions, checking results and taking corrective actions.

Thus, process improvement helps in delivering high quality software in less time and cost through disciplined and continuous efforts.

7. Team Effectiveness

Team effectiveness refers to the ability of a team to achieve its goals in a efficient and effective manner. It depends on team structure, leadership, communication, coordination and motivation.

1) Team Structure :-

- Team structure defines how roles, responsibilities and authority are organized within a team.
- A well defined structure helps in clarity and reduces conflicts.
- Types of Team Structure :-
  - → Functional Structure
  - → Projectized Structure
  - → Matrix Structure

Example of Projectized Team Structure

2) Leadership :-

- Leadership is the ability to guide, influence and motivate team members to achieve common goals.
- A good leader provides direction, removes obstacles and builds confidence.
- Qualities of a Good Leader :-
  - → Visionary
  - → Decision making ability
  - → Communication skill
  - → Supportive and motivating

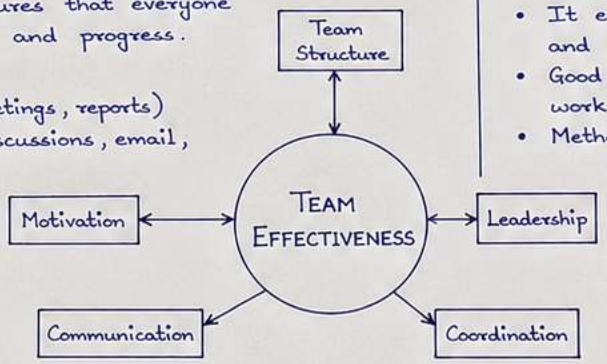
3) Communication :-

- Communication is the exchange of information between team members.
- Effective communication ensures that everyone understands the goals, tasks and progress.
- Types :-
  - → Formal Communication (meetings, reports)
  - → Informal Communication (discussions, email, chats)

Communication Process

4) Coordination :-

- Coordination is the integration of individual efforts towards achieving team goals.
- It ensures that all activities are aligned and resources are used properly.
- Good coordination avoids duplication of work and delays.
- Methods of Coordination :-
  - → Regular meetings
  - → Proper planning
  - → Clear roles and responsibilities
  - → Use of project management tools



5) Motivation :-

- Motivation is the driving force that encourages team members to perform better.
- It increases productivity and job satisfaction.
- Types of Motivation :-
  - → Intrinsic Motivation (internal satisfaction)
  - → Extrinsic Motivation (rewards, recognition)

Factors Affecting Team Effectiveness

1. Clear goals and objectives
2. Proper team structure
3. Effective leadership
4. Good communication
5. Better coordination
6. High motivation
7. Trust and respect among members

14 Marks Answer (RGPV Exam Style) :-

Team effectiveness is the ability of a team to achieve its goals with high quality and in less time. It depends on team structure, leadership, communication, coordination and motivation.

Team structure defines the organization of roles and responsibilities. A well defined structure provides clarity and avoids confusion. Projectized, functional and matrix are common structures.

Leadership is the ability to guide and influence team members. A good leader has vision, decision making ability, communication skill and supports the team.

Communication is the exchange of information among team members. It can be formal or informal. Effective communication ensures that all members are informed and errors are reduced.

Coordination is the integration of individual efforts towards common goals. It ensures that resources are used properly and activities are aligned. Regular meetings, proper planning and clear roles help in better coordination.

Motivation is the driving force that encourages team members to perform better. Intrinsic motivation comes from internal satisfaction while extrinsic motivation comes from rewards and recognition.

Thus, team effectiveness can be achieved by proper structure, good leadership, effective communication, better coordination and high motivation which lead to successful project completion.

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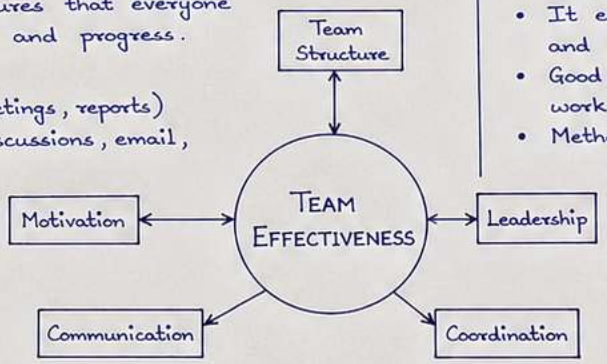

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9. Automation Through Software Environments

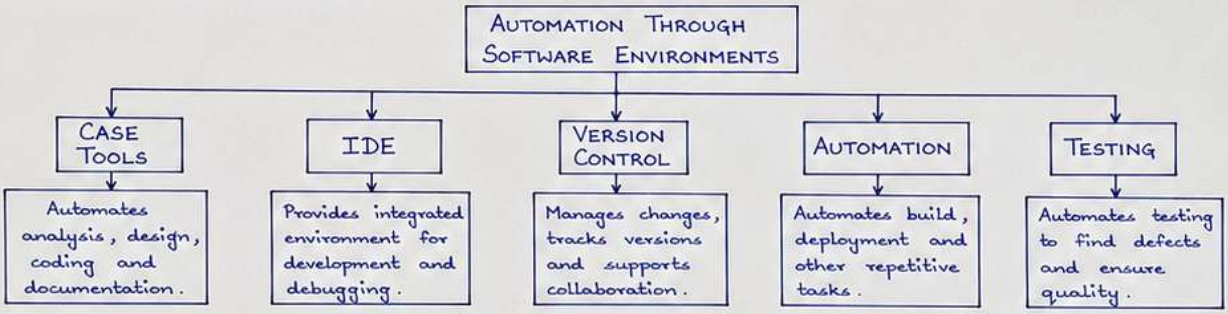
Automation through software environments means using tools and environments that support and automate various activities of software development to improve productivity, quality and reduce time and cost.

1) CASE Tools (Computer Aided Software Engineering)

- CASE tools are software tools that provide automated support for software development process.
- They help in requirement analysis, design, coding, testing, maintenance and documentation.
- Types of CASE Tools :-
  - → Upper CASE Tools :- Used in requirement analysis, design, planning.
  - → Lower CASE Tools :- Used in coding, testing, debugging, maintenance.
- Examples : Rational Rose, IBM Rational Suite, Microsoft Visio, Enterprise Architect.

2) IDE (Integrated Development Environment)

- IDE is a software application that provides comprehensive facilities to programmers for software development.
- Features :-
  - → Code editor
  - → Compiler / Interpreter
  - → Debugger
  - → Build automation
  - → Testing tools
- Examples : Visual Studio, Eclipse, IntelliJ IDEA, NetBeans, PyCharm.



3) Version Control

- Versions control systems (VCS) track changes in source code over time.
- They allow multiple developers to work concurrently.
- Features :
  - → Track changes
  - → Maintain history
  - → Branching and merging
  - → Backup and recovery
- Examples : Git, SVN, Mercurial, CVS.

4) Automation

- Automation reduces manual work and increases efficiency.
- Areas of automation :-
  - → Build automation
  - → Continuous Integration (CI)
  - → Deployment automation
  - → Code generation
  - → Documentation generation
- Tools : Jenkins, Maven, Gradle, GitHub Actions, Docker.

5) Testing

- Testing automation uses tools to execute tests automatically.
- Types :-
  - → Unit Testing
  - → Integration Testing
  - → System Testing
  - → Regression Testing
- Benefits :-
  - → Early defect detection
  - → Saves time and cost
  - → Improves quality
- Tools : Selenium, JUnit, TestNG, JMeter.

Advantages of Automation Through Software Environments

- Increases productivity and efficiency.
- Reduces development time and cost.
- Improves software quality.
- Ensures consistency and standardization.
- Supports collaboration among team members.
- Easy maintenance and reusability.
- Early error detection and quick feedback.
- Better project management and tracking.

14 Marks Answer (RGPV Exam Style) :-

Automation through software environments refers to the use of various tools and environments to automate different activities in software development. CASE tools provide automated support for analysis, design, coding and maintenance. IDEs integrate all necessary facilities such as editor, compiler, debugger and build tools for efficient development. Version control systems manage changes in source code and support team collaboration. Automation tools automate build, deployment and other repetitive tasks, which saves time and reduces errors. Testing tools automate test execution and help in early detection of defects. Together, these tools improve productivity, quality, consistency and help in delivering better software in less time and cost.

Key Points

- CASE Tools
- IDE
- Version Control
- Automation
- Testing
- Benefits

10. Software Development Environment

A Software Development Environment (SDE) is a collection of integrated tools, platforms and services that help developers to design, code, test, debug, build and deploy software efficiently.

1) IDE (Integrated Development Environment) :-

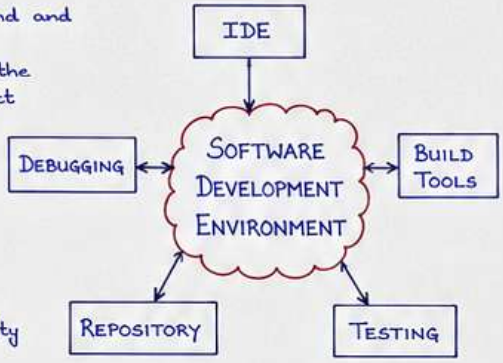
- IDE is a software application that provides comprehensive facilities to developers.
- It combines a code editor, compiler, debugger and other tools in a single interface.
- Features :-
  - → Code editing with syntax highlighting
  - → Auto-completion and code suggestions
  - → Project management
  - → Integrated debugging
  - → Supports multiple programming languages
- Examples :- Visual Studio Code, IntelliJ IDEA, Eclipse, PyCharm.

2) Build Tools :-

- Build tools automate the process of compiling source code, managing dependencies and packaging the application.
- They help in creating consistent builds.
- Functions :-
  - → Compile source code
  - → Manage libraries and dependencies
  - → Run tests
  - → Package and generate artifacts
- Examples :- Maven, Gradle, Ant, MSBuild.

3) Debugging :-

- Debugging tools are used to find and fix errors (bugs) in the code.
- They allow developers to run the program step-by-step and inspect variables.
- Features :-
  - → Breakpoints
  - → Step into / over / out
  - → Watch variables
  - → Stack trace analysis
  - → Memory inspection
- Good debugging improves code quality and reduces defects.



4) Testing :-

- Testing tools help in verifying that the software works as expected.
- Types of Testing :-
  - → Unit Testing
  - → Integration Testing
  - → System Testing
  - → Regression Testing
  - → UI Testing
- Features :-
  - → Test case management
  - → Automated test execution
  - → Result reporting
  - → Code coverage
- Examples :- JUnit, TestNG, Selenium, Postman, JMeter.

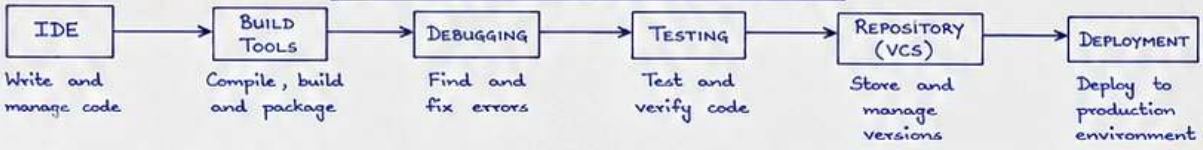
5) Repository / Version Control System :-

- Repository stores the source code and manages different versions of the project.
- It supports collaboration among team members.
- Features :-
  - → Track changes
  - → Branching and merging
  - → Backup and recovery
  - → Access control
- Examples :- Git, GitHub, GitLab, Bitbucket.

Advantages of SDE :-

- Increases developer productivity and efficiency.
- Improves code quality and consistency.
- Reduces development time and cost.
- Supports collaboration and teamwork.
- Provides automation for repetitive tasks.
- Easy tracking, maintenance and scaling of projects.

Software Development Environment Diagram



14 Marks Answer (RGPV Exam Style) :-

A Software Development Environment (SDE) is a set of integrated tools, platforms and services that support all activities of software development such as coding, building, debugging, testing, version control and deployment. It helps developers to work efficiently, improve quality and reduce time-to-market.

An IDE (Integrated Development Environment) provides a single interface for writing code, managing projects, compiling and debugging. It includes features like code editor, syntax highlighting, auto-completion, integrated debugger and project management. Examples are Visual Studio Code, Eclipse and IntelliJ IDEA.

Build tools are used to automate the compilation of code, manage dependencies and package the software. They ensure consistent and repeatable builds. Popular build tools are Maven, Gradle and Ant.

Debugging tools help in identifying and fixing errors in the program. They allow setting breakpoints, stepping through code, monitoring variables and analyzing stack traces. Effective debugging improves software reliability.

Testing tools verify that the software meets the requirements and works correctly. Different types of testing include unit testing, integration testing, system testing, regression testing and UI testing. Tools like JUnit, TestNG, Selenium and Postman help in automation of tests and reporting results.

Repository or Version Control System (VCS) stores the source code and manages different versions. It allows multiple developers to work together by tracking changes, merging code and maintaining history. Examples are Git, GitHub and GitLab.

Thus, an effective Software Development Environment improves productivity, maintains code quality, supports teamwork and ensures faster and reliable software delivery.

Key Points

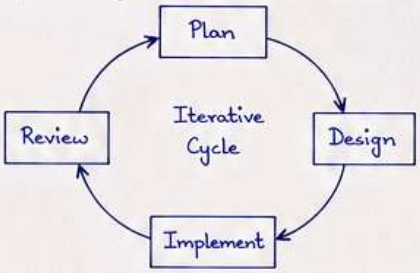
- IDE
- Build Tools
- Debugging
- Testing
- Repository (VCS)
- Automation
- Integration
- Collaboration
- Efficiency
- Quality

11. Principles of Modern Software Management

Modern software management is based on a set of principles that help in delivering high quality software in less time, within budget and with customer satisfaction. The major principles are explained below.

1) Iterative Development :-

- Work is done in small iterations (repeated cycles).
- Each iteration produces a working software increment.
- Feedback is taken early and changes are incorporated.
- It reduces risk and improves quality.
- Example : Agile, Scrum.



2) Risk Management :-

- Identify risks early in the project.
- Analyze the impact and probability of risks.
- Plan risk responses (avoid, reduce, transfer, accept).
- Monitor risks throughout the project.
- Helps in minimizing unexpected problems and cost.

Steps :

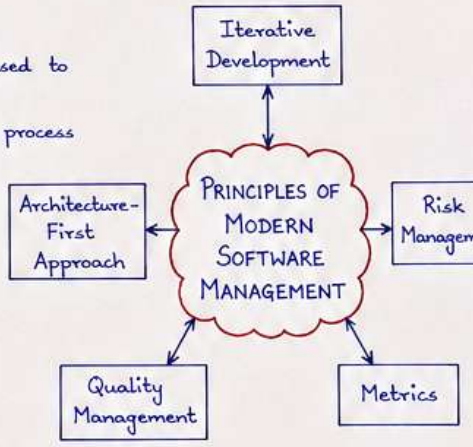
→ Risk Identification
→ Risk Analysis
→ Risk Planning
→ Risk Monitoring
→ Risk Control

Types of Risks

- Technical Risk
- Schedule Risk
- Cost Risk
- Resource Risk
- Business Risk

3) Metrics :-

- Metrics are quantitative measures used to track progress and quality.
- They help in decision making and process improvement.
- Examples of Metrics :
  → Size (LOC, Function Points)
  → Effort (Person-hours)
  → Time (Schedule Variance)
  → Quality (Defect Density)
  → Productivity (LOC/Person-month)



4) Architecture-First Approach :-

- Focus is on creating a strong architecture before detailed design and coding.
- A good architecture provides a solid foundation for development.
- It improves maintainability, scalability and reusability.
- Helps in identifying major risks early.
- Architecture acts as a blueprint for the entire system.

5) Quality Management :-

- Quality is planned, assured and controlled throughout the software life cycle.
- Focus on prevention of defects rather than detection.
- Follows standards and best practices.
- Involves reviews, testing, quality audits and continuous improvement.
- Goal : Deliver software that meets customer requirements and is reliable, usable and efficient.

Advantages of Following These Principles :-

- Better control over cost, time
- Early detection and reduction of risks.
- Improved product quality.
- Higher productivity and efficiency.
- Increased customer satisfaction.
- Continuous improvement in processes.

14 Marks Answer (RGPV Exam Style) :-

Modern software management is based on certain principles that help in managing software projects effectively. The key principles are iterative development, risk management, metrics, architecture-first approach and quality management.

Iterative development divides the project into small iterations or cycles. Each iteration produces a working increment of software. It allows early feedback and easy incorporation of changes, thus reducing risk and improving quality.

Risk management identifies potential risks in the project, analyzes their impact and probability and plans responses such as avoiding, reducing or transferring the risk. It continuously monitors and controls risks to keep the project on track.

Metrics are quantifative measures used to monitor and control the project. They provide objective data for decision making. Common metrics include size, effort, time, quality and productivity.

The architecture-first approach emphasizes designing the system architecture before detailed design and coding. A well-planned architecture ensures maintainability, scalability, reusability and helps in managing risks.

Quality management ensures that quality is built into the process from the beginning. It includes reviews, testing, quality audits and process improvement activities. The goal is to deliver software that meets customer requirements and is reliable and maintainable.

These principles help in delivering high quality software within cost and time with customer satisfaction.

Key Points

- Iterative Development
- Risk Management
- Metrics
- Architecture-first Approach
- Quality Management
- Advantages
  → Quality
  → Control
  → Satisfaction

12. Software Productivity

Software productivity refers to the effectiveness and efficiency with which software products are developed. It measures how much useful software output is produced per unit of input (effort, time, cost, resources).

1) Definition :-

- Software productivity is the ratio of software output to the software input.
- It indicates how efficiently the software development process is converting inputs (such as effort, time, cost) into outputs (such as size, functionality, quality of software).

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}} \quad \text{Or} \quad P = \frac{O}{I}$$

Higher the productivity, better is the performance of the development process.

2) Productivity Metrics :-

- Metrics are used to quantify productivity.
- Common software productivity metrics are :-
  - → Lines of Code / Person-Month (LOC/PM)
  - → Function Points / Person-Month (FP/PM)
  - → Features / Person-Month
  - → Use Case Points / Person-Month (UCP/PM)
  - → Story Points / Sprint
  - → Defect Density (Defects / KLOC)
  - → Cost per Function Point
  - → Schedule Variance, Velocity (in Agile)
  - → Quality Index (based on defects, test results)

3) Measurement Process :-

- Software productivity measurement involves the following steps :-
  - → Define objective of measurement
  - → Select suitable metrics
  - → Collect data (effort, size, time, defects)
  - → Compute productivity value
  - → Analyze and interpret results
  - → Use results for improvement
- Measurements should be consistent, repeatable and meaningful.

4) Factors Affecting Productivity :-

- Productivity depends on many factors :-
  - → Personnel Factors (skill, experience, motivation)
  - → Process Factors (methodology, planning, practices)
  - → Product Factors (complexity, size, quality requirements)
  - → Project Factors (tools, resources, deadlines)
  - → Environment Factors (technology, infrastructure, support).

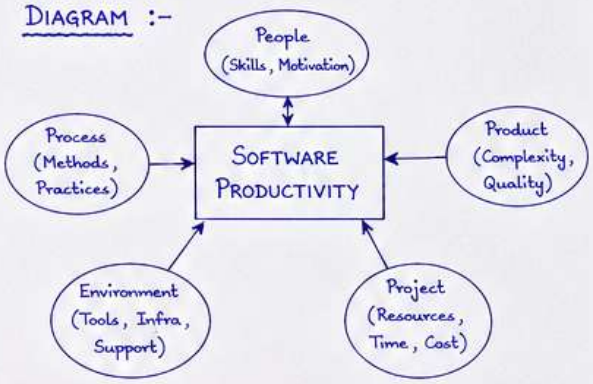
5) Techniques to Improve Productivity :-

- → Use of modern tools and automation
- → Reuse of components and libraries
- → Standard processes and methodologies
- → Training and skill development
- → Better planning and estimation
- → Code reviews and pair programming
- → Continuous integration and testing
- → Clear requirements and communication
- → Eliminate waste and rework.
- → Motivation and good working environment

Improvement Approaches

- Process improvement
- Technology improvement
- Tool improvement
- People improvement
- Measurement and feedback.
- Automation
- Reuse and component-based development
- Quality focus (reduce defects)

Diagram :-



Advantages of Improving Software Productivity :-

- Reduces development time and cost
- Enables early delivery of software
- Improves quality and reliability
- Enhances customer satisfaction
- Better utilization of resources
- Increases competitiveness
- Supports continuous improvement
- Allows taking more projects
- Encourages innovation
- Increases profit and growth

14 Marks Answer (RGPV Exam Style) :-

Software productivity refers to the effectiveness and efficiency with which useful software is developed. It is defined as the ratio of software output to the software input. Output may be measured in terms of lines of code, function points, features or use case points, while input may be effort, time or cost. Higher productivity means that more output is produced per unit of input.

Productivity is measured using various metrics such as LOC per person-month, Function Points per person-month, defect density, cost per function point, velocity and others. Measurement involves defining objectives, selecting suitable metrics, collecting data, computing productivity, analyzing the results and using them for improvement.

Many factors affect productivity such as personnel factors (skills, experience, motivation), process factors (methodology, practices), product factors (complexity, size, quality requirements), project factors (tools, resources, deadlines) and environment factors (technology, infrastructure, support).

Productivity can be improved by using modern tools and automation, reusing components and libraries, following standard processes, training and skill development, better planning, code reviews, continuous integration and testing, clear requirements, eliminating waste and rework and providing motivation and good working environment.

Improving productivity has many advantages such as reduction in development time and cost, early delivery, better quality, customer satisfaction, better resource utilization, increased competitiveness, ability to handle more projects and overall profit and growth.

Thus, measuring and improving software productivity is essential for successful software project management and for delivering high quality software within time and budget.

Key Points

- Definition
- Metrics
- Measurement
- Factors
- Improvement
- Diagram
- Advantages
- Conclusion