



fit@hcmus

Software Testing

CSC13003

Test Management

Content

- **Independent testing**
- Test roles and their tasks
- Test management
- Planning
 - Risk Analysis
 - Test Estimation
 - Test Planning
 - Test Organization
- Execution
 - Test Monitoring and Control
 - Issue Management
 - Test Report and Evaluation

Independent testing

- A certain degree of independence often makes the tester more effective at finding defects due to differences between the author's and the tester's cognitive biases.

Five degrees of independence

1. No independent testers; developers test their own code.
2. Independent developers or testers within the development teams or the project team.
3. Independent test team or group within the organization.
4. Independent testers from the business organization or user community, or within specializations in specific test types.
5. Independent testers external to the organization, either working on-site (insourcing) or off-site (outsourcing)

Benefits of independence

- Independent testers are likely to recognize different kinds of failures.
- An independent tester can verify, challenge or reject assumptions made by stakeholders.

Drawbacks of independence

- Isolation from the development team.
- Developers may lose a sense of responsibility for quality.
- Independent testers may be seen as bottleneck or blamed for delays in release.
- Independent testers may back some important information.

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Test Roles

- Test manager.
- Tester.

Test manager tasks

- Test policy.
 - The policy of the organization, not related to a specific project.
 - “We can not deliver any project without executing all the test scenarios inside the project.”
- Test strategy.
 - Describe the whole test process from planning until completion, list of activities, higher level than test plan, but lower than test policy.
- Test plan.

Test manager tasks

- Test monitoring and control.
 - Write the test progress report and the test summary report.
- Initiate the analysis, design, implementation, and execution of tests.
 - Prepare test basis for testers.
- Configuration management.
- Metrics.

Test manager tasks

- Tools selection.
- Test environment implementation decision.
- Develop the skills and careers of testers.

Tester tasks

- Review and contribute to test plans.
- Assess requirements for testability.
- Test conditions, test cases, test procedures, test data, and test execution schedule.
- Test environment setup.

Tester tasks

- Test execution.
- Test automation.
- Non-functional testing.
- Review tests developed by others

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Test Management

- A process of managing the testing activities in order to ensure high quality and high-end testing of the software application.
- Consists of organizing, controlling, ensuring traceability and visibility of the testing process.
- Ensures that the software testing process runs as expected

2 main parts

1. Planning

- a. Risk Analysis
- b. Test Estimation
- c. Test Planning
- d. Test Organization

2. Execution

- a. Test Monitoring and Control
- b. Issue Management
- c. Test Report and Evaluation

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Planning - Risk Analysis and Solution - Definition

- Risk is the probability of occurrence of an undesirable event.
- Risk Analysis in Software Testing is the process of analyzing the risks associated with your Testing Project.
- For the success of your project, Risk should be identified and corresponding solutions should be determined before the start of the project.
- Risk Identification helps you to identify probable risks in the early stages.

Planning - Risk Analysis and Solution - Benefit

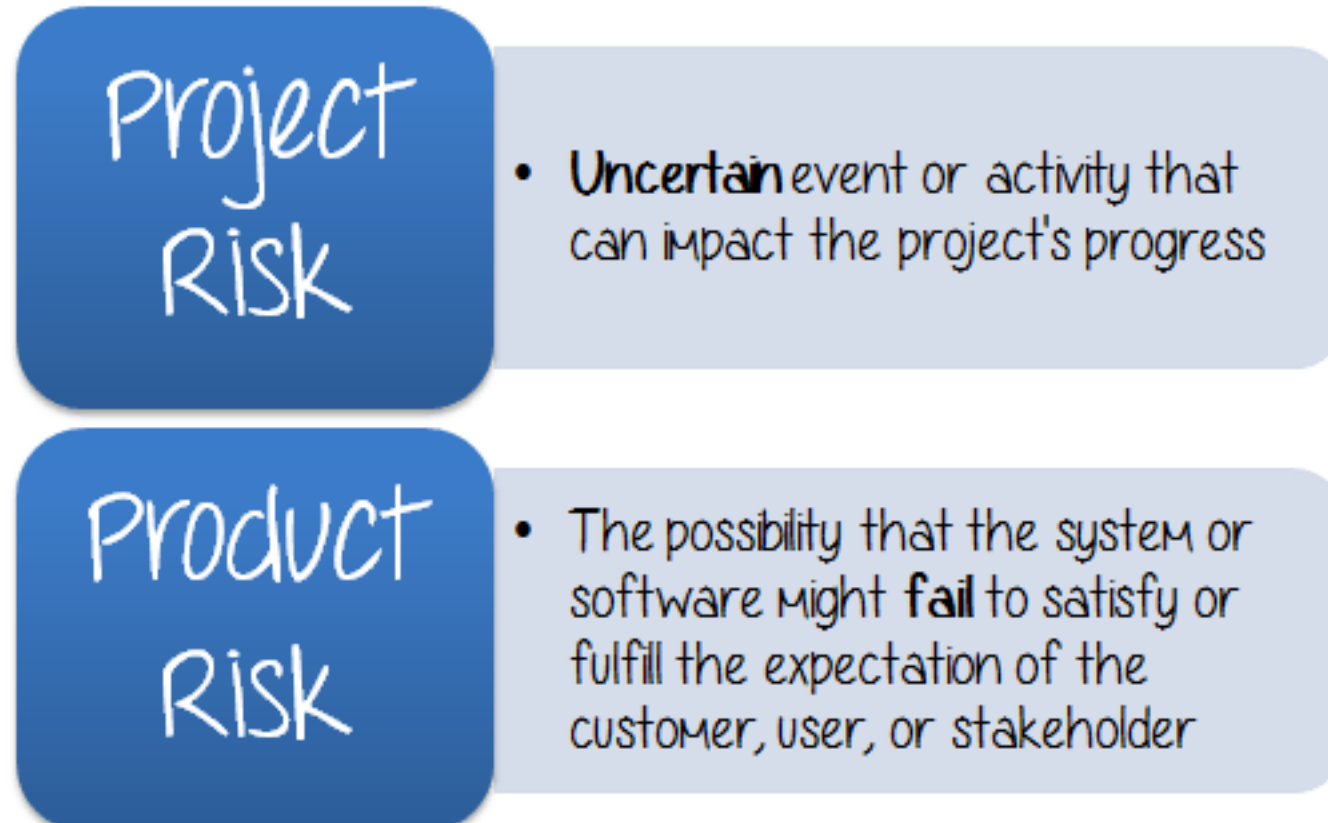
- Early forecast of unwanted situations in your project.
- Estimate potential loss of such situations.
- Make decision to deal with such situations.
- Avoid the future consequences.

Planning - Risk Analysis and Solution – 3-step process

1. Identify the Risks
2. Analyze Impact of each Identified Risk
3. Take counter measures for the identified & Analyzed risk



Step 1 – Identify Risk



Project Risk

- Project risk can be defined as an uncertain event or activity that can impact the project's progress.
- The impact has a positive or negative effect on the prospects of achieving project objectives.

Project Risk



Project Risk – Organization Risk

- It is a risk related to your human resource or your Testing team.
- For example, in your project, lack of technically skilled members is a risk.
- Not having enough manpower to complete the project on time is another risk.

Project Risk – Organization Risk

Test Manager

- **Manages** the whole project and takes **full responsibility** for the project's success

Test Administrator

- Builds up and ensures test environment and assets are **managed** and **maintained**

Test Designer

- Responsible for defining the test approach and ensuring it's successful implementation

Tester

- Executes the test case on software product to ensure quality, design integrity and proper functionality.

Project Risk – Organization Risk

- Is this a well-organized Team?
 - If No => Create stronger team and foster an environment of co-operation
- Does each team member has the skill to do his/her job?
 - If No => Build the training course to skill up members
- Compare to project size and schedule, do we have enough human resource to finish this project at the deadline?
 - If No => Ask the project board to get more human resource

Project Risk – Technical Risk

- Technical Risk is the probability of loss incurred during the execution of a technical process such as untested engineering, wrong testing procedure...
- Example:
 - Your task in this project is testing a banking website.
 - You have to set up proper test environments which mirror real business environments.
 - If the Test Environment is not setup properly, the product will be not be tested correctly and many defects will not be detected.



Project Risk – Business Risk

- The risk involves an external entity.
- It is the risk which may come from your company, your customer but not from your project.

Project Risk – Business Risk

- Example.



Project Risk – Business Risk

- Solution.
 - Set priority for the testing phases, focus on testing the main features of website
 - Utilize a testing tool to increase the productivity of testing
 - Apply process improvement to reduce the management effort.

Project Risk – Product Risk

- Product risk is the possibility that the system or software might fail to satisfy or fulfill the expectation of the customer, user, or stakeholder.

Project Risk – Product Risk

- Example.
 - The software skips some key function that the customers specified in the users' requirement
 - The software is unreliable and frequently fails to work.
 - Software fail in ways that cause financial or other damage to a user or the company that uses the software.
 - The software has problems related to a particular quality characteristic such as security, reliability, usability, maintainability or performance.

Project Risk – Product Risk

- Steps

Step 1



Investigate the specification documents

Step 2



Discuss with developer to know more about this website

Step 3



Walk around the website as real user

Step 2 – Analyze the impact of the risk occurring

- Several risks from a specific project.
 - You may not have enough human resource to finish the project on the deadline
 - The Testing environment may not be setup properly like real business environment.
 - Your project budget may cut by half because of business situation
 - This website may lack security functions

Step 2 – Analyze the impact of the risk occurring

- Each risk should be classified on the basis of following two parameters:
 - The probability of occurrence
 - The impact on the project

Step 2 – Analyze the impact of the risk occurring

Probability	
High (3)	Has very high probability to occur, may impact to the whole project
Medium (2)	50% chance to occur
Low (1)	Low probability of occurrence

Impact	
High (3)	Cannot continue with project activity if it is not solved immediately
Medium (2)	Cannot continue the project activity if it is not solved
Low (1)	Need to solve it but it is possible to take alternative solution for a while

Step 2 – Analyze the impact of the risk occurring

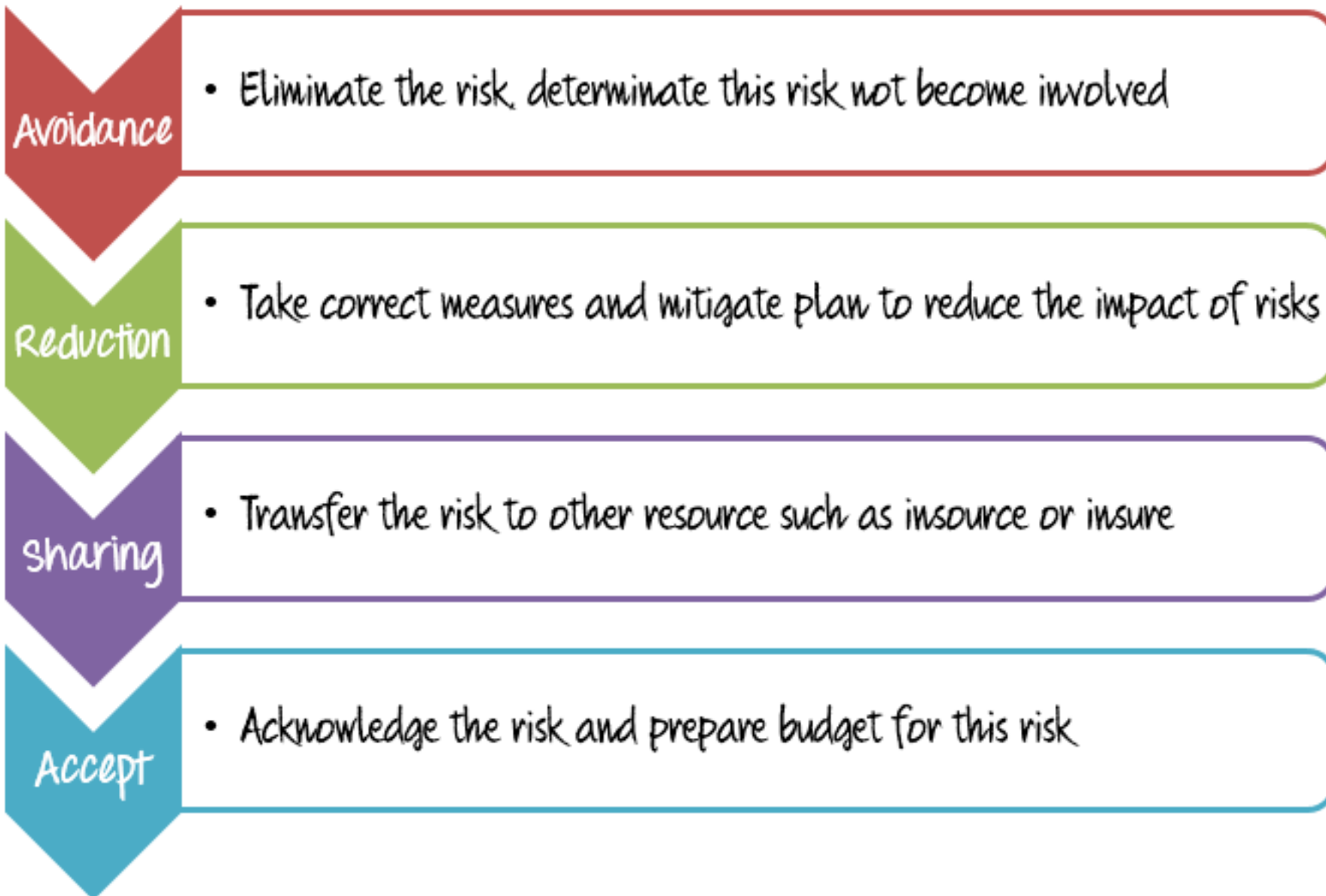
Risk	Probability	Impact	Priority = Probability* Impact
Project deadline not met	3	3	9
Electricity Failure	1	2	2

Priority		Risk Management Method
High	6 -9	<i>Take mitigation action immediately and monitor the risk every day until its status is closed.</i>
Middle	3-5	<i>Monitor the risk every week at internal progress meeting</i>
Low	1-2	<i>Accept the risk and monitor the risk on milestone basis.</i>

Step 3 - Take COUNTERMEASURES to mitigate the risk



Risk Response



Risk Response - Example

- You may not have enough human resource to finish the project at the deadline
 - This risk cannot be avoided because of company's situation; you cannot request more human resource for the project. In such case, you can reduce the impact of risks by choosing some options below
 - Select the talented and experienced member to join the Project Team
 - Create the training course to skill up the member, help them to improve the productivity

Risk Response - Example

- The testing environment may not be setup properly like real business environment
 - This risk could be avoided if you do the following activities
 - Ask the development team for their help to build up the test environment
 - Prepare all the equipment or materials (Server, database, PC..) needed for setting up environment

Risk Response - Example

- Your project may cut by half because of business situation
 - This risk is a critical; it may prevent the whole project from proceeding. In that case, you should do
 - Re-define the project scope, identify what will be tested and what will be ignored in such case
 - Negotiate with customer about the term of project to fit for the project budget
 - Improve the productivity of each project phase such as testing, making test specs,...If you can save time, you can save cost

Risk Response - Example

- This website may lack security features
 - This risk is considered as Medium priority, because it doesn't affect to the whole project and could be avoided. You can request the development team to check and add these functions to the website.

Register Risk

- All the risk must be recorded, documented and acknowledged by project managers, stakeholder and the project member.
- The risk register should be freely accessible to all the members of the project team.
- There're some useful to register risk such as Redmine, MITRE... etc.

Monitor and Control Risk

- Risks can be monitored on a continuous basis to check if any changes are made.
- New risk can be identified through the constant monitoring and assessing mechanisms.

Planning – Test Estimation

- Test Estimation is approximately determining how long a task would take to complete.
- Benefits of correct estimation:
 - Accurate test estimates lead to better planning, execution, and monitoring of tasks under a test manager's attention.
 - Allow for more accurate scheduling and help realize results more confidently.

What to Estimate?



How to estimate?

- Work Breakdown Structure
- 3-Point Software Testing Estimation Technique
- Wideband Delphi technique
- Function Point/Testing Point Analysis
- Use Case Point Method
- Percentage distribution
- Ad-hoc method

How to estimate?

Work Breakdown Structure (WBS)

- Breaking down the test project into small pieces

Three Point Estimation

- Estimation method is based on statistical data

Functional Point Method

- Measure the size and give weightage to each function point

How to estimate?

Step 1) Divide the whole project into the smallest tasks

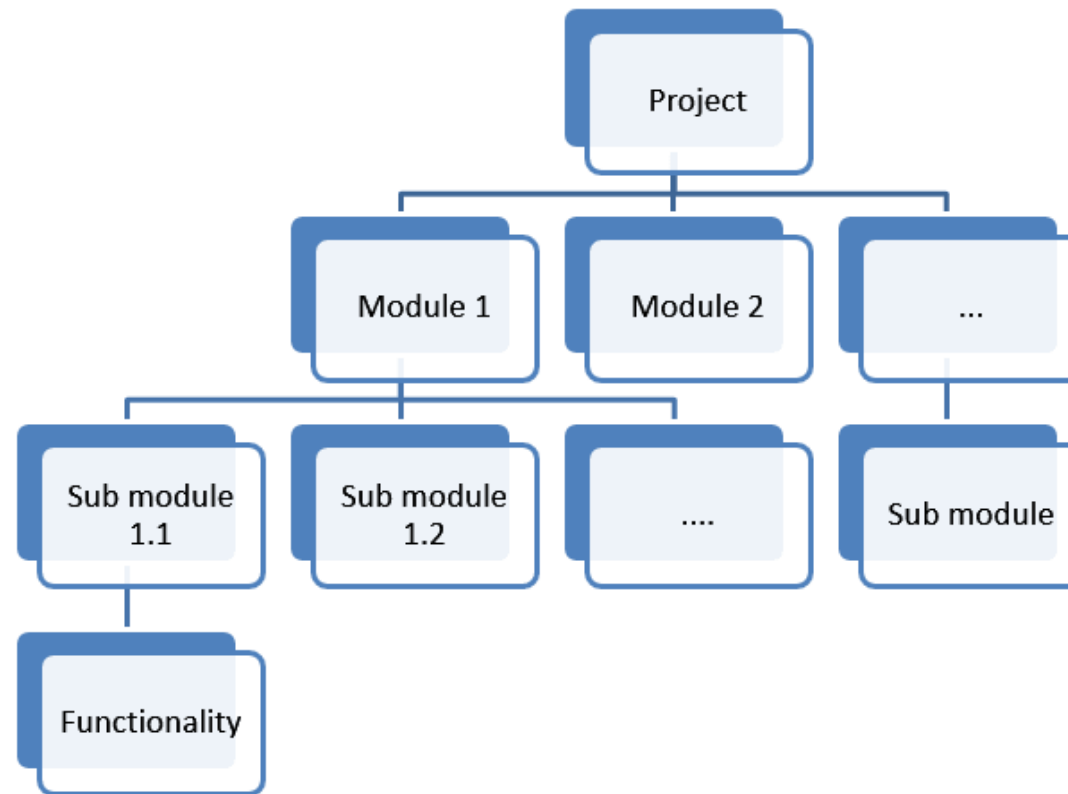
Step 2) Allocate each task to team members

Step 3) Estimate the effort required to complete each task

Step 4) Validate the estimation

Step 1 - Divide the whole project task into subtasks

- To do this, you can use the Work Breakdown Structure technique.



Step 1 - Divide the whole project task into subtasks

Task	Sub task
Analyze software requirement specification	Investigate the soft requirement specs
	Interview with the developer & other stakeholders to know more about the website
Create the Test Specification	Design test scenarios
	Create test cases
	Review and revise test cases
Execute the test cases	Build up the test environment
	Execute the test cases
	Review test execution results
Report the defects	
	Create the <u>Defect</u> reports
	Report the defects

Step 2 - Allocate each task to team member

Task	Members
Analyze software requirement specification	All the members
Create the test specification	Tester/Test Analyst
Build up the test environment	Test Administrator
Execute the test cases	Tester, Test Administrator
Report defects	Tester

Step 3 - Effort Estimation For Tasks

- Functional Point Method
- Three Point Estimation

Method 1 - Function Point Method

Step A) Size



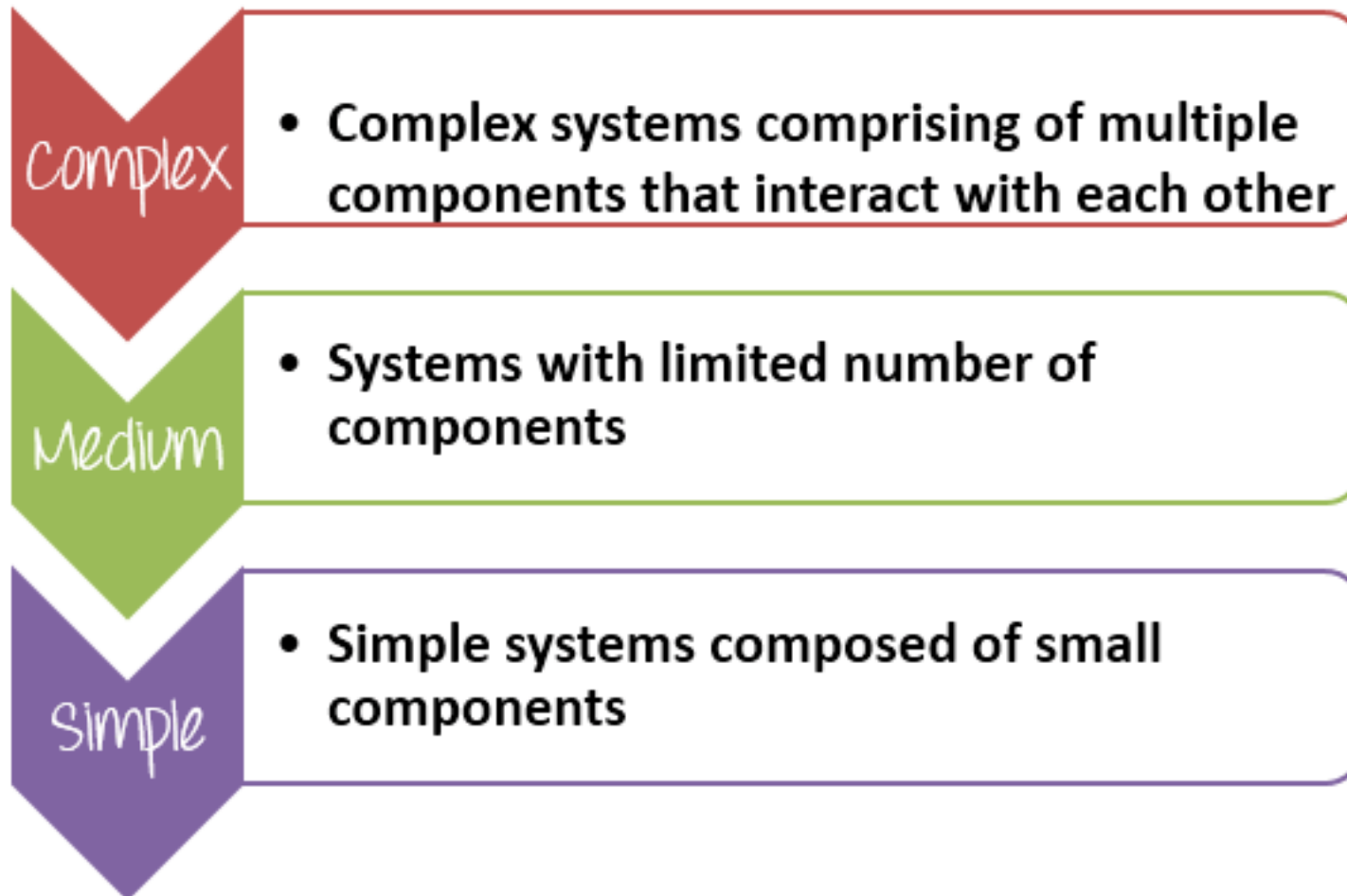
Step B) Duration



Step C) Cost



Step A - Estimate size for the task



Group	Weightage
Complex	5
Medium	3
Simple	1

Step A - Estimate size for the task

No.	Module Name	Applicable Roles	Description	Weightage
1.	Balance Enquiry	Manager Customer	Customer: A customer can have multiple bank accounts. He can view balance of his accounts only Manager: A manager can view balance of all the customers who come under his supervision	3
2.	Fund Transfer	Manager Customer	Customer: A customer can have transfer funds from his "own" account to any destination account. Manager: A manager can transfer funds from any source bank account to destination account	5
3.	Mini Statement	Manager Customer	A Mini statement will show last 5 transactions of an account Customer: A customer can see mini-statement of only his "own" accounts Manager: A manager can see mini-statement of any account	3

Step A - Estimate size for the task

No.	Module Name	Applicable Roles	Description	Weightage
4.	Customized Statement	Manager Customer	A customized statement allows you to filter and display transactions in an account based on date, transaction value Customer: A customer can see Customized- statement of only his “own” accounts Manager: A manager can see Customized -statement of any account	5
5.	Change Password	Manager Customer	Customer: A customer can change password of only his account. Manager: A manager can change password of only his account. He cannot change passwords of his customers	1
6.	New Customer	Manager	Manager: A manager can add a new customer. Manager: A manager can edit details like address, email, telephone of a customer.	3

Step A - Estimate size for the task

No.	Module Name	Applicable Roles	Description	Weightage
7.	New Account	Manager	<p>Currently system provides 2 types of accounts</p> <ul style="list-style-type: none"> •Saving •Current <p>A customer can have multiple saving accounts (one in his name, other in a joint name etc).</p> <p>He can have multiple current accounts for different companies he owns.</p> <p>Or he can have a multiple current and saving accounts.</p> <p>Manager: A manager can add a new account for an existing customer.</p>	5
8.	Edit Account	Manager	Manager: A manager can add an edit account details for an existing account	1
9.	Delete Account	Manager	Manager: A manager can add a delete an account for a customer.	1

Step A - Estimate size for the task

No.	Module Name	Applicable Roles	Description	Weightage
10.	Delete Customer	Manager	A customer can be deleted only if he/she has no active current or saving accounts Manager: A manager can delete a customer.	1
11.	Deposit	Manager	Manager: A manager can deposit money into any account. Usually done when cash is deposited at a bank branch.	3
12.	Withdrawal	Manager	Manager: A manager can withdraw money from any account. Usually done when cash is withdrawn at a bank branch.	3

Step B - Estimate duration for the task

$$\boxed{\text{Total Effort}} = \boxed{\text{Total Function Points}} * \boxed{\text{Estimate defined per Function Points}}$$

	Weightage	# of Function Points	Total
Complex	5	3	15
Medium	3	5	15
Simple	1	4	4
Function Total Points			34
Estimate define per point			5
Total Estimated Effort (Person Hours)			170 man-hours

Step C - Estimate the cost for the tasks

- Suppose, on average your team salary is \$5 per hour.
 - The time required for “Create Test Specs” task is 170 hours.
 - Accordingly, the cost for the task is $5 \times 170 = \$850$.
 - Now you can calculate budget for other activities in WBS and arrive at overall budget for the project.
-
- As a project manager, you have to decide how to get the most return for your company's investment.
 - The more accurate your estimate of project cost is, the better able you will be to manage your project's budget.

Method 2 - Three Point Estimation

- In three-point estimation, three values are produced initially for every task based on prior experience or best-guesses as follows



Step 4 - Validate the estimation

- Once you create an aggregate estimate for all the tasks mentioned in the WBS, you need to forward it to the management board, who will review and approve it.
- The member of management board could comprise of the CEO, Project Manager & other stakeholders.
- The management board will review and discuss your estimation plan with you. You may explain them your estimation logically and reasonably so that they can approve your estimation plan.

Test estimation best practices

- Add some buffer time
- Account Resource planning in estimation
 - What should you do if some members in your team take long leaves?
- Use the past experience as reference
- Stick to your estimation

Software Test Estimation Template

- Download the Software Test Estimation Excel on Guru99.

Planning - Test Planning

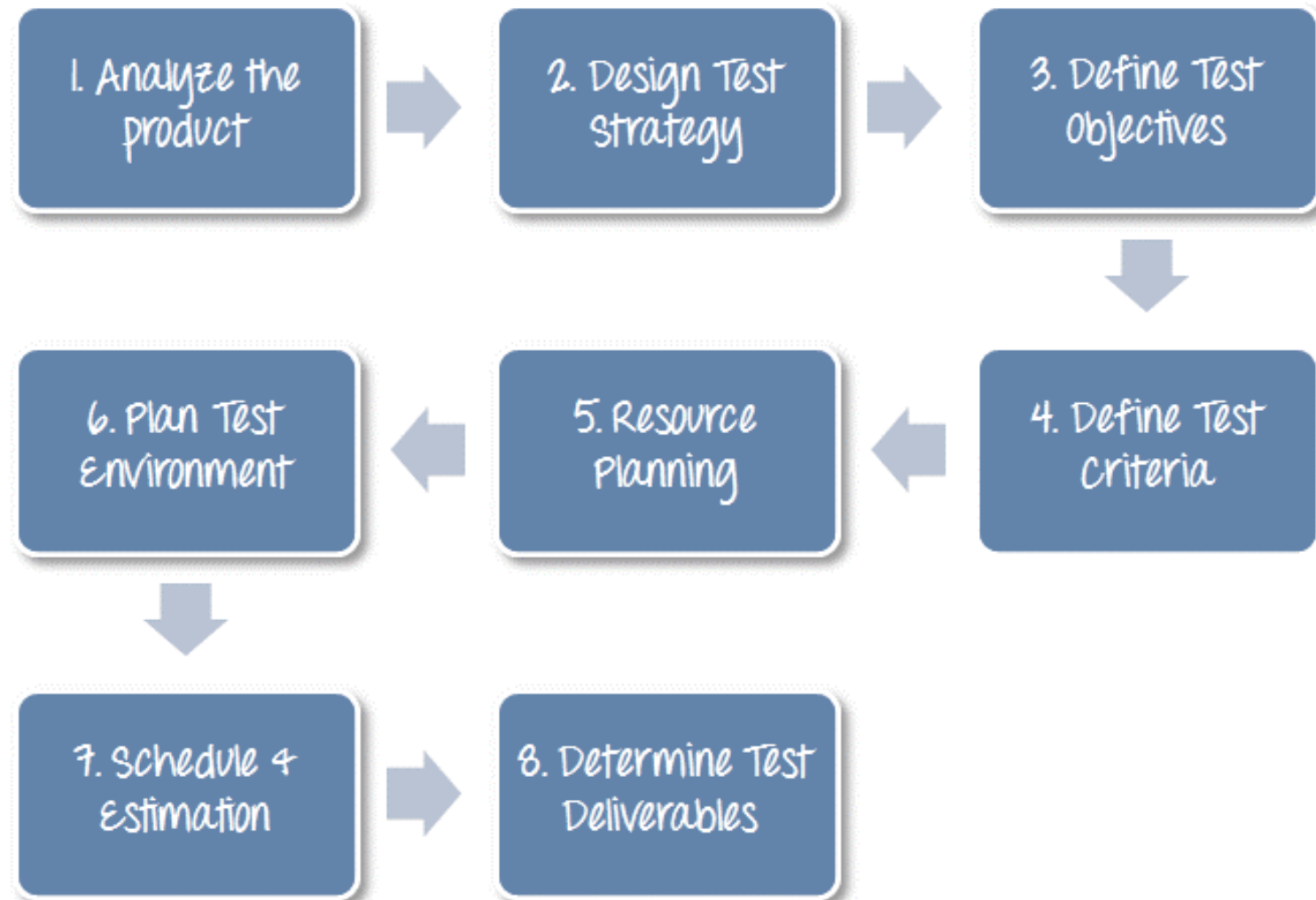
- A Test Plan can be defined as a document describing the scope, approach, resources, and schedule of intended Testing activities.
- In software testing, a test plan gives detailed testing information regarding an upcoming testing effort, including:
 - Test Strategy
 - Test Objective
 - Exit /Suspension Criteria
 - Resource Planning
 - Test Deliverables

What is the Importance of Test Plan?

- Help people outside the test team such as developers, business managers, customers understand the details of testing.
- Test Plan guides our thinking. It is like a rule book, which needs to be followed.
- Important aspects like test estimation, test scope, Test Strategy are documented in Test Plan, so it can be reviewed by Management Team and re-used for other projects.

How to write a Test Plan

- IEEE 829



Step 1 - Analyze the product

- Who will use the website?
- What is it used for?
- How will it work?
- What are software/ hardware the product uses?

Step 1 - Analyze the product



Step 2 - Develop Test Strategy

- The project's testing objectives and the means to achieve them
- Determines testing effort and costs



Step 2.1 - Define Scope of Testing

- Before the start of any test activity, scope of the testing should be known. You must think hard about it.
 - The components of the system to be tested (hardware, software, middleware, etc.) are defined as “in scope”
 - The components of the system that will not be tested also need to be clearly defined as being “out of scope.”

Step 2.1 - Define Scope of Testing

- Defining the scope of your testing project is very important for all stakeholders. A precise scope helps you
 - Give everyone a confidence & accurate information of the testing you are doing
 - All project members will have a clear understanding about what is tested and what is not

Step 2.1 - Define Scope of Testing

- How do you determine scope your project?
 - Precise customer requirement
 - Project Budget
 - Product Specification
 - Skills & talent of your test team

Step 2.1 - Define Scope of Testing

- How do you determine scope your project? An example.
 - As the software requirement specs, the project Guru99 Bank only focus on testing all the functions and external interface of website Guru99 Bank (in scope testing)
 - Nonfunctional testing such as stress, performance or logical database currently will not be tested. (out of scope)

Step 2.1 - Define Scope of Testing

- Problem Scenario

- The customer wants you to test his API. But the project budget does not permit to do so.
- In such case you need to convince the customer that API Testing is extra work and will consume significant resources.
- Give him data supporting your facts.
- If API Testing is included in-scope the budget will increase by XYZ amount.

Step 2.2 - Identify Testing Type

Unit Test	<ul style="list-style-type: none">• Test the smallest piece of verifiable software in the application
API Testing	<ul style="list-style-type: none">• Test the API's created for the application
Integration Test	<ul style="list-style-type: none">• Individual software modules are combined and tested as a group
System Test	<ul style="list-style-type: none">• Conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements
Install/uninstall Testing	<ul style="list-style-type: none">• Focuses on what customers will need to do to install/uninstall and set up/remove the new software successfully
Agile Testing	<ul style="list-style-type: none">• Testing the system using Agile methodology

Step 2.3 - Document Risk & Issues

Risk	Mitigation
Team member lack the required skills for website testing.	Plan training course to skill up your members
The project schedule is too tight; it's hard to complete this project on time	Set Test Priority for each of the test activity.
Test Manager has poor management skill	Plan leadership training for manager
A lack of cooperation negatively affects your employees' productivity	Encourage each team member in his task, and inspire them to greater efforts.
Wrong budget estimate and cost overruns	Establish the scope before beginning work, pay a lot of attention to project planning and constantly track and measure the progress

Step 2.4 - Create Test Logistics

- Who will test?
- When will the test occur?

Step 2.4 - Create Test Logistics

- Who will test?
- Person having the following skills is most ideal for performing software testing:
 - Ability to understand customers point of view
 - Strong desire for quality
 - Attention to detail
 - Good cooperation

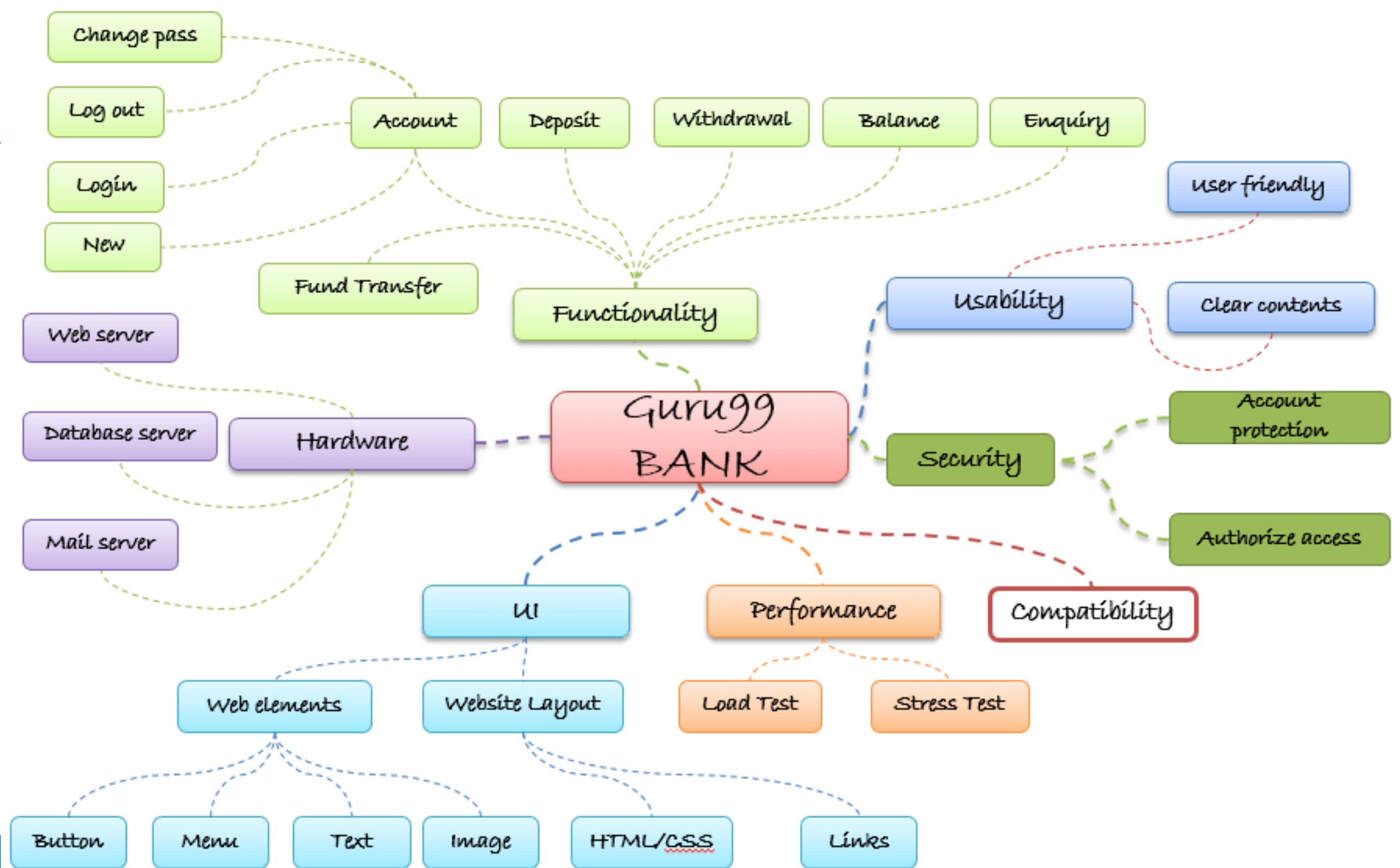
Step 2.4 - Create Test Logistics

- When will the test occur?



Step 3 - Define Test Objective

- Test Objective is the overall goal and achievement of the test execution.
- The objective of the testing is finding as many software defects as possible; ensure that the software under test is bug free before release.
- To define the test objectives, you should do 2 following steps:
 - List all the software features (functionality, performance, GUI...) which may need to test.
 - Define the target or the goal of the test based on above features



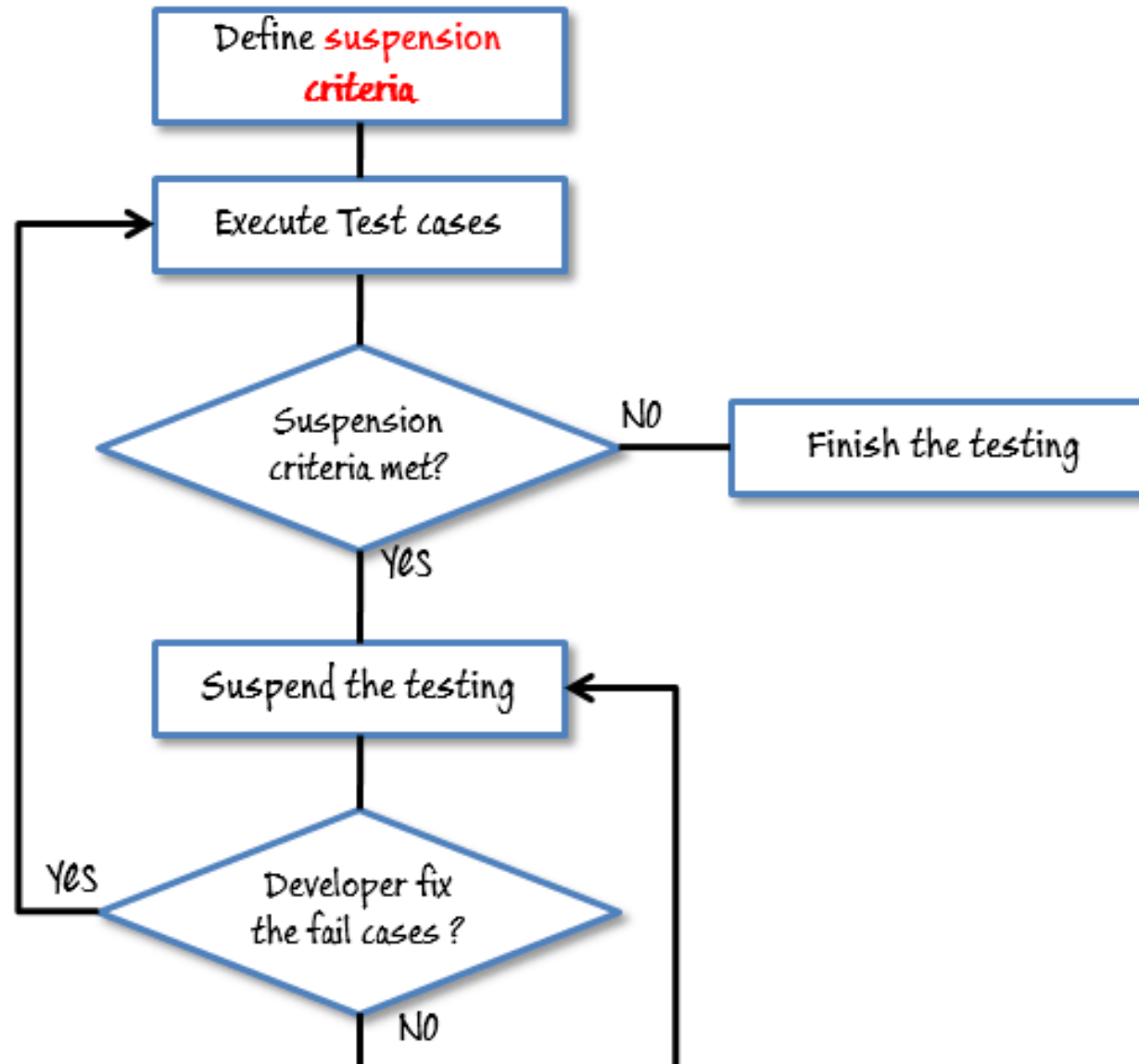
Step 3 - Define Test Objective

- Based on above features, you can define the Test Objective of the project Guru99 as following:
 - Check that whether website Guru99 functionality(Account, Deposit...) is working as expected without any error or bugs in real business environment
 - Check that the external interface of the website such as UI is working as expected and & meet the customer need
 - Verify the usability of the website. Are those functionalities convenient for user or not?

Step 4 - Define Test Criteria

- Suspension Criteria
 - Specify the critical suspension criteria for a test. If the suspension criteria are met during testing, the active test cycle will be suspended until the criteria are resolved.
- Example.
 - If your team members report that there are 40% of test cases failed, you should suspend testing until the development team fixes all the failed cases.

Step 4 - Define Test Criteria



Step 4 - Define Test Criteria

- Exit Criteria
 - It specifies the criteria that denote a successful completion of a test phase.
 - The exit criteria are the targeted results of the test and are necessary before proceeding to the next phase of development.
- Example: 95% of all critical test cases must pass.

Step 4 - Define Test Criteria

- Exit Criteria.
 - Run rate is ratio between number test cases executed/total test cases of test specification. For example, the test specification has total 120 TCs, but the tester only executed 100 TCs, So the run rate is $100/120 = 0.83$ (83%)
 - Pass rate is ratio between numbers test cases passed / test cases executed. For example, in above 100 TCs executed, there're 80 TCs that passed, so the pass rate is $80/100 = 0.8$ (80%)

Step 4 - Define Test Criteria

- Exit Criteria.
 - Run rate is mandatory to be 100% unless a clear reason is given.
 - Pass rate is dependent on project scope, but achieving high pass rate is a goal.

Step 5 - Resource Planning – Human Resource

No.	Member	Tasks
1.	Test Manager	Manage the whole project Define project directions Acquire appropriate resources
2.	Tester	Identifying and describing appropriate test techniques/tools/automation architecture Verify and assess the Test Approach Execute the tests, Log results, Report the defects. Tester could be in-sourced or out-sourced members, base on the project budget For the task which required low skill, I recommend you choose outsourced members to save project cost.
3.	Developer in Test	Implement the test cases, test program, test suite etc.
4.	Test Administrator	Builds up and ensures <u>Test Environment</u> and assets are managed and maintained Support Tester to use the test environment for test execution
5.	SQA members	Take in charge of quality assurance Check to confirm whether the testing process is meeting specified requirements

Step 5 - Resource Planning – System Resource

No.	Resources	Descriptions
1.	Server	Install the web application under test This includes a separate web server, database server, and application server if applicable
2.	Test tool	The testing tool is to automate the testing, simulate the user operation, generate the test results There are tons of test tools you can use for this project such as Selenium, QTP...etc.
3.	Network	You need a Network include LAN and Internet to simulate the real business and user environment
4.	Computer	The PC which users often use to connect the web server

Step 6 - Plan Test Environment

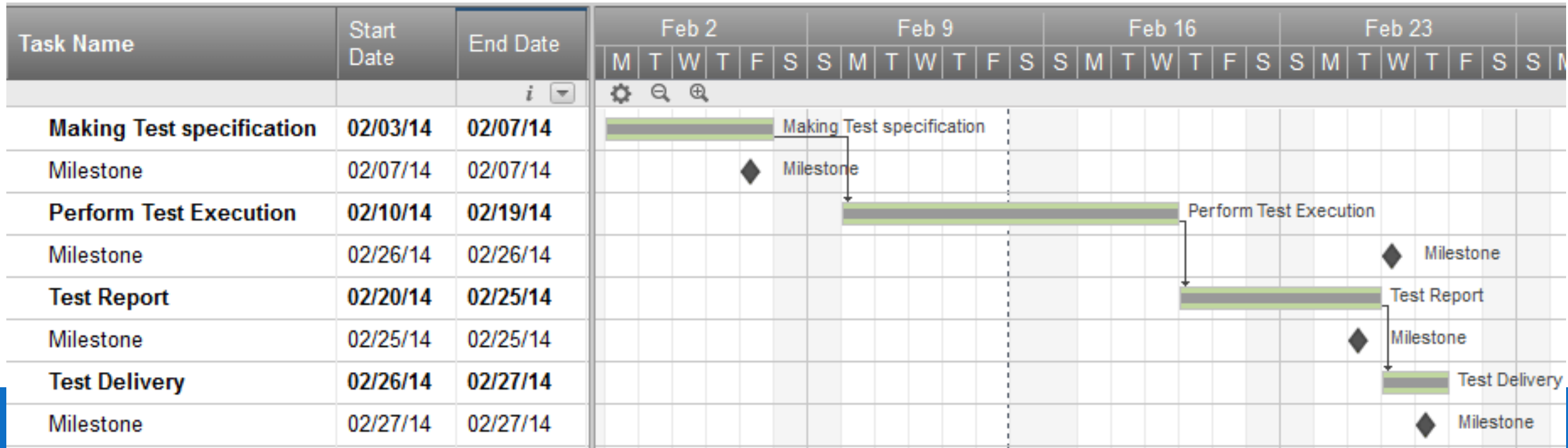
- A testing environment is a setup of software and hardware on which the testing team is going to execute test cases.
- The test environment consists of real business and user environment, as well as physical environments, such as server, front end running environment.

Step 6 - Plan Test Environment

- What is the maximum user connection which this website can handle at the same time?
- What are hardware/software requirements to install this website?
- Does the user's computer need any particular setting to browse the website?

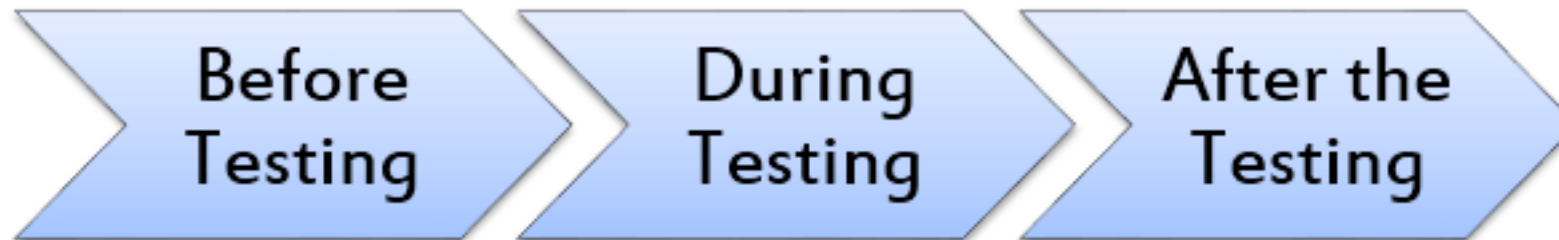
Step 7 - Schedule & Estimation

- Employee and project deadline
- Project estimation
- Project Risk



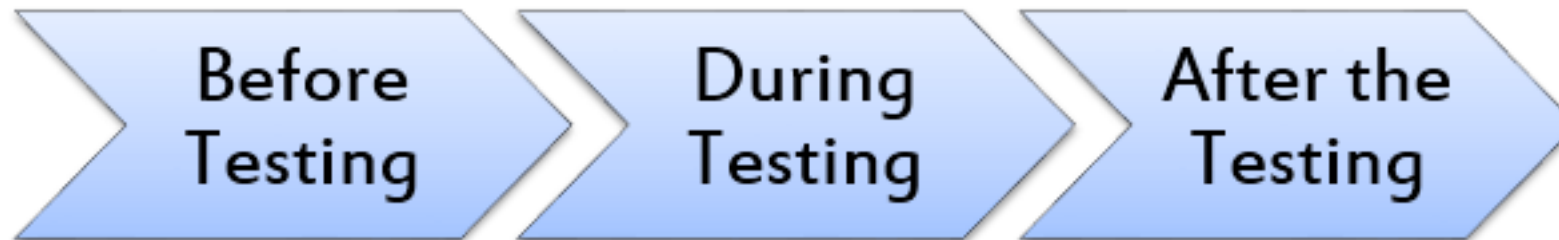
Step 8 - Test Deliverables

- Before testing
 - Test plans document.
 - Test cases documents
 - Test Design specifications.



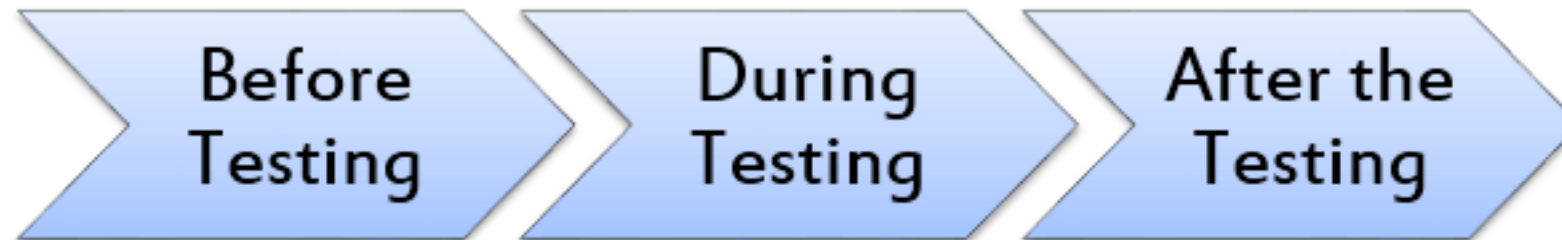
Step 8 - Test Deliverables

- During testing
 - Test Scripts
 - Simulators.
 - Test Data
 - Test Traceability Matrix
 - Error logs and execution logs.



Step 8 - Test Deliverables

- After testing
 - Test Results/reports
 - Defect Report
 - Installation/ Test procedures guidelines
 - Release notes



Planning - Test Organization

- Test Organization in Software Testing is a procedure of defining roles in the testing process.
- It defines who is responsible for which activities in the testing process.
- Now you have a Plan, but how will you stick to the plan and execute it? To answer that question, you have Test Organization phase.

How to create a highly effective team?



Step 1 - Develop Human Resource Plan

Designation	Responsibilities
Test Manager	Manage the whole project Defines the project direction
Tester	Builds up the Test Cases Generate Test Suites Execute the tests, Log results, Report the defect
Developer in Test	Creates program to test – code created by developers Creates test automation scripts
Test Administrator	Builds up and ensures <u>Test Environment</u> and assets are managed and maintained Support the team to use test environment for test execution
SQA Members	Take in Charge of Quality Assurance

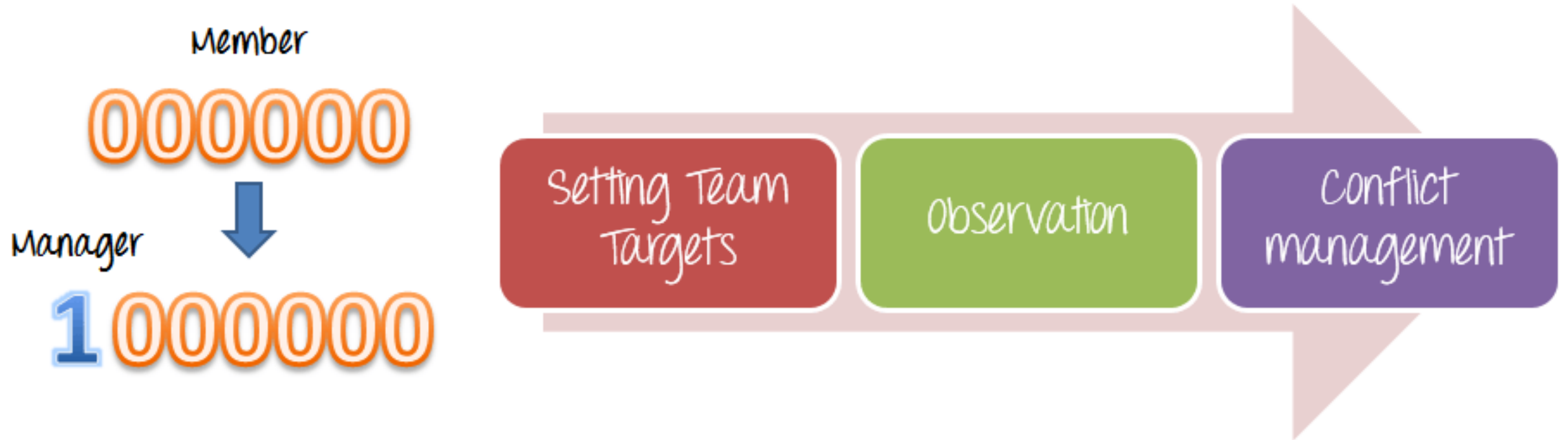
Step 1 - Develop Human Resource Plan

- Step 1.1 - Demand Forecasting
- Step 1.2 - Competency Evaluation
- Step 1.3 - Skill up planning

Step 2 - Build the Project Team



Step 3 - Manage Project Team



Content

- Independent testing
- Test roles and their tasks
- Test management
- Planning
 - Risk Analysis
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 - Test Organization
- **Execution**
 - Test Monitoring and Control
 - Issue Management
 - Test Report and Evaluation

Execution - Test Monitoring and Control

- What will you do when your project runs out of resources or exceeds the time schedule?
 - You need to Monitor and Control Test activities to bring it back on schedule.
- Test Monitoring and Control is the process of overseeing all the metrics necessary to ensure that the project is running well, on schedule, and not out of budget.

Test Monitoring

- Monitoring is a process of collecting, recording, and reporting information about the project activity that the project manager and stakeholder needs to know
- To Monitor, Test Manager does the following activities:
 - Define the project goal, or project performance standard
 - Observe the project performance, and compare the actual and the planned performance expectations
 - Record and report any detected problem which happens to the project

Test Controlling

- Project Controlling is a process of using data from monitoring activity to bring actual performance to planned performance.
- In this step, the Test Manager takes action to correct the deviations from the plan.
- In some cases, the plan has to be adjusted according to project situation.

Execution - Issue Management

Execution - Test Report & Evaluation

- The project has already been completed. It's now time to look back at what you have done.
- “Test Evaluation Report” describes the results of the Testing in terms of Test coverage and exit criteria.
- The data used in Test Evaluation are based on the test results data and test result summary.

