

# Software Testing Interview questions

By

Shivprasad Koirala  
Sham Sheikh

(Covering SQA, CMMI, SIX Sigma, Software automation and Software estimation)

**Dedicated to the true spirit of Software testing**

**If you want to buy from amazon**

[http://www.amazon.co.uk/Software-Testing-Interview-Shivprasad-Koirala/dp/8183332366/ref=sr\\_1\\_2?ie=UTF8&s=books&qid=1196215846&sr=1-2](http://www.amazon.co.uk/Software-Testing-Interview-Shivprasad-Koirala/dp/8183332366/ref=sr_1_2?ie=UTF8&s=books&qid=1196215846&sr=1-2)

**( This is a sample book buy complete book below 200 rs  
call you local book store now )**

**If you want to buy any of our book mail [bpb@bol.net.in](mailto:bpb@bol.net.in)  
for more details or call any of our book shops**

**MUMBAI-22078296/97/022-22070989,**

**KOLKATA-22826518/19**

**HYDERABAD-24756967,24756400,**

**BANGALORE-25587923, 25584641,**

**AHMEDABAD-26421611,**

**BHATINA(PUNJAB)-2237387,**

**CHENNAI-28410796,28550491,**

**DELHI -23254990/91,23325760,26415092,24691288**

What's in the CD.....	6
What does this book contain .....	6
Dedication.....	7
About the author.....	7
Organization Hierarchy.....	8
Resume Preparation Guidelines.....	10
Salary Negotiation.....	12
Salary Structure.....	13
Interview rating sheet.....	13
Points to be remembered during interviews.....	15
How to read this book .....	17
<b>Software Testing Basics.....</b>	<b>17</b>
(B) In which Software Life cycle phase does testing occur? .....	17
(B) Can you explain PDCA cycle and where does testing fit? .....	17
(B) What is the difference between white box, black box and gray box testing?....	18
(B) Define Defect? .....	19
(B) What is the difference between Defect and Failure? .....	19
(B) What are the broader categories of defects? .....	20
(B) What is the difference between Verification and Validation? .....	20
(B) How does testing affect risk?.....	21
(B) Does Increase in testing always mean good to the project? .....	21
(I) As a manager what process did you adopt to define testing policy? .....	22
(B) Should testing be only after build and execution?.....	23
(B) Are number of defects more in design phase or coding phase? .....	24
(B) What kind of inputs do we need from the end user to start proper testing? .....	25
(B) What is the difference between Latent and Masked Defect? .....	26
(B) A defect which could have been removed during initial stage is removed in later stage how does it affect cost? .....	27
(I) In testing can you explain the concept of work bench? .....	27
(B) What's the difference between Alpha and Beta testing? .....	30
(I) Can you explain the concept of defect cascading? .....	30
(B) Can you explain how one defect leads to other defects? .....	30
(B) Can you explain what is Usability testing? .....	30
(B) What are the different strategies of rollout to the end users?.....	31
(I) Can you explain requirement traceability and its importance?.....	32
(B) What is the difference between Pilot and Beta testing? .....	33
(B)How will you do a risk analysis during software testing? .....	33
(B)How do you conclude which section is most risky in your application? .....	33
(B) What does entry and exit criteria mean in a project?.....	36
(B) On what basis is the Acceptance plan prepared?.....	37
(B) What's the relation between environment reality and test phases? .....	37
(B) What are different types of verifications? .....	38
(B) What's the difference between Inspections and Walkthroughs? .....	38
(B) Can you explain regression testing and confirmation testing? .....	39

(I) what do you mean by coverage and what are the different types of coverage techniques?.....	39
(A) How does fundamentally a coverage tool work? .....	40
(B) What is configuration management? .....	40
(B) Can you explain the concept of baseline in software development? .....	41
(B) What are the different test plan documents in project? .....	42
(B) How do test documents in a project span across software development life cycle? .....	43
(B) Can you explain inventories?.....	44
(B) How do you do Analysis and design for testing projects? .....	44
(A) Can you explain calibration? .....	44
(B) Which test cases are first written white boxes or black box? .....	45
(I) Can you explain Co-habiting software?.....	46
(B) What different impact rating's you have used in your project? .....	46
(B) Can you explain what a test log is? .....	47
(I) Explain SDLC (Software development Life Cycle) in detail? .....	48
(I) Can you explain waterfall model? .....	48
(I) Can you explain big-bang waterfall model? .....	48
(I) Can you explain phased waterfall model? .....	48
(I) Explain Iterative model, Incremental model, Spiral model, Evolutionary model and V-Model? .....	48
(I) Explain Unit testing, Integration tests, System testing and Acceptance testing? .....	48
(I) what's the difference between system and acceptance testing? .....	52
(I) Which is the best model? .....	53
(I) What group of teams can do software testing? .....	53
Testing techniques.....	55
(B) Can you explain boundary value analysis?.....	55
(B) What is BV in software testing? .....	55
(B) Can you explain Equivalence partitioning? .....	55
(B) Can you explain how state transition diagram can be helpful during testing? ...	57
(B) Can you explain random testing? .....	58
(B) Can you explain monkey testing?.....	58
(B) What is negative and positive testing? .....	59
(I) Can you explain exploratory testing? .....	59
(A) What exactly are semi-random test cases? .....	60
(I) Can you explain the concept of orthogonal array? .....	60
(I) Can you explain pair-wise defect fundamental? .....	60
(I) Can you explain the concept of decision tables? .....	62
(B) How did you define severity ratings in your project? .....	63
Software process .....	64
(B) What is a Software process? .....	64
(I) what are the different cost element involved in implementing process in an organization? .....	65
(B) What is a model? .....	66
(B) What is maturity level? .....	66
(B) Can you explain the concept of process area in CMMI? .....	67

(B) Can you explain the concept of tailoring? .....	67
CMMI.....	68
(B) What is CMMI and what's the advantage of implementing CMMI in an organization? .....	68
(I) what's the difference between implementation and Institutionalization? .....	70
(I) what are different models in CMMI?.....	71
(I) Can you explain staged and continuous models in CMMI? .....	71
(I) Can you explain the different maturity levels in staged representation? .....	73
(I) Can you explain capability levels in continuous representation? .....	74
(I) which model should we use and under what scenarios?.....	75
(A) How many process areas are present in CMMI and in what classification do they fall in? .....	76
(B) What the difference between every level in CMMI?.....	77
(I) what different sources are needed to verify authenticity for CMMI implementation?.....	79
(I) Can you explain SCAMPI process?.....	80
(I) How is appraisal done in CMMI?.....	80
(I) which appraisal method class is the best? .....	81
(I) Can you explain the importance of PII in SCAMPI? .....	82
(A) Can you explain implementation of CMMI in one of the Key process areas? ..	83
(B) Explanation of all process areas with goals and practices? .....	86
(A)Can you explain the process areas?.....	86
Six Sigma .....	98
(B) What is six sigma?.....	98
(I) Can you explain the different methodology for execution and design process in SIX sigma? .....	99
(I) What does executive leaders, champions, Master Black belt, green belts and black belts mean? .....	100
(I) what are the different kinds of variations used in six sigma? .....	102
(A) Can you explain the concept of standard deviation? .....	104
(B) Can you explain the concept of fish bone/ Ishikawa diagram? .....	107
(A) Can you explain QFD? .....	108
(A) Can you explain FMEA? .....	108
(A) Can you explain X bar charts? .....	109
(A) Can you explain Flow charting and brain storming? .....	109
Metrics .....	109
(B) What is meant by measure and metrics?.....	109
(I) Can you explain Number of defects measure? .....	109
(I) Can you explain number of production defects measure? .....	110
(I) Can you explain defect seeding?.....	110
(I) Can you explain DRE? .....	112
(B) Can you explain Unit and system test DRE?.....	112
(I) How do you measure test effectiveness? .....	115
(B) Can you explain Defect age and Defect spoilage? .....	115
Automated Testing .....	117
(B) What are good candidate for automation in testing? .....	117

(B) Does automation replace manual testing? .....	117
(I) which automation tool have you worked and can you explain them in brief? ..	118
(I) Can you explain how does load testing conceptually work for websites?.....	124
(A) Can you explain how did you perform load testing using tool?.....	125
(I) What does load test summary report contain? .....	133
(I) Can you explain the concept of data-driven testing? .....	133
(I) Can you explain table-driven testing?.....	133
(I) How can you perform data-driven testing using Automated QA? .....	134
Testing Estimation.....	134
(B) What are the different ways of doing black box testing? .....	134
(B) Can you explain TPA analysis?.....	134
(A) Can you explain in brief Function points? .....	135
(B) Can you explain the concept Application boundary? .....	136
(B) Can you explain the concept of elementary process?.....	137
(B) Can you explain the concept of static and dynamic elementary process?.....	137
(I) Can you explain concept of FTR, ILF, EIF, EI, EO , EQ and GSC ? .....	138
(A) How can you estimate number of acceptance test cases in a project?.....	158
(A) Can you explain on what basis does TPA actually work? .....	163
(A) How did you do estimation for black box testing?.....	165
(A) How did you estimate white box testing? .....	171
(A) Is there a way to estimate acceptance test cases in a system? .....	171
Question left for second edition.....	185
Interview questions .....	186
.NET Interview Questions Book .....	186
SQL Server Interview Questions Book.....	195
JAVA Interview Questions Book .....	204

## **What's in the CD**

The CD has all that you need for Software testing:-

- Sample resumes which can help you in making your resume better.
- testcomplete512demo setup is a software automation tool. In the automation chapter we are using this tool for explanation. You can get the latest update for this automated testing tool from  
<http://www.automatedqa.com/downloads/testcomplete/index.asp>
- Estimation TPA sheet
- Free Estimation PDF book.

## **What does this book contain**

- As the name suggests “Software testing interview questions”, it’s mainly meant for fresher’s as well as professional’s who are searching for opportunities in software testing field.
- Other than software testing basics this book also covers software process interview question (i.e. SIX sigma and CMMI) which are important from SQA point of view. SQA is a position which every tester finally wants to reach on a senior level.
- This book also goes one step further and covers Software estimation area by covering topics like Function points and TPA analysis.
- Automation testing is one of the most frequented sections during software testing interview. The same is covered in this book by using Test complete software.
- From the senior level point of view Metrics forms an important aspect during software testing interview. A complete chapter is dedicated for the same which covers the most used metrics like DRE, spoilage, Phage, Defect density and so on.
- During software testing interview quality of a tester is judged by the various testing techniques he is aware of. This book has dedicated a complete chapter for the same which covers complicated concepts like boundary Value analysis (BVA), equivalence , Exploratory ,Random/Monkey testing , pair-wise , orthogonal and decision tables.
- The best part of the book is other than the software testing aspect it also dwells in non-technical aspects like resume making , salary negotiations and points to be remembered ( why do want to leave the organization ? , Where do you see yourself after 3 years and so on) during interviews.
- With the book we also have a CD accompanied which has testcomplete software testing tool setup , free software estimation PDF , interview rating sheet and lot more).
- With the CD we have also provided interview rating sheet which can be used to judge till what extent are you ready for Software testing interviews.
- In CD we have also provided sample resume which can help for a quick kick start to prepare your resume.

## **Dedication**

### **Shivprasad Koirala**

This book is dedicated to my kids Sanjana and Simran, whose dad's play time has been stolen and given to this book. I am thankful to my wife for constantly encouraging me and also to BPB Publication to give new comer a platform to perform. Finally on top of all thanks to the two old eyes my mom and dad for always are blessing me. I am blessed to have Raju as my brother who always keeps my momentum moving on. I am grateful to Bhavnesh Asar who initially conceptualized the idea I believe concept thinking is more important than execution. Thanks to Shaam for all the effort. It was his tiresome three months of continuous writing that we have finally made it. Tons of thanks to my reviewers whose feedback provided an essential tool to improve my writing capabilities.

### **Sham Sheikh**

The credit of being a part of this book goes to three persons my mom and dad for every thing they did, sacrificed for the sake of me because of which I am here and Mr.Shiv because of him I have learnt and understood how to share knowledge through books.Thanks to him from my bottom of my heart for giving me a opportunity to participate in this book. Above all thanks to almighty LORD sitting right on the top on all of us for showing his presence and showering his blessings, love in the form of these three persons. In case you want to get in contact with me please email at [ahteshamax@hotmail.com](mailto:ahteshamax@hotmail.com) .

## **About the author**

Author works in a big multinational company and has a good experience in software industry. He is working presently as project lead and in past has led projects in banking, travel and financial sectors. But on top of all, I am a simple developer like you all guys there doing an 8 hour job. Writing is something I do extra and I love doing it. No one is perfect and same holds true for me .So anything you want to comment, suggest, and point typo / grammar mistakes or technical mistakes regarding the book you can mail me at [shiv\\_koirala@yahoo.com](mailto:shiv_koirala@yahoo.com). Believe me guys your harsh words would be received with love and treated to the top most priority. Without all you guys I am not an author. Writing an interview question book is really a great deal of responsibility. I have tried to cover maximum questions for the topic because I always think probably leaving one silly question will cost someone's job there. But huge natural variations in an interview are something difficult to cover in this small book. So if you have come across such questions during interview which is not addressed in this book do mail at [shiv\\_koirala@yahoo.com](mailto:shiv_koirala@yahoo.com) .Who knows probably that question can save some other guys job.

## Organization Hierarchy

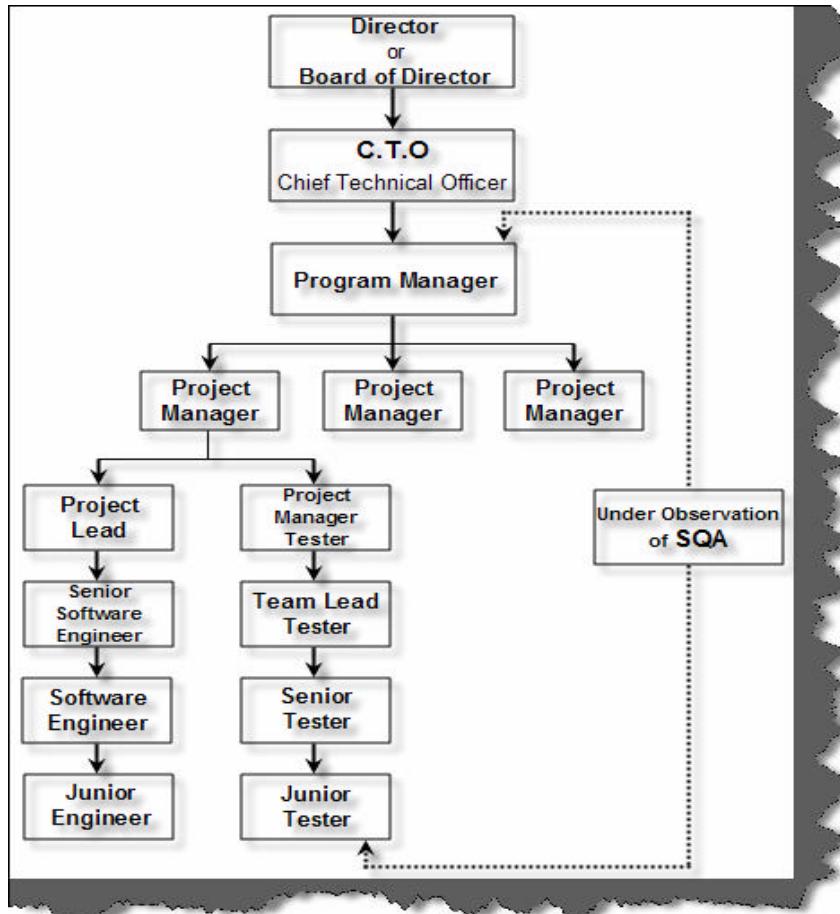


Figure: - Organization hierarchy

It's very important during interview to be clear about what position you are targeting. Depending on the position you are targeting the interviewer shoots you questions. Example if you are looking for a project manager testing position you will be asked around 20% technical questions and 80% management.

**Note:** - In small scale software house and mid scale software companies there are chances where they expect a PM to be very much technical. But in big software houses the situations are very much different, interview are conducted according to positions.... Unless the interviewer changes the rule.

Above is a figure of a general hierarchy across most IT companies.

**Note:- There are many small and medium software companies which do not follow this hierarchy and they have their own adhoc way of defining positions in the company.**

So why is the need of hierarchy in a interview. "*Interview is a contract between the employer and candidate to achieve specific goals.*"

So employer is looking for a suitable candidate and candidate looks for a better career. Normally in interviews the employer is very clear about what type of candidate he is looking for. But 90% times the candidate is not clear about the positions he is looking for. How many times it has happened with you that you have given a whole interview and when you mention the position you are looking for...pat comes the answer, "we do not have any requirements for this position". So be clarified about the position right from when you start the interview.

There are basically two streams in a software organization one is the projects team and the other is the quality team. Projects teams are those who execute the project and quality team comprises of testers and SQA. The quality team looks after the quality part of the project. Director and CTO are on the top hierarchy of the company. Main role of director is to do finance and he is the owner of all happenings in the company... he is the final guy who earns profit. CTO's (Chief technical officer) main role is to have a bird eye view of technical as well as management operations happening in the project. He is closely involved with the director in reporting, budgeting and people management across organization. Program manager comes below the CTO and is mostly involved in interacting with the project managers to see at a higher level day to day operation in every project. Program manager normally does not interact directly with the developers or testers (in case of serious scenarios is an exception), he only takes daily reports and metrics from project manager and checks the health of the project. Now lets understand both project and quality team hierarchy step by step. Following are the number of years of experience according to position for projects team:-

- Junior engineers are especially fresher and work under software engineers.
- Software engineers have around 1 to 2 years of experience. Interviewer expects software engineers to be technically at a medium level.
- Senior Software Engineers have around 2 to 4 years of experience. Interviewer expects them to technically be very strong.
- Project leads should handle majority technical aspect of project and should have around 4 to 8 years of experience. They are also indirect architect of the project. Interviewer expects them to be technically strong and in terms of architecture to be decent. Interviewer also expects them to have people management skills.
- Project Manager are expected to be around 40% technically strong and should have experience above 10 years plus. But they are more interviewed from aspect of project management, client interaction, people management, proposal preparation etc. So now judge where you stand, and where you want to go.....

The quality hierarchy for various reasons comes under the project manager of the project. Let's start from the bottom of the hierarchy:-

- Junior tester: - junior testers are normally 1 to 2 years of experience or freshers. Their main task is executing test procedures prepared by seniors.
- Senior tester: - senior testers have mainly 2 to 4 years of experience and are expected to know how to prepare test plans. They are also aware of various metrics and testing techniques which help them to communicate the project health. But the main expectation from a senior tester is that he should independently prepare test plans looking at the requirement document.
- Team lead tester: - Team lead tester mainly helps and guides the senior tester. They are primarily involved in decision making of what is the testing strategy, what kind of automation tool we used etc. They also act as a bridge between the project manager and the other team members. Not to mention they have lot of say in your appraisal :-).
- Project manager tester: - The main job of project test manager is to collect accurate metrics and report the same to the project manager of the project. He is also responsible for interacting with SQA to give update about the quality of the project. They are also involved from the requirement phase.
- SQA: - If you are starting your career as a tester then you would surely aim to become a SQA lead sometimes down the line or when you are quiet senior. The main job of SQA is to define the quality standard of the organization and to ensure that every project follows the quality process.

## Resume Preparation Guidelines

**Note :- First impression the last impression**

**Note: - A sample resume is provided in "Sample Resume" folder.**

Even before the interviewer meets you he will first meet your resume. Interviewer looking at your resume is almost a 20% interview happening without you knowing it. I was always a bad guy when it comes to resume preparation. But when I looked at my friends resume they were gorgeous. Now that I am writing series of book on interviews I thought this will be a good point to put in. You can happily skip it if you are confident about your resume. There is no hard and fast rule that you have to follow the same pattern but just see if these all check list are attended.

- Use plain text when you are sending resumes through email. For instance you sent your resume using Microsoft word and what if the interviewer is using Linux he will never be able to read your resume. You can not be sure both wise, you sent your resume in Word 2000 and the guy has Word 97...ouch.
- Attach a covering letter it really impresses and makes you look traditionally formal. Yes, even if you are sending your CV through email send a covering letter.

Below is the check list of content you should have in your resume:-

- Start with an objective or summary, for instance :-

- Working as a senior tester for more than 4 years. Implemented testing automation in projects.
  - Followed the industry's best practices and adhered and implemented processes, which enhanced the quality of technical delivery.
  - Pledge to deliver the best technical solutions to the industry.
- Specify your Core strengths at the start of the resume by which the interviewer can make a quick decision are you eligible for the position.

For example: -

- Looked after SQA and testing department independently.
- Played a major role in software testing automation
- Worked extensively in Software testing planning and estimation.
- Well versed with CMMI process and followed it extensively in projects.
- Looking forward to work as a SQA or senior manager position. This is also a good position to specify your objective or position which makes it clear to the interviewer that should he call you for an interview.

For instance, if you are looking for senior positions specify it explicitly 'looking for this job profile'. Any kind of certification like CSTE etc you can make it visible in this section.

- Once you have specified briefly your goals and what you have done its time to specify what type of technology you have worked with. For instance BVA, Automated QA, process (Six sigma, CMMI), TPA analysis etc.
- After that you can make a run through of your experience company wise that is what company you have worked with, year / month joining and year / month left. This will give an overview to the interviewer what type of companies you have associated your self. Now its time to mention all your projects you have worked till now. Best is to start in descending order that is from your current project and go backwards.

## **For every project try to put these things:-**

- Project Name / Client name (It's sometimes unethical to mention clients name; I leave it to the readers).
- Number of team members.
- Time span of the project.
- Tools, language and technology used to complete the project.
- Brief summary of the project. Senior people who have huge experience will tend to increase their CV with putting in summary for all project. Best for them is to just put description of the first three projects in descending manner and rest they can say verbally during interview. I have seen CV above 15 pages... I doubt who can read it.
- Finally comes your education and personal details.
- Trying for onsite, do not forget to mention your passport number.

- Some guys tend to make their CV large and huge. I think an optimal size should be not more than 4 to 5 pages.
- Do not mention your salary in CV. You can talk about it during interview with HR or the interviewer.
- When you are writing your summary for project make it effective by using verbs like managed a team of 5 members, architected the project from start to finish etc. It brings huge weight.
- This is essential very essential take 4 to 5 Xerox copies of your resume you will need it now and then.
- Just in case take at least 2 passport photos with you. You can escape it but many times you will need it.
- Carry all your current office documents specially your salary slips and joining letter.

## Salary Negotiation

Ok that's what we all do it for **MONEY**... not everyone but still money means a lot. This is probably the weakest area for techno savvy guys. They are not good negotiators. I have seen so many guys at the first instance they will smile and say "NEGOTIABLE SIR". So here are some points:-

- Do a study of what is the salary trend? For instance have some kind of baseline. For example what is the salary trend on number of years of experience? Discuss this with your friends out.
- Do not mention your expected salary on the resume?
- Let the employer first make the salary offer. Try to delay the salary discussion till the end.
- If they say what you expect? Come with a figure with a little higher end and say negotiable. Remember never say negotiable on something which you have aimed, HR guys will always bring it down. So negotiate on AIMED SALARY + some thing extra.
- The normal trend is that they look at your current salary and add a little to it so that they can pull you in. Do your home work my salary is this much and I expect this much so whatever it is now I will not come below this.
- Do not be harsh during salary negotiations.
- It's good to aim high. For instance I want 1 billion dollars / month but at the same time be realistic.
- Some companies have those hidden costs attached in salary clarify it rather to be surprised at the first salary package.
- Many of the companies add extra performance compensation in your basic which can be surprising at times. So have a detailed breakdown. Best is to discuss on hand salary rather than NET or CTC.
- Talk with the employer in what frequency does the hike happen.
- Take everything in writing, go back to your house and have a look once with a cool head is the offer worth it of what your current employer is giving.

- Do not forget once you have job in hand you can come back to your current employer for negotiation.
- Remember the worst part is cribbing after joining the company that your colleague is getting more. So be careful while interview or be sportive to be a good negotiator in the next interview.
- One very important thing is that the best negotiation ground is not the new company where you are going but the old company which you are leaving. So once you have offer on hand get back to your old employee and show them the offer and then make your next move. It's my experience that negotiating with the old employer is easy than the new one....Frankly if approached properly rarely any one will say no as you have spent quiet a amount of time with them Just do not be aggressive or egoistic that you have an offer on hand.
- Top of all some time some things are worth above money: - **JOB SATISFACTION**. So whatever you negotiate if you think you can get JOB SATISFACTION aspect on higher grounds go for it. I think its worth more than money.

## Salary Structure

Below is the salary structure for a tester. This card rate is from only Indian perspective. We have two sections below one for small and midscale and the other from MNC perspective. The entire amounts below are CTC per month (Cost to Company).

Salary Chart for Testers Applicable only in India		
Years of Experience	Amount in Rupees CTC ( Cost to Company ) / months	
	Small & Mid Scale Company	Multi National Company (MNC)
Fresher's	4000 to 6000	5000 to 8000
1 to 2 years	6000 to 8000	8000 to 10000
3 to 4 years	8000 to 15000	10000 to 20000
4 to 6 years	15000 to 25000	20000 to 35000
6 to 8 years	25000 to 35000	35000 to 45000
12 to 15 years	35000 to 45000	45000 to 65000
15 years & above	Depends upon negotiations	Depends upon negotiations

Figure: - Salary card for Software testers

## Interview rating sheet

In the CD we have provided Interview rating excel sheet. This sheet will help you in Providing insight of really how much you are ready for Software testing, JAVA, .NET or SQL Server Interviews. In the sheet we have nine sections:-

- Guidelines
- JAVA
- Java results

- .NET
- .NET Results
- SQL Server
- SQL Server results
- Software testing
- Software testing results

The guidelines sheet defines the guidelines for the rating. For every question you can give One to five rating. Ratings are rated using the following guidelines:-

- 0-You have no idea about the question
- 1-You know only the definition.
- 2-You know the concept but don't have depth knowledge of the subject.
- 3-You know the concept and have partial knowledge about the concept.
- 4-You know the concept and have in depth knowledge about the subject.
- 5- You are an expert and no one can touch you in this area.

The remaining eight sections are questions and results. For instance we have the Software testing section and the Software testing results section. Software testing section will take in the rating inputs for every questions and Software testing result will show the output. Same hold true for .NET, JAVA and SQL Server.

**JDBC**

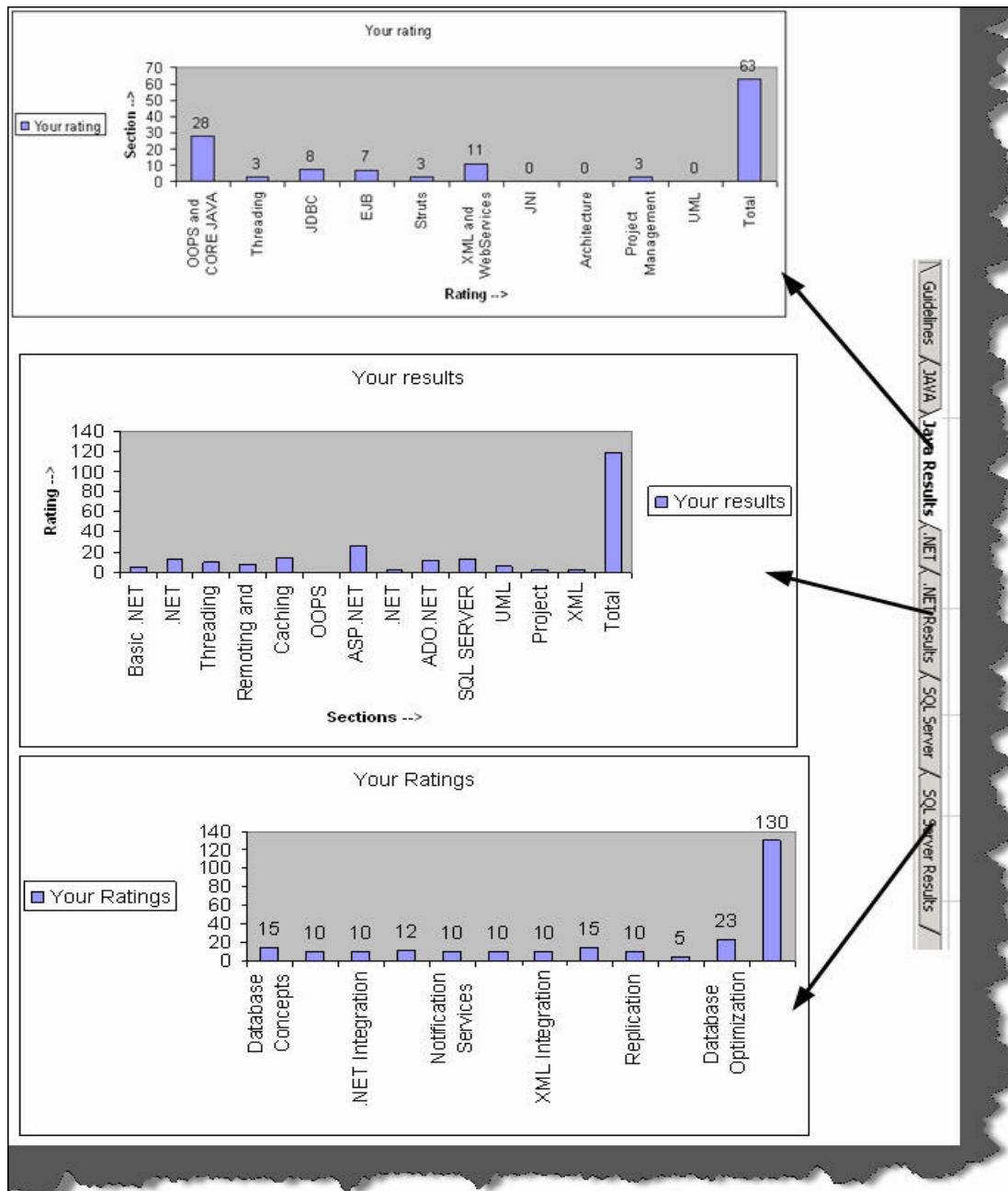
How does JAVA interact with databases?  
Can we interact with non-relational sources using JDBC?  
Can you explain in depth the different sections in JDBC?  
Can you explain in short how you go about using JDBC API in code?  
How do you handle SQL exceptions?  
If there is more than one exception in SQLException class how to go about displaying it?

93

0 -You have no idea about the question  
1- You know only the definition.  
2- You Know the concept but not the depth of the subject.  
3- You know the concept and have partial knowledge about the concept.  
4 - You know the concept and have in depth knowledge about the subject. But its possible that you will stumble in some in depth question.  
5 - You are a expert and no one can touch you in this.

**Figure: - Choose rating**

For every question you need to select ratings. So go through every question and see how good you are. Definitely you do not have any one to govern you but finally you have to clear the interview so be fair and know your results before hand.



**Figure: - Overall rating values**

Above figure shows how you have performed in every section and the overall rating.

## Points to be remembered during interviews

- One of the first questions asked during interview is “Can you say something about yourself”?

- Can you describe about your self and what you have achieved till now?
- Why do you want to leave the current company?
- Where do you see yourself after three years?
- What are your positive and negative points?
- How much do you rate yourself in Software testing in one out of ten?
- Are you looking for onsite opportunities? (Be careful do not show your desperation of abroad journeys)
- Why have you changed so many jobs? (Prepare a decent answer do not blame companies and individuals for your frequent change).
- Never talk for more than 1 minute straight during interview.
- Have you worked with Software automation?
- Do not mention client names in resume. If asked say that it's confidential which brings ahead qualities like honesty
- When you make your resume keep your recent projects at the top.
- Find out what the employer is looking (Automation or manual testers) for by asking him questions at the start of interview and best is before going to interview.
- Can you give brief about your family background?
- As you are fresher do you think you can really do this job?
- Have you heard about our company? Say five points about our company? Just read at least once what company you are going for?
- Can you describe your best project you have worked with?
- Do you work on Saturday and Sunday?
- Which is the biggest team size you have worked with?
- Can you describe your current project you have worked with?
- How much time will you need to join our organization? What's notice period for your current company?
- What certifications have you cleared CSTE etc ?
- Do you have pass port size photos, last year mark sheet, previous companies employment letter, last months salary slip, pass port and other necessary documents.
- What is the most important thing that motivates you?
- Why you want to leave the previous organization?
- Which type of job gives you greatest satisfaction?
- What is the type of environment you are looking for?
- Do you have experience in software testing project management?
- Do you like to work as a team or as individual?
- Describe your best project manager you have worked with?
- Why should I hire you?
- Have you been ever fired or forced to resign?
- Can you explain some important points that you have learnt from your past project experiences?

- Have you gone through some unsuccessful projects, if yes can you explain why did the project fail?
- Will you be comfortable with location shift? If you have personal problems say no right at the first stage.... or else within two months you have to read my book again.
- Do you work late nights? Best answer if there is project deadline yes. Do not show that it's your culture to work during nights.
- Any special achievements in your life till now...tell your best project which you have done best in your career.
- Any plans of opening your own software company...Beware do not start pouring your bill gate's dream to him.....can create a wrong impression.

## **How to read this book**

If you can read English, you can read this book....kidding. There are some legends which will make your reading more effective. Every question has simple tags which mark the rating of the questions.

These rating are given by Author and can vary according to companies and individuals.

(B) Basic Questions: - Basic Grade means according to the interviewer it's a fundamental question and should be answered. Example Can you explain unit testing? Guy's stumbling on this question will rarely pass software testing interviews.

(I) Intermediate Questions: - These are Mid-level questions and will be expected to be answered if you are looking for a decent position in the company.

(A) Advanced Questions: - These are advanced level question which are expected when they are looking for specialist in the field.

(P) Psyche Questions: - These levels of questions do not judge anything for a candidate but I see it as a attitude problem of the interviewer.

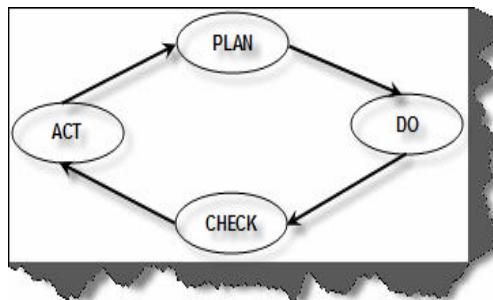
**Note:** - While reading you can come across section marked as "Note", which highlight special points of that section. One advice do not read this book from top to last. Read the index and see which sections you are targeting and revise those.

## **Software Testing Basics**

**(B) In which Software Life cycle phase does testing occur?**

**(B) Can you explain PDCA cycle and where does testing fit?**

Software testing is an important part of software development process. In normal software development below are the four important steps and also referred in short as the PDCA cycle.



**Figure: - PDCA cycle**

Let's try to understand the above four steps in detail fashion.

**Plan:** - Define your goal and the plan of how you will achieve that goal.

**Do / Execute:** - Depending on the plan strategy decided during the plan stage we do execution accordingly in this phase.

**Check:** - Check / Test to make sure that we are moving according to plan and we are getting the desired results.

**Act:** - During the check cycle if any issues are there then take appropriate action accordingly and revise your plan again.

So now to answer our question where does testing fit in.... You guessed it right the check part of the cycle. So developers and other stakeholders of the project do the "plan and build", while testers do the check part of the cycle.

### **(B) What is the difference between white box, black box and gray box testing?**

Black box testing is a testing strategy which is based solely on the requirements and specifications. Black box testing requires no knowledge of the internal paths, structure, or implementation of the software under test.

White box testing is a testing strategy which is based on the internal paths, code structure, and implementation of the software under test. White box testing generally requires detailed programming skills.

There is one more type of testing called gray box testing. In this we look into the "box" under test just long enough to understand how it has been implemented. Then we close up the box and use our knowledge to choose more effective black box tests.

Below figure shows how both the types of testers view an accounting application during testing. In case of black box tester they view in terms of pure accounting application. While in terms of White box testing the tester know about the internal structure of the application. In most scenarios white box testing is done by developers as they know the internals of the application. In Black box testing we check the overall functionality of the application while in white box we do code reviews , view the architecture , remove bad code practices and component level testing.

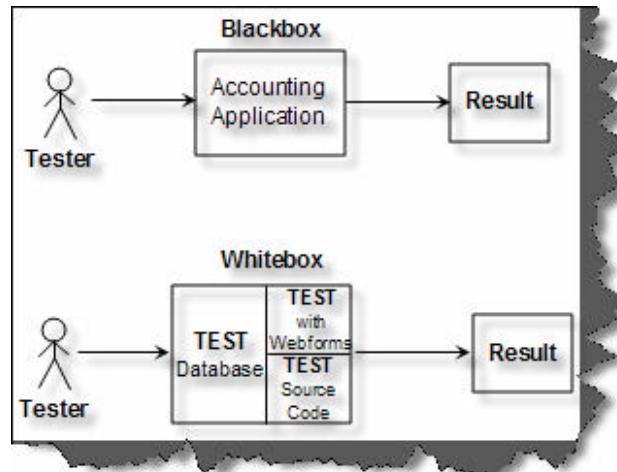


Figure: - White box and black box in action

### (B) Define Defect?

Defect is a variance from a normal flow.

### (B) What is the difference between Defect and Failure?

When a defect reaches the end customer it is termed as failure and if the defect is detected internally and resolved it's called as a defect.

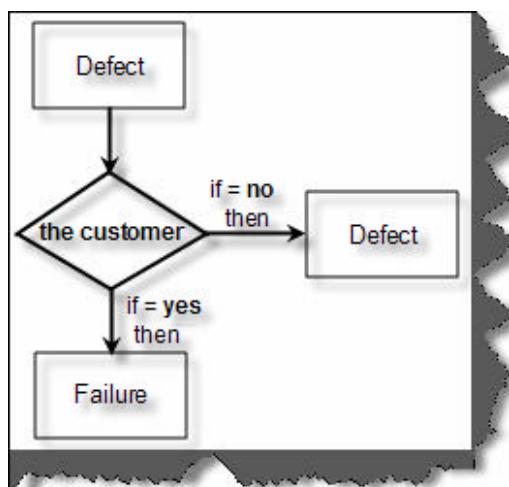


Figure: - Defect and the failure

## (B) What are the broader categories of defects?

There are mainly three categories of defect:-

**Wrong**:- The requirements have been implemented incorrectly. This defect is a variance from the given specification

**Missing**:- There is a requirement given by the customer and is not done. This is a variance from specification, an indication that the specification was not implemented, or a requirement of the customer was noted properly.

**Extra**:- A requirement incorporated into the product that was not given by the end customer. This is always a variance from specifications, but may be an attribute desired by the user of the product. However, it is considered a defect because it's a variance from the existing requirements.

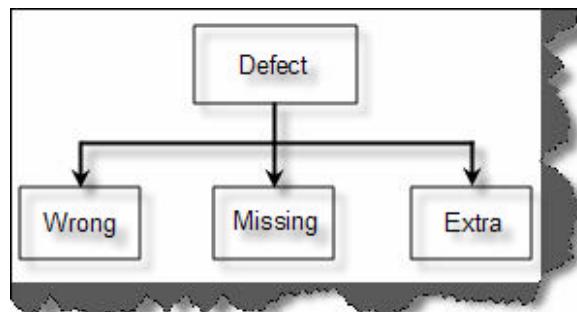


Figure: - Broader classification of defects

## (B) What is the difference between Verification and Validation?

Verification is a review without actually executing the process while validation is checking the product with actual execution. For instance code review and syntax check is verification while actually running the product and checking the results is validation.

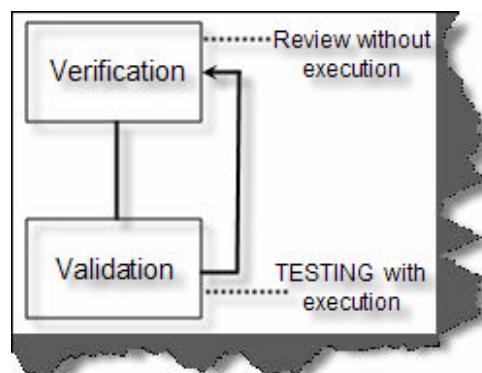


Figure: - Verification and Validation

## (B) How does testing affect risk?

A risk is a condition that can result in a loss. Risk can only be controlled in many scenarios but not eliminated completely. Defect normally converts to a risk. For instance let's say you are developing an accounting application and you have done wrong tax calculation. There is a huge possibility this will lead to risk of company running under loss. But if this defect is controlled then we can either remove this risk completely or minimize it. Below diagram shows how a risk is converted to a defect and with proper testing how it can be controlled.

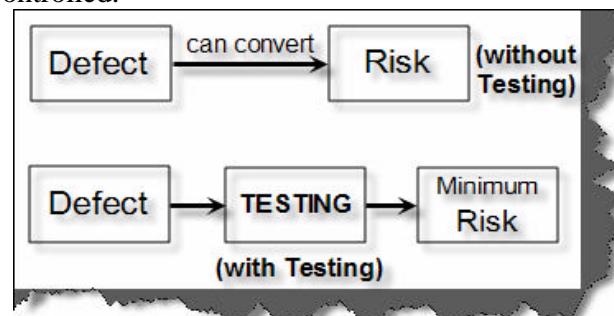


Figure: - Defect and risk relationship

## (B) Does Increase in testing always mean good to the project?

No increase in testing does not mean always good for the product, company or the project. In real test scenarios from 100% test plans only 20% test plans are critical from business angle. Running those critical test plans will assure that the testing is proper rather than running the full 100% test plans again and again. Below is the graph which explains the impact of under testing and over testing. If you under test a system your number of defect will increase, but on the contrary if you over test a system your cost of testing will increase. Even if your defects come down your cost of testing has shoted up.

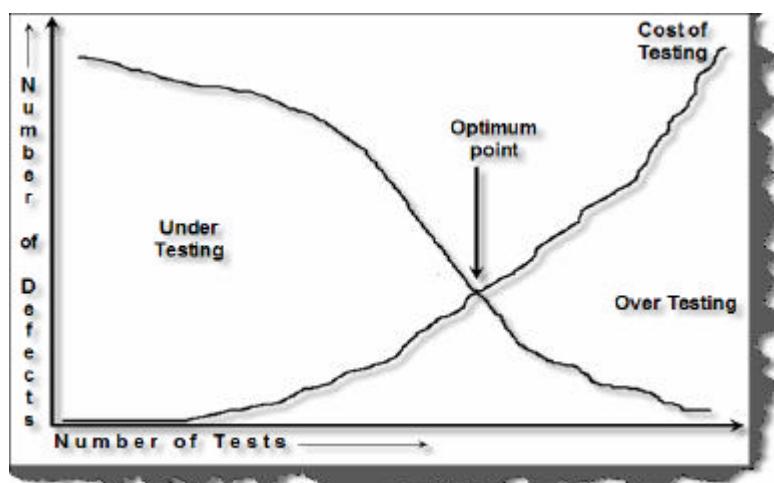


Figure: - Testing cost curve

## (I) As a manager what process did you adopt to define testing policy?

**Note:** - This question will be normally asked to test whether you can independently setup testing departments. Many companies still think testing as secondary. That's where a good testing manager should show the importance of testing. To bring in the attitude of testing in companies which never had a formal testing department is a huge challenge. Because it's not about bringing in new process but about changing the mentality.

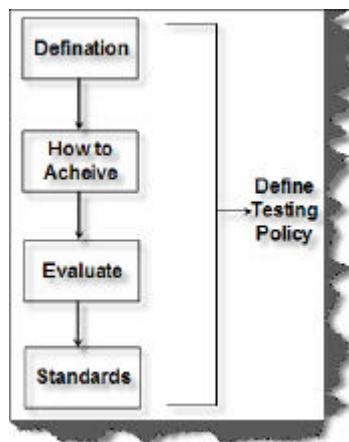
Below are the important steps to define testing policy in general. But it can change according to how you implemented in your organization. Let's understand in detail the below steps of implementing a testing policy in an organization.

**Definition:** - The first thing any organization need to do is define one unique definition for testing within organization. So that every one is on the same mind set.

**How to achieve:** - How are we going to achieve our objective?. Is there going to be a testing committee, will there be compulsory test plans which needs to be executed etc etc.

**Evaluate** : - After testing is implemented in project how do we evaluate the same. Are we going to derive metrics of defect per phase, per programmer etc etc. Finally it's important to let know every one how testing has added value to the project.

**Standards** : - Finally what are the standards we want to achieve by testing. For instance we can define saying that more than 20 defects per KLOC will be considered below standard and code review should be done for the same.



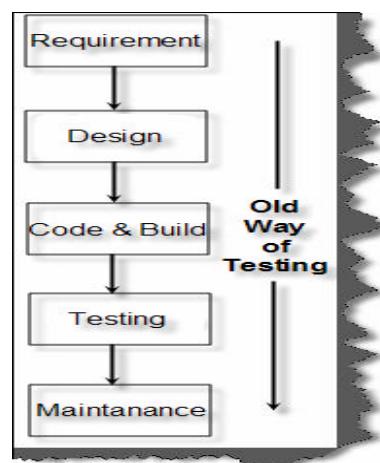
**Figure: - Establishing a testing policy**

The above said methodology is from a general point of view. Probably you can answer the same in a different way; the only thing to note in mind is that you should cover the above steps in broader aspects.

### (B) Should testing be only after build and execution?

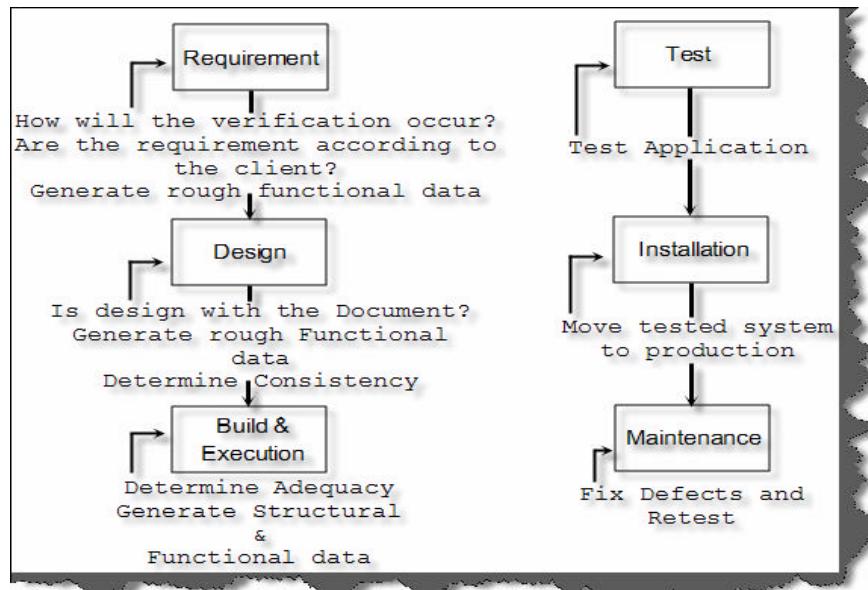
**Note:** - This question will normally be asked to judge whether you have traditional or the modern way of testing attitude.

In traditional testing methodology (sad to say many companies still have that attitude) testing is always done after the build and execution. But that's a wrong thinking. Because earlier we catch a defect, the more cost effective it is. For instance fixing a defect in maintenance is 10 times costly than fixing the same during execution.



**Figure: - Traditional way of testing**

Testing after code and build is a traditional approach and many companies have improved on the same. Testing should occur in conjunction with each phase as shown in the below figure.



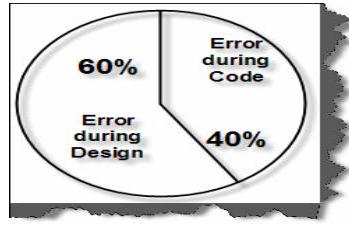
**Figure: - Modern way of testing**

In requirement phase we can verify are the requirements according to the customer needs. During design we can check whether the design document covers the entire requirement. In this stage we can also generate rough functional data. We can also review the design document from the architecture and the correctness perspective. In build and execution phase we can execute unit test cases and generate structural and functional data. And finally comes the testing phase as it was in the traditional way i.e. run the system test cases and see if the system work according to the standards. During installation we need to check if the system is compatible for the software. Finally during maintenance phase when any fixes are made we can check retest the fixes and follow the regression testing.

### (B) Are number of defects more in design phase or coding phase?

**Note:** - This question is to check do you really know practically which phase is the most defect prone.

Design phase is the more error prone than the execution phase. One of the most frequent defects which occur during design is that, it does not cover the complete requirements of the customer. Second wrong or bad architecture and technical decision makes the next phase that is execution more prone to defects. Because the design phase drives the execution phase it's the most critical phase to test. The testing of the design phase can be done by good review. On an average 60% defect occur during design and 40% during execution phase.

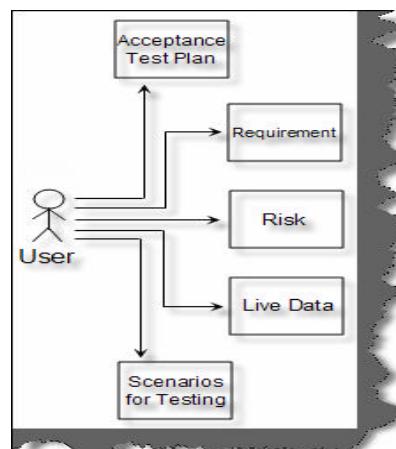


**Figure: - Phase wise defect percentage**

### **(B) What kind of inputs do we need from the end user to start proper testing?**

The product has to be finally used by the user. So he is the most important person as he has highest interest than any one else in the project. From the user we need the following data as shown in the below figure:-

- The first important thing is the Acceptance test plan from the end user. Acceptance test defines the entire test which the product has to pass so that it can go in production.
- Requirement document from the customer. In normal scenarios customer never writes a formal document until really he is so matured. But we need to document and the customer should sign saying yes this is what he wants.
- Customer should also define the risky sections of the project. For instance in a normal accounting project if a voucher entry screen does not work that will stop the accounting functionality completely. But yes if reports are not derived the accounting department can stay with it for some time. Customer is the right person to say which section will hit him the most. With this feedback the testers can prepare a proper test plan for those areas and test it thoroughly.
- Customer should also provide proper data for testing. Feeding proper data during testing is the most important thing. In many scenarios testers key in wrong data and expect results which are of no interest to the customer.



**Figure: - Expectation from the end user for testing**

## (B) What is the difference between Latent and Masked Defect?

Latent defect is an existing defect that has not yet caused a failure just because the exact set of conditions has never been met.

Masked defect is an existing defect that hasn't yet caused a failure, just because another defect has prevented that part of the code from being executed.

Below scenario flow explains latent defect practically. The application has facility to print invoice either by Laser printer or by Dot Matrix printer (DMP). In order to achieve the same the application first searches laser printer. If he gets a laser printer he uses the laser printer and prints it. If he does not get a laser printer, application searches for DMP. If the application finds a DMP application prints using DMP or else an error is thrown.

Now for what ever good reason for this application till now there was never a chance that laser printer was not present. So the application never got tested for DMP. That means the exact conditions never met for DMP. This is called as Latent defect.

Now the same application has two defects one defect is in the DMP search and the other defect is in the DMP print. But because the search of the DMP fails the print DMP defect is never detected. So the Print DMP defect is a masked defect.

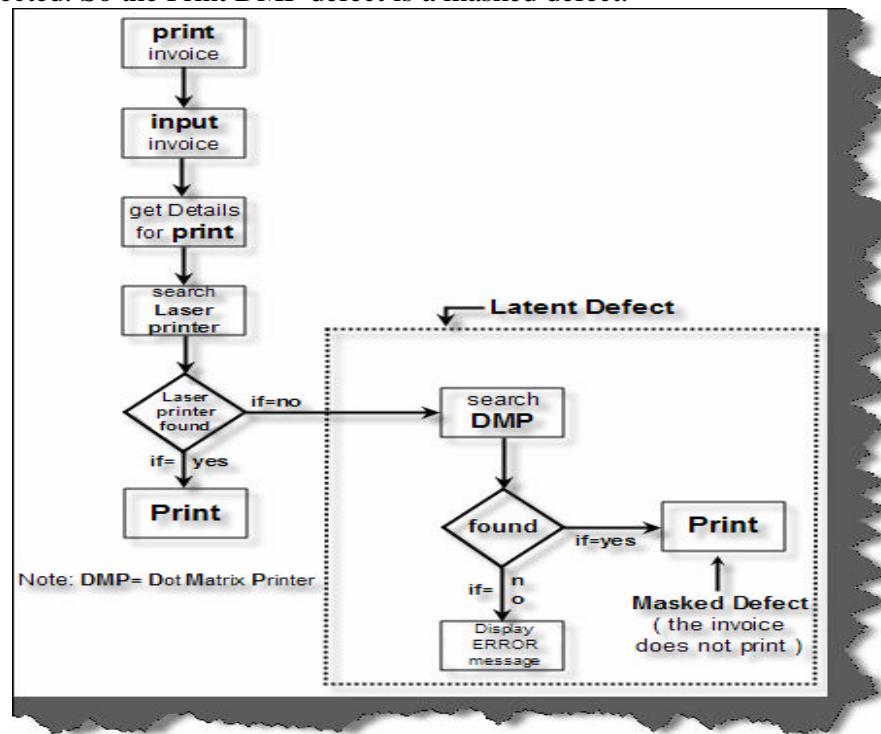
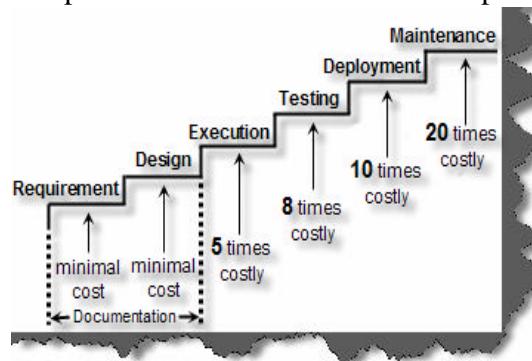


Figure: - Latent and Masked defect

## **(B) A defect which could have been removed during initial stage is removed in later stage how does it affect cost?**

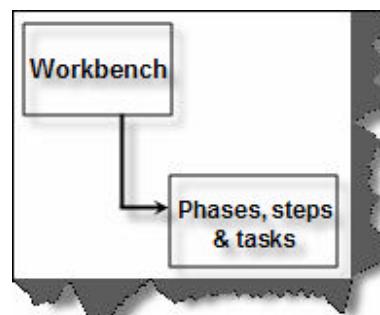
If a defect is known at the initial stage then it should be removed during that stage / phase itself rather than doing it some later stages. It's a recorded fact that if a defect is delayed for later phases are proven more costly. Below figure shows how a defect is costly as the phase moves ahead. A defect if identified and removed during the requirement and design phase is the most cost effective, while a defect removed during maintenance is 20 times costlier than requirement and design phases. For instance if a defect is identified during requirement and design we only need to change documentation , but if identified during the maintenance we not only need to fix the defect , but also change our test plans , do regression testing and change all documentation for the same. This is why a defect should be identified / removed in earlier phases and the testing department should be involved right from the requirement phase and not after the execution phase.



**Figure: - Cost of defect increases with phase**

## **(I) In testing can you explain the concept of work bench?**

In order to understand testing methodology we need to understand the concept of workbench. Work bench is a way of documenting how a specific activity has to be performed. A work bench is referred as phases, steps and tasks as shown in the below figure.

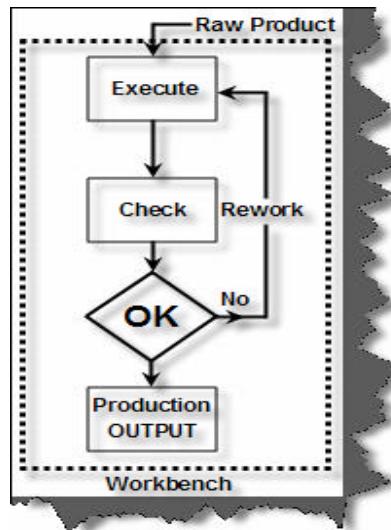


**Figure: - Workbench with phases and steps**

There are four sections for every work bench:-

- **Input:** - Every task needs some defined input and entrance criteria. So for every work bench we need defined inputs. Input forms the first steps of the work bench
- **Execute :** - This is the main task of the work bench which will transform the input in to expected output.
- **Check:** - Check steps assure that the output after execution meets the desired result.
- **Production output:** - If the check is right Production output forms the exit criteria of the workbench.
- **Rework:** - During the check step if the output is not as desired then we need to again start from the execute step.

Below figure shows all the steps for a workbench.



**Figure: - Details phases in workbench**

In real scenarios projects is not made of one work bench but of many connected work benches. A work bench gives you a way of organized thinking to perform any kind of task with proper testing. You can visualize every software phase as a work bench with execute and check steps. The most important point to note is if we visualize any task as a work bench by default we have the check part in the task. Below figure shows how every software phase can be visualized with a concept of workbench. Let us understand the work bench concept in a detailed fashion:-

**Requirement phase work bench:** - Input is the customer's requirement, we execute the task of writing a requirement document, we check if the requirement document addresses all the customer needs and the output is the requirement document.

**Design phase work bench:** - Input is the requirement document, we execute the task of preparing a technical document, review / check is done to see if the design document is technically correct and addresses all the requirements mentioned in the requirement document and output is a technical document.

**Execution phase work bench:** - This is the actual execution of the project. Input is the technical document; execution is nothing but implementation / coding according to the technical document and output of this phase is the implementation / source code.

**Testing phase work bench:** - This is the testing phase of the project. Input is the source code which needs to be tested; execution is executing the test case and output is the test results.

**Deployment phase work bench:** - This is the deployment phase. There are two inputs for this phase one is the source code which needs to be deployed and that is dependent on the test results. Output of this project is that the customer gets the product which he can now start using.

**Maintenance phase work bench:** - Input to this phase is the deployment results, execution is implementing change request from the end customer, check part is nothing but running regression testing after every change request implementation and output is a new release after every change request execution.

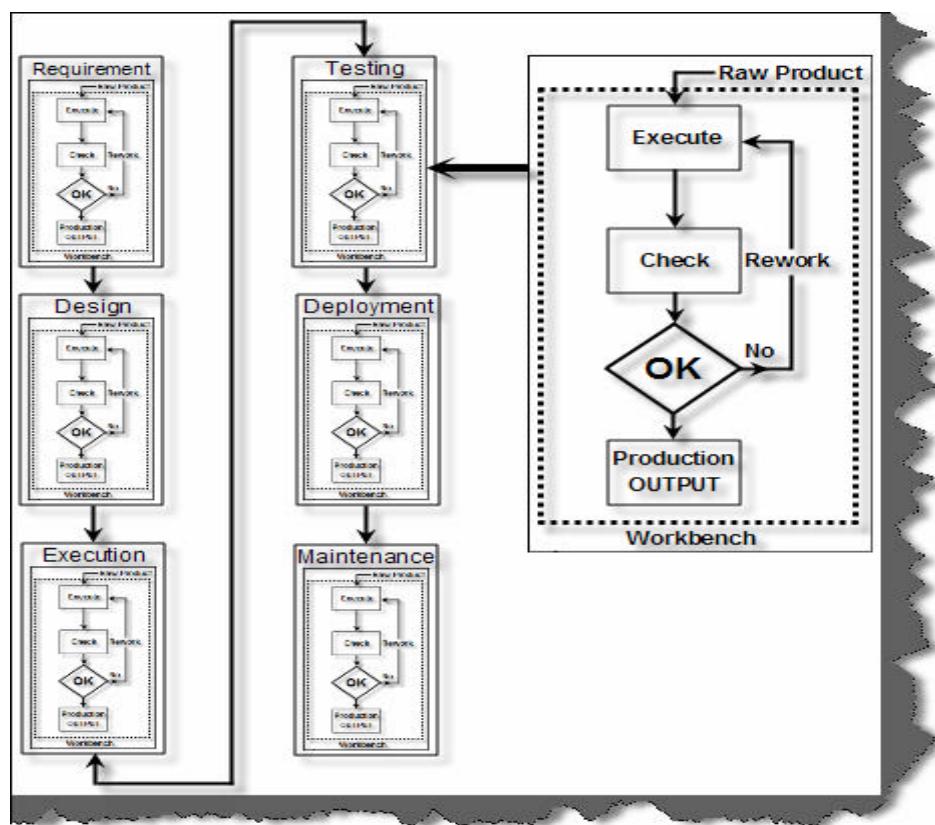
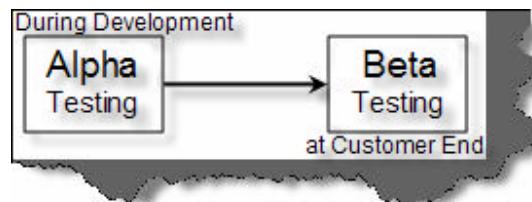


Figure: - Workbench and software life cycles

## **(B) What's the difference between Alpha and Beta testing?**

Alpha and Beta testing means different for different people. Alpha testing is the acceptance testing done at the development site. Some organizations have a bit different visualization of Alpha testing. They consider alpha testing as a testing which is conducted on early, unstable version of software. On the contrary Beta testing is acceptance testing conducted at the customer end. In short the difference between Beta testing and Alpha testing is the location where the tests are done.

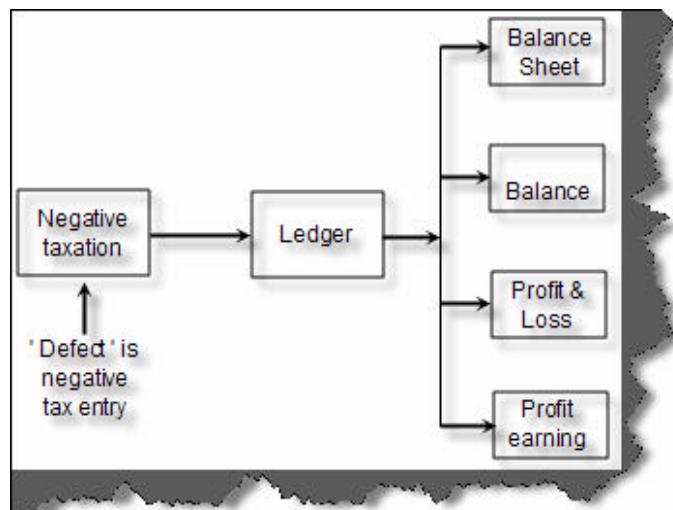


**Figure: - Alpha and Beta testing**

## **(I) Can you explain the concept of defect cascading?**

## **(B) Can you explain how one defect leads to other defects?**

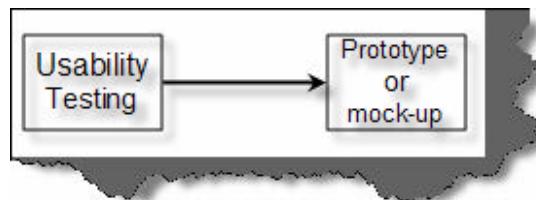
Defect Cascading is a defect which is caused by other defect. So one defect triggers other defect. For instance in the accounting application below there is one defect called negative taxation. So the negative taxation defect affects the Ledger which in turn affects four other modules.



**Figure: - Defect cascading**

## **(B) Can you explain what is Usability testing?**

Usability testing is a testing methodology where the end customer is asked to use the software to see if the product is easy to use, to see the customer perception and task time. The best way to finalize customer point of view for usability is by using prototype or mock up software during the initial stages. By giving customer prototype before the development startup we confirm that we are not missing anything from the user point of view.



**Figure: - Prototype and Usability testing**

## **(B) What are the different strategies of rollout to the end users?**

There are major four ways of rolling out any project:-

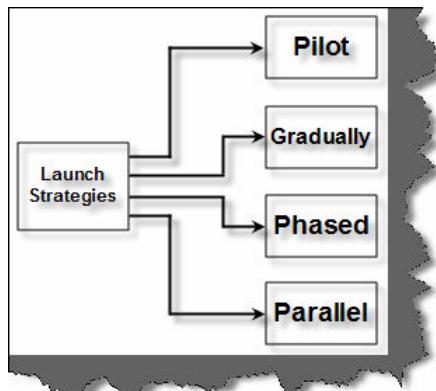
**Pilot:** - Actual production system is installed at a single or to limited number of users. Pilot basically means that the product is actually rolled out to limited users for real work.

**Gradual Implementation:** - In this implementation we ship the entire product to the limited users or all users at the customer end. Here the developers get instant feedback from the earlier recipients which allow them to make changes before the product is available. But yes the downside is that developers and testers maintain more than one version at one time.

**Phased implementation:** - In this the product is rolled out to all users in a increment fashion. That means each successive roll out has some added functionality. So as new functionality come in, new installations happen and customer tests progressively. The good part for this kind of roll outs are that customer can start using the functionality and provide valuable feedback progressively. The only issue here is with each roll out and added functionality the integration becomes more complicated.

**Parallel Implementation:** - In these types of rollouts the existing application is run side by side with the new application. If there are any issues with the new application we again move back to old application. One of the biggest problem with parallel implementation is we need extra hardware, software and resources.

Below figure shows the different launch strategies for a project roll out.



**Figure: - Launch Strategies**

### **(I) Can you explain requirement traceability and its importance?**

In most organization testing only starts after execution / coding phase of the project. But if the organization wants to really benefit from testing, then testers should get involved right from the requirement phase.

If the tester is getting involved right from the requirement phase then requirement traceability is one of the important reports which can give what kind of test coverage the test cases have.

Below is the figure which shows how we can measure the coverage using the requirement traceability matrix.

We have extracted the important functionality from the requirement document and aligned the same on the left hand side of the sheet. On the other side at the top we have mapped the test cases with the requirement. With this we can ensure that all requirements are covered by our test cases. As shown in the below figure we can have one or more test cases covering the requirement. This is also termed as requirement coverage.

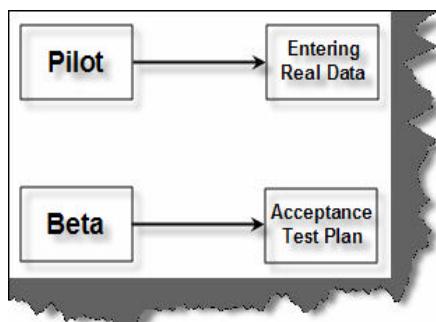
Accounting Application				
Requirement	Test Case - 1	Test Case - 2	Test Case - 3	Test Case - 4
Should not allow Duplicate receipt number		✓		✓
Amount field should be numeric	✓		✓	
Debit & Credit should not be zero		✓		

**Figure: - Requirement Traceability**

**Note:** - Many professionals still think testing as executing test cases on the application. But testing should be performed at all levels. In requirement we can use review and traceability matrix to check validity of our project. In design time we can use design review to check the correctness of the design and so on.

### **(B) What is the difference between Pilot and Beta testing?**

The difference between Pilot and Beta testing is that Pilot is nothing but actually using the product (only that it is limited to some users) and in Beta testing we do not input real data, but it's installed at the end customer to validate if the product can be used in production.



**Figure: - Pilot and Beta testing**

### **(B) How will you do a risk analysis during software testing?**

### **(B) How do you conclude which section is most risky in your application?**

**Note:** - Here the interviewer is expecting a proper approach of rating risk to the application modules. So that while testing you pay more attention to those risky modules and thus minimizing risk in projects.

Below is step by step approach towards testing planning:-

- The first important thing is to collect features and the concern from the current documentation and data available from requirement phase. For instance below are list of some features and concern :-

Features
Add a user
Check user preferences
Login User

Add new invoice
Print invoice
<b>Concerns</b>
Maintainability
Security
Performance

**Table: - Features and Concerns**

Above table shows the features and concerns. Features are functionalities which the end user will use, while concerns are global attributes of the project. For instance Security concern has to be applied to all the features listed above.

- Once we have listed the features and concern, we need to rate the probability / likelihood of failures in this feature. In the below section we have rated the same with Low, High and Medium. But you can put numerical values if you want.

<b>Features</b>	<b>Probability of failure</b>
Add a user	Low
Check user preferences	Low
Login User	Low
Add new invoice	High
Print invoice	Medium
<b>Concerns</b>	<b>Probability of failure</b>
Maintainability	Low
Security	High
Performance	High

**Table: - Probability rating according to Features and concerns**

- Once we have rated the failure probability, we need to rate the impact. Impact means if we make changes to this feature in how many other features does it affect. You can see in the below table we have marked the impact section accordingly.

<b>Features</b>	<b>Probability of failure</b>	<b>Impact</b>
Add a user	Low	Low
Check user preferences	Low	Low
Login User	Low	High
Add new invoice	High	High
Print invoice	Medium	High
<b>Concerns</b>	<b>Probability of failure</b>	<b>Impact</b>
Maintainability	Low	Low
Security	High	High

Performance	High	Low
-------------	------	-----

**Table: - Impact and Probability rating**

- We also need to define master priority rating table depending on Impact and Probability ratings. Below table defines the risk priority.

Probability of failure	Impact	Risk Priority
Low	Low	1
Low	High	2
Medium	High	3
High	High	4

**Table: - Priority rating**

- Depending on the priority rating table we have defined priority for the below listed features. You can see below the priority rating table below for the features. Now depending on priority you can start testing those features first.

Features	Probability of failure	Impact	Priority
Add a user	Low	Low	1
Check user preferences	Low	Low	1
Login User	Low	High	2
Add new invoice	High	High	4
Print invoice	Medium	High	3
Concerns	Probability of failure	Impact	
Maintainability	Low	Low	1
Security	High	High	4
Performance	High	Low	3

**Figure: - Priority set according to Risk Priority table**

- Once the priority is set you can then review the same with your team members to validate the same.

Below figure shows the summary of the above steps. So list your concerns, rate the probabilities of failures, Give impact rating, calculate risk / priority and then review, review and review.

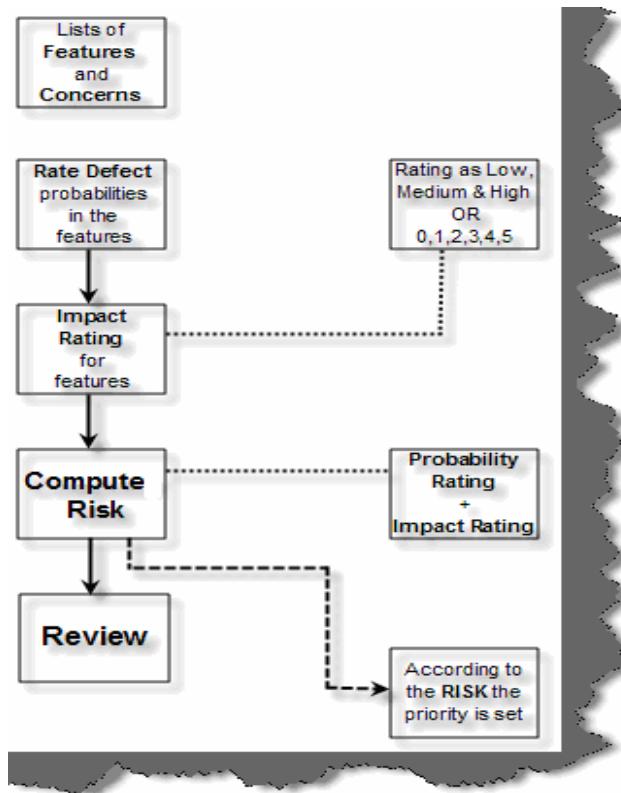


Figure: - Testing Analysis and design

### (B) What does entry and exit criteria mean in a project?

Entry and exit criteria are a must for the success of any project. If you do not know from where to start and where to finish then your goals are not clear. By defining exit and entry criteria you define your boundaries. For instance you can define entry criteria that the customer should give the requirement document or acceptance plan. If these entry criteria's are not met then you will not start the project. On the other end you can also define exit criteria for your project. For instance one of the common exit criteria's in all project is that customer has successfully executed all the Acceptance Test plan.

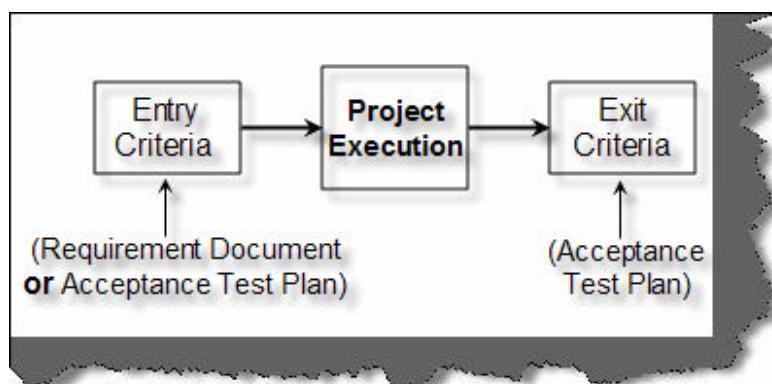


Figure: - Entry and exit criteria

## (B) On what basis is the Acceptance plan prepared?

In any project Acceptance document is normally prepared using the following inputs. This can vary from company to company and from project to project.

- Requirement document: - This document specifies what exactly is needed in the project from the customer perspective.
- Input from customer: - This can be discussions, informal talks, emails etc.
- Project plan: - Project plan prepared by the project manager also serves as a good input to finalize your acceptance test.

**Note:** - In projects Acceptance test plan can be prepared by numerous inputs. It is not necessary that the above list is the only criteria. So If you think you have something extra to add please go ahead.

Below diagram shows the most common inputs to prepare Acceptance test plans.

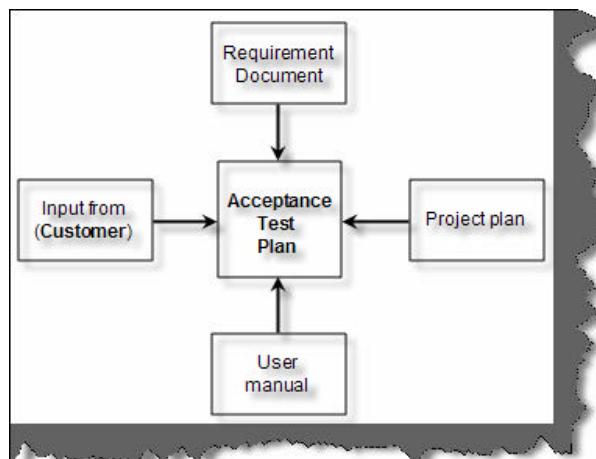
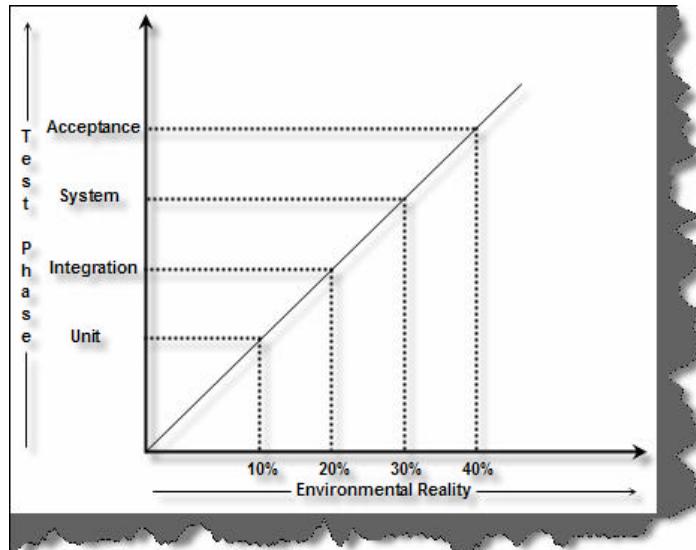


Figure: - Acceptance test input criteria

## (B) What's the relation between environment reality and test phases?

Environment reality becomes more important as test phases start moving ahead. For instance during unit testing you need the environment to be least real , but at the acceptance phase you should have a 100 % real environment , or we can say it should be the real environment. Below graph shows how with every phase the environment reality should also increase and finally during acceptance it should be to the maximum.

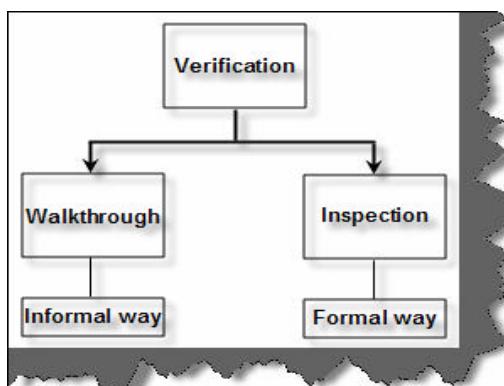


**Figure:- Environment reality**

### **(B) What are different types of verifications?**

### **(B) What's the difference between Inspections and Walkthroughs?**

As said in the previous sections the difference between validation and verification is that in validation we actually execute the application, while in verification we do review without actually running the application. Verifications are basically of two main types Walkthrough and Inspection. Walkthrough is an informal way of verification. For instance you can call your colleague and do an informal walkthrough to just check if the documentation and coding is proper. Inspection is a formal procedure and official. For instance in your organization you can have an official body which approves design documents for any project. Every project in your organization need to go through an inspection which reviews your design documents. In case there are issues in the design documents then your project will get a NC (Non conformance) list. You can not proceed ahead with out clearing the NC's given by the inspection team.

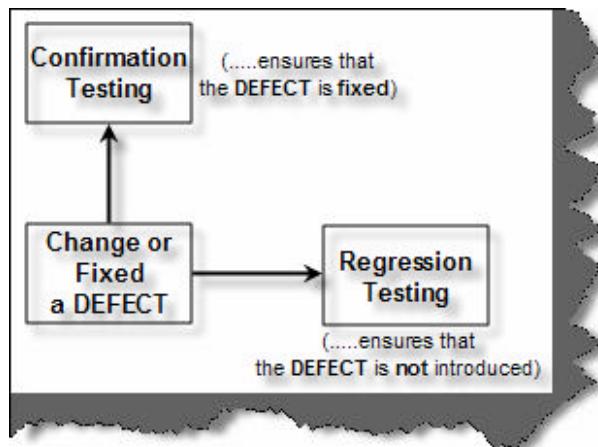


**Figure: - Walkthrough and Inspection**

**(B) Can you explain regression testing and confirmation testing?**

Regression testing is meant for regression defects. Regression defects are defects due to which the functionality which was working first normally has stopped working. This is probably because of changes made in the program or the environment. To uncover such kind of defect regression testing is conducted.

Below figure shows the clear explanation and difference between regression and confirmation testing. If we fix a defect in an existing application we use confirmation testing to test if the defect is removed. It's very much possible because of this defect or changes to the application it can affect other sections of the application. So to ensure that no other section is affected we can use regression testing to confirm the same.

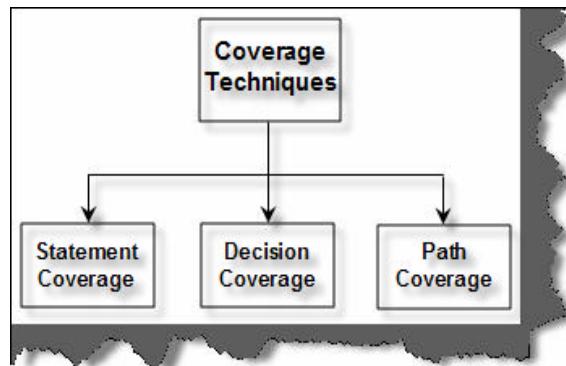


**Figure: - Regression testing in action**

**(I) what do you mean by coverage and what are the different types of coverage techniques?**

Coverage is a measure used in software testing to describe to the degree to which the source code is tested. There are three basic types of the coverage techniques as shown in the below figure:-

- Statement coverage: - This coverage ensures that each line of source code has been executed and tested.
- Decision coverage: - This coverage ensures that every decision (true/ false) in the source code has been executed and tested.
- Path coverage: - In this coverage we ensure that every possible route through a given part of code is executed and tested.

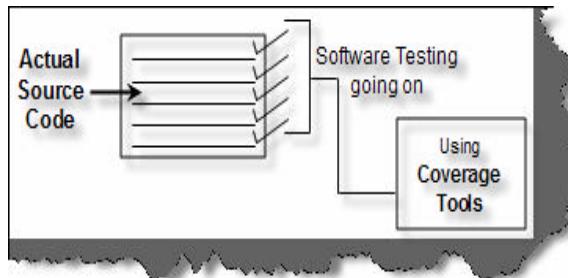


**Figure: - Coverage techniques**

### **(A) How does fundamentally a coverage tool work?**

**Note:** - We will be covering coverage tools in more details in the coming chapters , but for now lets understand the fundamentals of how a code coverage tool will work .

While doing testing on the actual product, code coverage testing tool is run simultaneously. While the testing is going on code coverage tool monitors the executed statements of the source code. When the final testing is completed we can get a complete report of the pending statements and also get the coverage percentage.



**Figure: - Coverage tool in action**

### **(B) What is configuration management?**

Configuration management is a detailed recording and updating information for hardware and software components. When we say components it does not only mean source code. It can be tracking of changes for software documents like requirement, design, test cases etc.

When changes are done in ADHOC and uncontrolled manner more chaotic situations arise and more defects are injected. So whenever changes are done it should be done in a controlled fashion and with proper versioning. At any moment of time we should be able to revert back to the old version. The main intension of Configuration management is that

we can track our changes back if we have issues with the current system. Configuration management is done by using baselines.

Note :- Please refer the baseline concept in the next question.

### (B) Can you explain the concept of baseline in software development?

Base lines are logical ends in a software development cycle. For instance let's say you have software whose releases which will be done in phases i.e. Phase 1, Phase 2 etc. So you can base line your software product after every phase. In this way you will now be able to track the difference between Phase 1 and Phase 2. Changes can be in various sections for instance the requirement document (because some requirements changed), technical (due to changes the architecture was needed to be changed), Source code (source code change), test plan change and so on.

For example consider the below figure which shows how an accounting application had undergone changes and was then base lined with each version. When the accounting application was released it was released with Ver 1.0 and base lined. After some time some new features were added and version 2.0 was generated. This was again a logical end so we again base lined the application. So now in case we want to track back and see what are the changes from VER 2.0 to VER 1.0 we can easily understand the same as we have logical base lines. After some time the accounting application had gone through some defect removal i.e. VER 3.0 was generated and again base lined and so on.

Below figure depicts the all the scenarios properly.

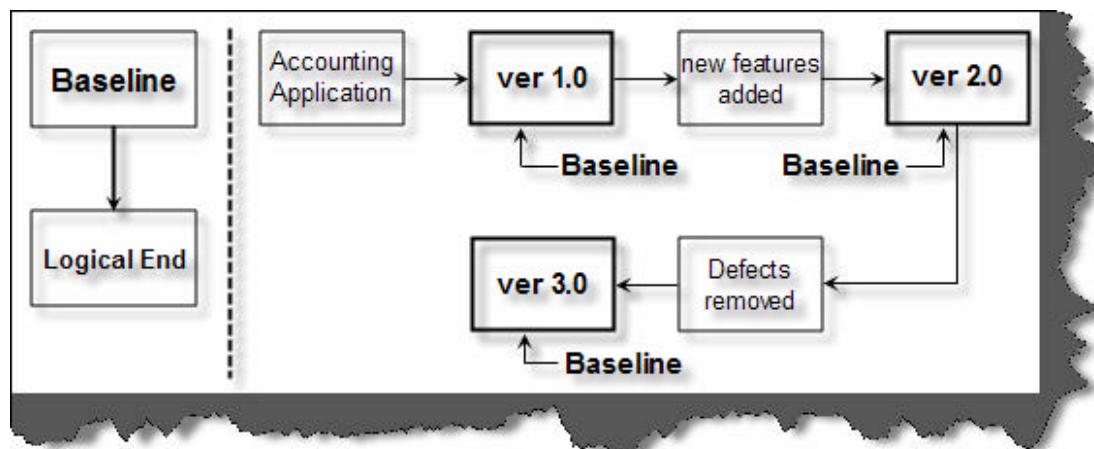


Figure: - Base line

Base line is very important from testing perspective. Because testing on a software product which is constantly changing will not take you anywhere. So when you actually start testing you need to first base line the application so that what you test is for that base

line. If the developer fixes something then create a new base line and perform testing on the same. In this way any kind of conflicts will be avoided.

## (B) What are the different test plan documents in project?

Note: - This answer varies from project to project and company to company. You can tailor this answer according to your experience. This book will try to answer the question from the authors view point.

There are minimum four test plan documents needed in any software project. But depending on project and team members agreement some of the test plan document can be cut off.

**Central / Project test plan:** - Central test plan is one of the important communication channels for all project participants. This document can have essentials like resource utilization, testing strategy, estimation, risk, priorities and lot more.

**Acceptance test plan:** - Acceptance test plan is mostly based on user requirements and is used to verify whether the requirements are satisfied according to customer needs. Acceptance test cases are like a green flag for the application whether or not the application should go in a production.

**System test plan:** - System test plan is where all main action of testing happens. This testing in addition to functionality testing has also load, performance and reliability tests.

**Integration testing :** - Integration testing ensures that various components in the system interact properly and data is passed properly between them.

**Unit testing**:- Unit testing is more at a developer level. In unit testing we check the individual module in isolation. For instance the developer can check his sorting function in isolation, rather than checking in integrated fashion.

Below figure shows the interaction between the entire project test plan.

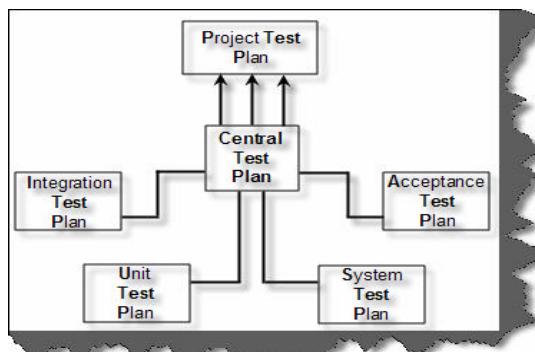


Figure: - Different test plans in project

## (B) How do test documents in a project span across software development life cycle?

Below figure shows pictorially how test document span across SDLC. We will try to understand step by step how it works.

**Central / Project test plan:** - This is the main test plan which outlines the complete test strategy of the software project. This document should be prepared before the start of the project and is used till the end of SDLC.

**Acceptance test plan:** - This test plan is normally prepared in joint venture with the end customer. This document commences during the requirement phase and completes till the final delivery.

**System test plan:** - This test plan starts during the design phase and proceeds till the end of the project.

**Integration and unit test plan:** - Both of these test plans start during the execution phase and continue till the final delivery.

**Note:** - The above answer is nothing but a different interpretation of V model testing. We have explained V model in this chapter in more detail in one of the questions do read it once to understand the concept.

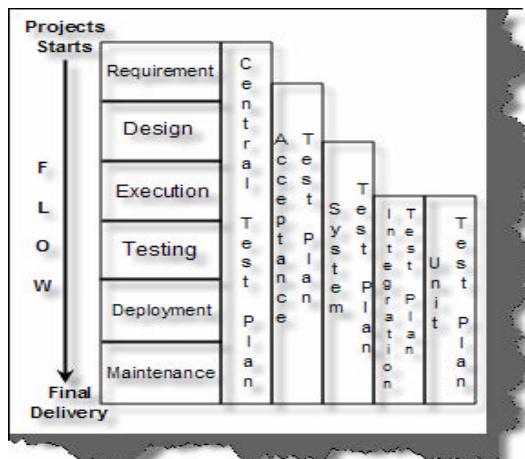


Figure: - Test document across phases

## **(B) Can you explain inventories?**

## **(B) How do you do Analysis and design for testing projects?**

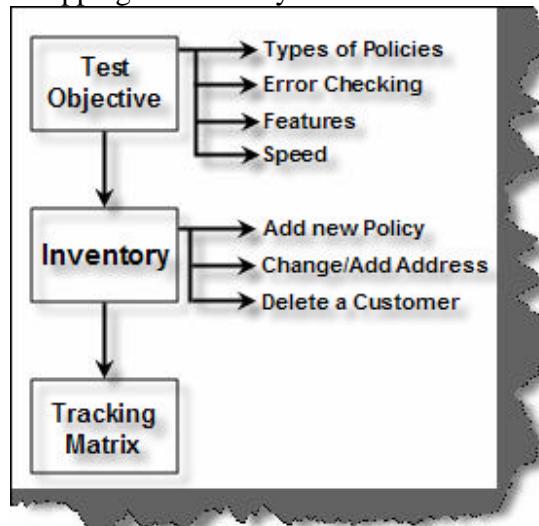
### **(A) Can you explain calibration?**

Below are three important steps for doing analysis and design for testing:

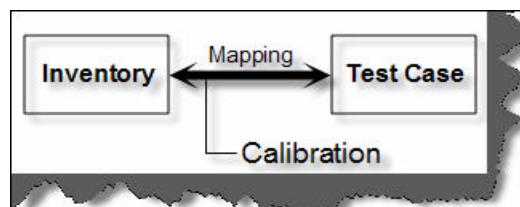
**Test objective**: - They are broader categories of things which need to be tested in the application. For instance in the below figure we have four broader category of test areas Polices, Error checking, features and speed.

**Inventory**: - Inventory is nothing but list of things to be tested for an objective. For instance the below figure shows we have identified inventory like add new policy which is tested for the object types of policies. Change / Add Address and delete customer is tested for the features objective.

**Tracking matrix**: - Once we have identified our inventories we need to map the inventory to test cases. Mapping of inventory to the test cases is termed as calibration.



**Figure: - Software testing planning and design**



**Figure: - Calibration**

Below is a sample of inventory tracking matrix. "Features" is the objective and "Add new Policy", "Change Address", "Delete a customer" are the inventory for the objective. Every inventory is mapped to a test case. Only the "Delete a customer" inventory is not mapped to any test case. This way we can know if we have covered all the aspects of the application in testing. Inventory tracking matrix gives us a quick global view of what is pending and hence helps us to also measure coverage of the application. Below figure shows the "delete a customer" inventory is not covered by any test case thus giving a red signal of what is not covered.

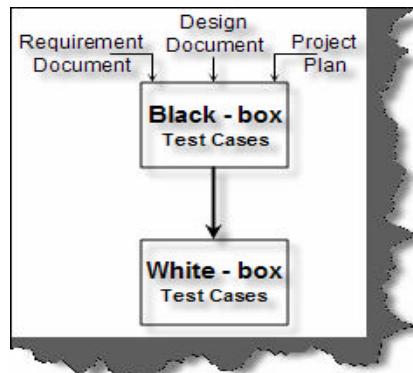
Inventory Tracking Matrix				
Objectives / Inventories	Test Case - 1	Test Case - 2	Test Case - 3	Test Case - 4
<b>Features</b>				
Add New Policy	✓		✓	
Change Address			✓	
Delete a Customer				
				

**Figure: - Inventory tracking matrix**

**Note:** - During interview try to explain all the above three steps.  
Because that's how testing is planned and designed in big companies.  
Inventory form the main back bone of Software testing.

### **(B) Which test cases are first written white boxes or black box?**

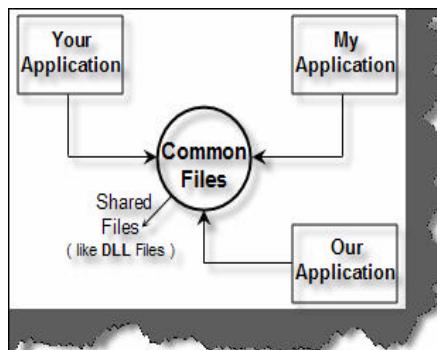
Normally black box test cases are written first and white box test cases later. In order to write black box test cases we need requirement document, design or project plan. All these documents are easily available in the initial start of the project. White box test cases can not be started in the initial phase of the project because it needs more architecture clarity which is not available at the start of the project. So normally white box test cases are written after black box test cases are written. Black box test cases do not require the system understanding as such while white box needs more structural understanding. And structural understanding is more clear in the later part of project i.e. while execution or designing. For black box you need to only analyze more from the functional perspective which is easily available by a simple requirement document.



**Figure: - White box and black box**

### **(I) Can you explain Co-habiting software?**

When we install the application at the end client it is very much possible that on the same PC other applications also exist. It is very much possible that those application share common DLL's, resource etc with your application. There is a huge chance in such situations that your changes can affect the cohabiting software working. So the best practice is after you install your application or after any changes, tell other application owners to run a test cycle on their application.

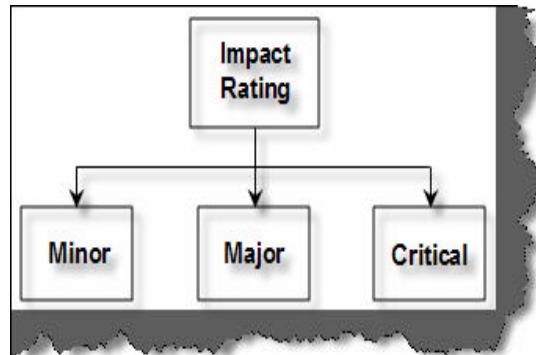


**Figure: - Cohabiting software**

### **(B) What different impact rating 's you have used in your project?**

Normally impact rating for defects is classified in to three types:-

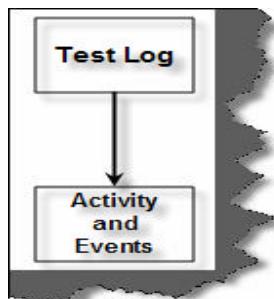
- Minor: - Very low impact but does not affect operations on large scale.
- Major: - Affects operations on a very large scale.
- Critical: - Brings the system to halt and complete show stopper.



**Figure: - Test Impact rating**

### **(B) Can you explain what a test log is?**

The IEEE Std. 829-1998 defines the test log as a chronological record of relevant details about the execution of test cases. It's a detail view of activity and events in a chronological manner. Below figure shows what a test log is , followed by a sample test log



**Figure: - Test Log**

ID	TIME	Activity and Event Entries
1	08:00	Kicked off data entry for all banks
2	09:30	System has issues and crashed
3	10:00	Banking application recovered
4	10:05	Restarted data entry for all banks

**Figure: - Sample test log**

**Note: -** Below we are answering a bunch of frequently asked question in one shot. So read it not by head but by your heart.

**(I) Explain SDLC (Software development Life Cycle) in detail?**

**(I) Can you explain waterfall model?**

**(I) Can you explain big-bang waterfall model?**

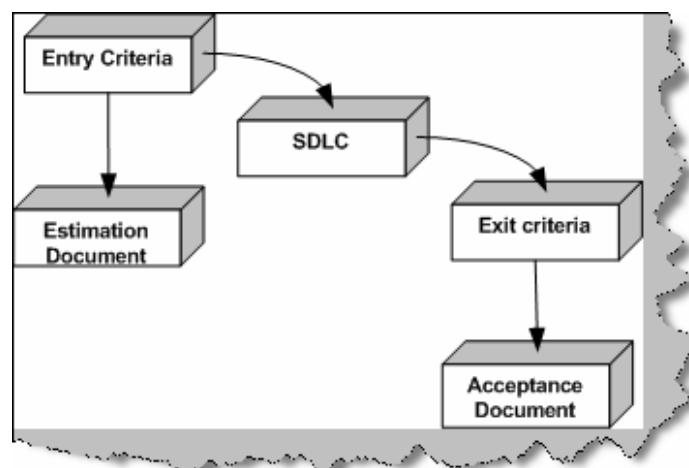
**(I) Can you explain phased waterfall model?**

**(I) Explain Iterative model, Incremental model, Spiral model, Evolutionary model and V-Model?**

**(I) Explain Unit testing, Integration tests, System testing and Acceptance testing?**

Every activity has a life cycle and software development process is not an exception for the same. Even if you are not aware of SDLC you still must be following it unknowingly. But if a software professional is aware about SDLC he can execute the project in a much controlled fashion. One of the big benefits of this awareness is that hot blooded developers will not start directly execution (coding) which can really lead to project running in an uncontrolled fashion. Second it helps customer and software professional to avoid confusion by anticipating the problems and issues before hand. In short SDLC defines the various stages in a software life cycle.

But before we try to understand what SDLC is all about. We need to get a broader view of the start and end of SDLC. Any project started if it does not have a start and end then its already in trouble. It's like if you go out for a drive you should know where to start and where to end or else you are moving around endlessly.



**Figure: - Entry, SDLC and Exit in action**

Above is a more global view of the how the start and end of SDLC. Any project should have entry criteria and exit criteria. For instance a proper estimation document can be an entry criteria condition. That means if you do not have a proper estimation document in

place the project will not start. It can be more practical, if half payment is not received the project will not start. So there can be list of points which needs to be completed before a project starts. Finally there should be end of the project also which defines saying that this is when the project will end. For instance if all the test scenarios given by the end customer is completed that means the project is finished. In the above figure we have the entry criteria as an estimation document and exit criteria as a signed document by the end client saying the software is delivered.

Below is the figure that shows typical flow in SDLC which has five main models .As per use developers can select model for their project.

- Waterfall - Big Bang and Phased model.
- Iterative - Spiral and Incremental model.

## Waterfall

Let's have a look on Waterfall model which is basically divided into two subtypes:-

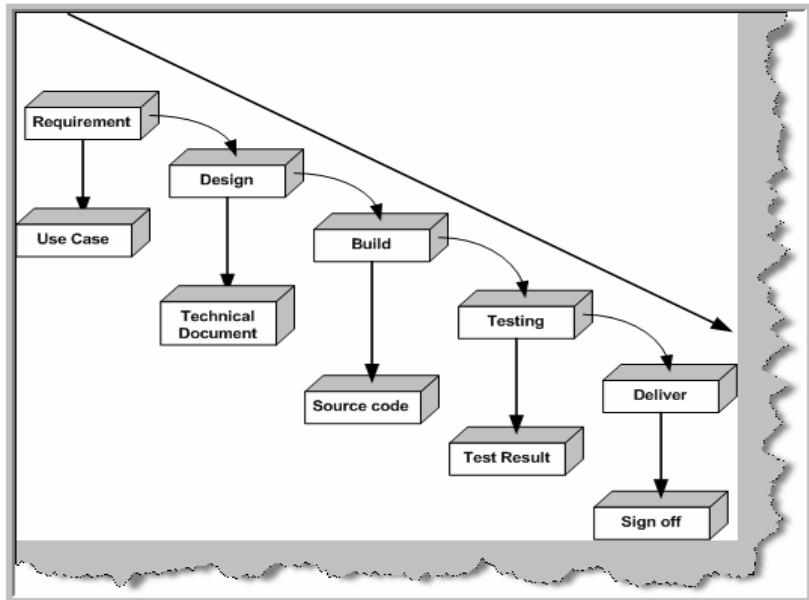
- Big Bang waterfall model.
- Phased waterfall model.

As the name suggests Waterfall means flow of water always goes in one direction so when we say waterfall model we expect every phase/stage is freezed.

### Big Bang waterfall model

The figure shows waterfall Big Bang model which has several stages and are described as below:-

- Requirement stage: - This stage takes basic business needs required for the project which is from a user perspective so this stage produces typical word documents with simple points or may be in a form of complicated use case documents.
- Design stage: - Use case document / requirement document is the input for this stage. Here we decide how to design the project technically and produce technical document which has Class diagram, pseudo code etc.
- Build stage:- This stage follow the technical documents as an input so code can be generated as an output by this stage. This is where the actual execution of the project takes place.
- Test stage: Here testing is done on the source code produced by the build stage and final software is given a green flag. Deliver stage: - After succeeding in Test stage the final product/project is finally installed at client end for actual production. This stage is start for the maintenance stage.



**Figure : - SDLC in action (Waterfall big bang model)**

In water fall big bang model, it is assumed that all stages are freezed that means it's a perfect world. But in actual projects such processes are impractical.

### **Phased Waterfall model**

In this model the project is divided into small chunks and delivered at intervals by different teams. In short, chunks are developed in parallel by different teams and get integrated in the final project. But the disadvantage of this model if there is improper planning may lead to fall of the project during integration or any mismatch of co-ordination between the team may cause huge failure.

### **Iterative model**

Iterative model was introduced because of problems faced in Waterfall model.

Now let's try to have a look on Iterative model which also has a two subtype as follows:

#### **Incremental model**

In this model work is divided into chunks like phase waterfall model but the difference is that in Incremental model one team can work on one or many chunks which was unlike in phase waterfall model.

#### **Spiral model**

This model uses series of prototype which refine on understanding of what we are actually going to deliver. Plans are changed if required as per refining of the prototype.

So every time in this model refining of prototype is done and again the whole process cycle is repeated.

## **Evolutionary model**

In Incremental and Spiral model the main problem is for any changes in between SDLC cycle we need to iterate the whole new cycle. For instance, During the final(Deliver)stage customer demands for change we iterate the whole cycle again that means we need to update all the previous (Requirement, Technical documents, Source code & Test plan) stages.

In Evolutionary model, we divide software into small units which can be earlier delivered to the customer's end which means we try to fulfill the customer's needs. In the later stages we evolve the software with new customers needs.

**Note:** - V model is one the favorite questions for any tester so please do read it carefully.

## **V-model**

This type of model was developed by testers to emphasize the importance of early testing. In this model testers are involved from requirement stage itself. So below is the diagram (V model cycle diagram) which shows how for every stage some testing activity is done to ensure that the project is moving as planned.

For instance,

- In requirement stage we have acceptance test documents created by the testers. Acceptance test document outlines that if these test pass then customer will accept the software.
- In specification stage testers create the system test document. In the coming section system testing is explained in more elaborate fashion.
- In design stage we have integration documents created by the testers. Integration test documents define testing steps of how the components should work when integrated. For instance you develop a customer class and product class. You have tested the customer class and the product class individually. But in practical scenario the customer class will interact with the product class. So you also need to test is the customer class interacting with product class properly.
- In implement stage we have unit documents created by the programmers or testers.

Lets try to understand every of this testing phase in more detail.

### **Unit Testing**

Starting from the bottom the first test level is "Unit Testing". It involves checking that each feature specified in the "Component Design" has been implemented in the component.

In theory an independent tester should do this, but in practice the developer usually does it, as they are the only people who understand how a component works. The problem

with a component is that it performs only a small part of the functionality of a system, and it relies on co-operating with other parts of the system, which may not have been built yet. To overcome this, the developer either builds, or uses special software to trick the component into believe it is working in a fully functional system.

### **Integration Testing**

As the components are constructed and tested they are then linked together to check if they work with each other. It is a fact that two components that have passed all their tests, when connected to each other produce one new component full of faults. These tests can be done by specialists, or by the developers.

Integration Testing is not focused on what the components are doing but on how they communicate with each other, as specified in the "System Design". The "System Design" defines relationships between components.

The tests are organized to check all the interfaces, until all the components have been built and interfaced to each other producing the whole system.

### **System Testing**

Once the entire system has been built then it has to be tested against the "System Specification" to check if it delivers the features required. It is still developer focused, although specialist developers known as systems testers are normally employed to do it. In essence System Testing is not about checking the individual parts of the design, but about checking the system as a whole. In fact it is one giant component.

System testing can involve a number of specialist types of test to see if all the functional and non-functional requirements have been met. In addition to functional requirements these may include the following types of testing for the non-functional requirements:

- Performance - Are the performance criteria met?
- Volume - Can large volumes of information be handled?
- Stress - Can peak volumes of information be handled?
- Documentation - Is the documentation usable for the system?
- Robustness - Does the system remain stable under adverse circumstances?

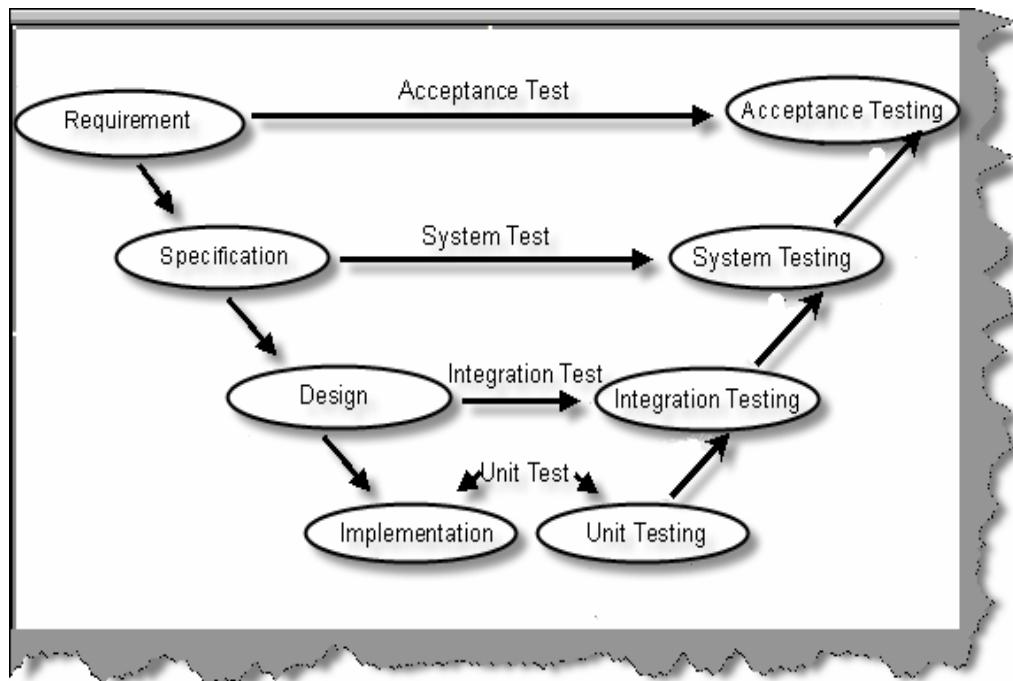
## **(I) what's the difference between system and acceptance testing?**

### **Acceptance Testing**

Acceptance Testing checks the system against the "Requirements". It is similar to systems testing in that the whole system is checked but the important difference is the change in focus:

Systems testing checks that the system that was specified has been delivered. Acceptance Testing checks that the system will deliver what was requested.

The customer should always do acceptance testing and not the developer. The customer knows what is required from the system to achieve value in the business and is the only person qualified to make that judgment. This testing is more of getting the answer for whether the software delivered as defined by the customer. It's like getting a green flag from the customer that the software is up to the expectation and ready to be used.



**Figure: - V model cycle flow**

### **(I) Which is the best model?**

In the previous section we looked through all the models. But in real projects, hardly one complete model can fulfill the entire project requirement. In real projects, tailor model are proven to be the best because they share features from all models such as Waterfall, Iterative, Evolutionary models etc and can fit in to real life time projects. Tailor model are most productive and benefited for many organization. If it's a pure testing project then V model is the best.

### **(I) What group of teams can do software testing?**

When it comes to testing every one in the world can be involved right from the developer to the project manager to the customer. But below are different types of team groups which can be present in a project.

**Isolated test team:** - There is a special team of testers which do only testing. The testing team is not related to any project. It's like having a pool of testers in an organization, which

are picked up on demand by the project and after completion again pushed back to the pool. This approach is costly but the best is we have a different angle of thinking from a different group which is isolated from development. But yes because it's a complete isolated team it definitely comes at a cost.

Outsource: - In this we contact an external supplier, hire testing resources and do testing for our project. Again it has two sides of the coins. Good part is resource handling is done by the external supplier. So you are freed from the worry about resource leaving the company, people management etc. But the bad side of the coin is because they are outsourced vendors they do not have domain knowledge of your business. Second at the initial stage you need to train them for domain knowledge which is again added cost.

Inside test team: - In this approach we have a separate team which belongs to the project. Project allocates separate budget for testing and this testing team specially works this project only. Good side you have a dedicated team and because they are involved in the project they have good knowledge about the same. Bad part you need to budget for them in short it increases the project cost.

Developer as Testers: - In this approach the developers of the project perform the testing activity. Good part of this approach is developers have a very good idea of the inner details so they can perform good level of testing. Bad part of this approach because the developer and tester both are same person; there is no different angle, so it's very much likely that many defects can be missed.

QA / QC team: - In this approach the quality team is involved in to testing. Good part because QA team is involved good quality of testing can be expected. Bad part QA and QC team of any organization is also involved with lot of other activity which can hamper testing quality of the project.

Below diagram shows the different team approaches.

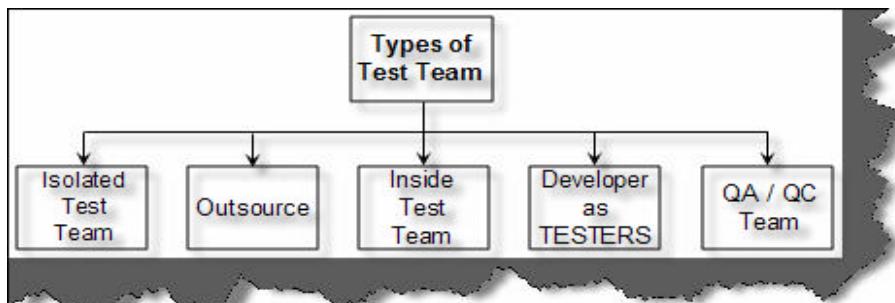


Figure: - Types of teams

## Testing techniques

**(B) Can you explain boundary value analysis?**

**(B) What is BV in software testing?**

In projects there can be scenarios where we need to do boundary value testing. For instance let's say for a bank application you can withdraw maximum 25000 and minimum 100. So in boundary value testing we only test the exact boundaries rather hitting in middle. That means we only test above the max and below the min. This covers all scenarios. Below figure shows the BV testing for the bank application which we described previously. TC1 and TC2 are sufficient to test all conditions for the bank. TC3 and TC4 are just duplicate / redundant test cases which really do not add any value to the testing. So by applying proper BV fundamentals we can avoid duplicate test cases which do not add value as such to testing.

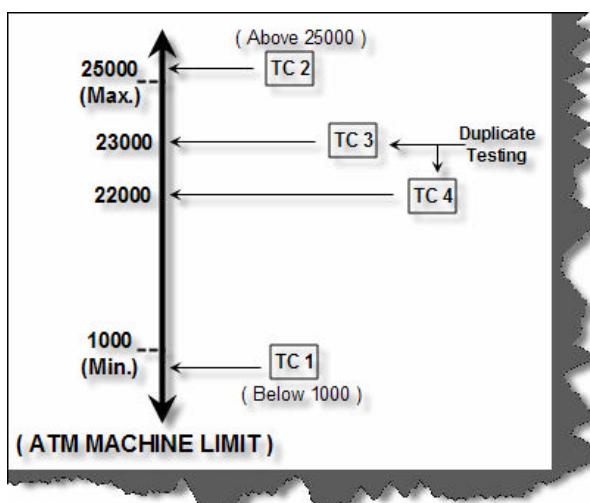
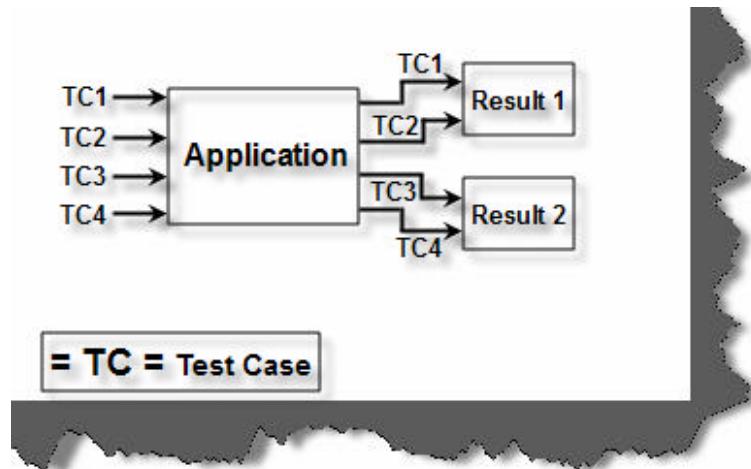


Figure: - Boundary value analysis

**(B) Can you explain Equivalence partitioning?**

In equivalence partitioning we identify inputs which are treated by system in the same way and produce the same results. You can see from the below figure application TC1 and TC2 both give same result i.e. Result1 and TC3 and TC4 both give same result i.e. Result2. In short we have two redundant test cases. By applying equivalence partitioning we minimize the redundant test cases.



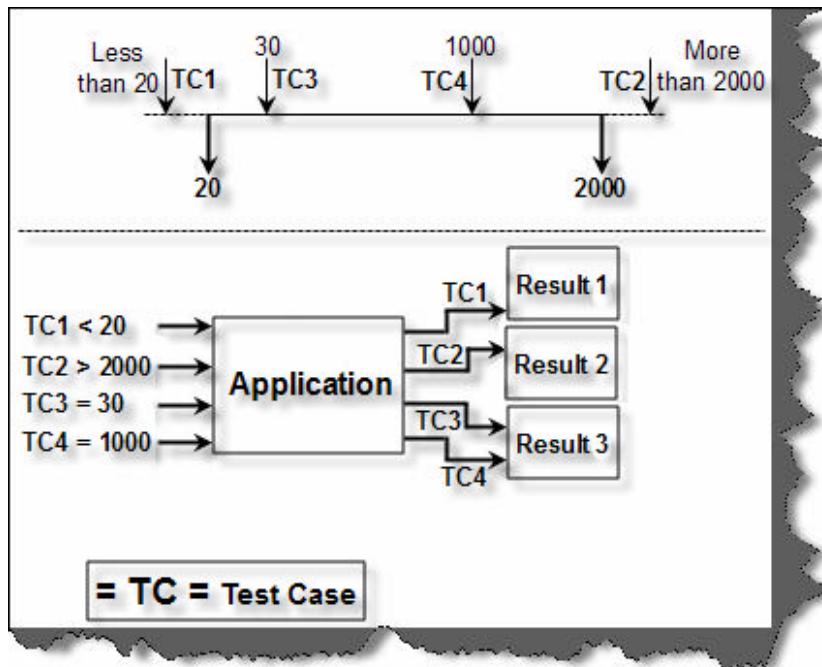
**Figure: - Equivalence partitioning**

So below test you can apply to see if it forms equivalence class or not:-

- All the test cases should test the same thing.
- They should produce the same results.
- If one test case catches a bug then the other should also catch.
- If one of them does not catch the defect then the other should also not catch.

Below figure shows how equivalence partition works. Below we have a scenario in which valid values lie between 20 and 2000. Any values beyond 2000 and below 20 are invalid. In the below scenario the tester has made four test cases:-

- Check below 20 ( TC1)
- Check above 2000 (TC2)
- Check equal to 30 (TC3)
- Check equal to 1000 (TC4)



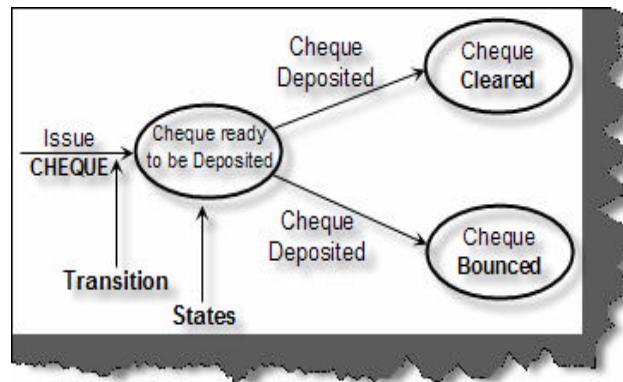
**Figure: - Sample of equivalence partitioning**

Test case 3 and 4 give same outputs so they lie in same partition. In short we are doing redundant testing. Both TC3 and TC4 fall in one equivalence partitioning. So we can prepare one test case by testing one value in between the boundary, thus eliminating redundancy testing in projects.

**(B) Can you explain how state transition diagram can be helpful during testing?**

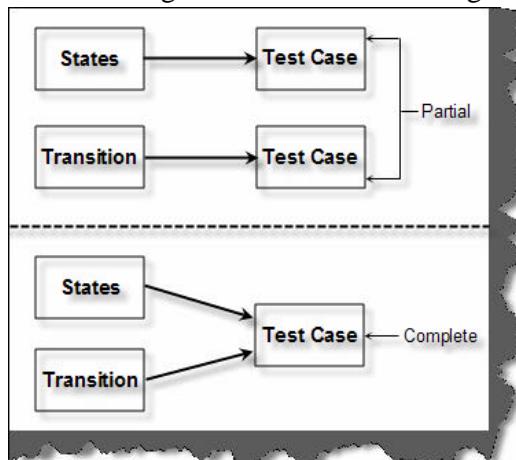
Before we understand how state transition diagrams can be useful in testing, let's understand what exactly is a state and transition. Result of a previous input is called as a state and transitions are actions which cause the state to change from one state to other.

Below figure shows a typical state transition diagram. The arrows signify that transition and the oval shape signify the states. The first transition in the diagram is issue of the cheque due to which the cheque gets a state that it is ready to be deposited. Second transition is that cheque is deposited, because of which we can have two states one either the cheque is cleared or it's bounced.



**Figure: - Sample state transition diagram**

Now that we are clear about state and transition how does it help us in testing. By using states and transition we can identify test cases. So we can identify test cases either using states or transitions. But if we use only one entity i.e. either state or transition it is very much possible that we can miss lot of scenarios. In order to get maximum benefit we should use the combination of state and transition. Below figure shows that if we only use states or transition in isolation it's possible that we will have partial testing. But the combination of state and transition can give us better test coverage for an application.

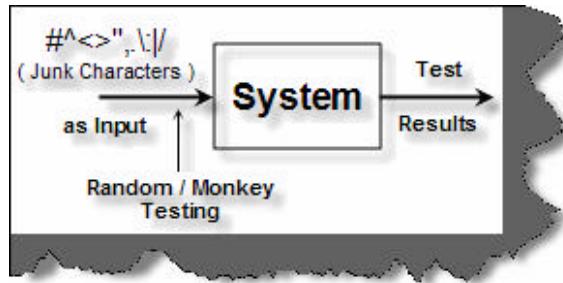


**Figure: - State, transition and test cases**

### **(B) Can you explain random testing?**

### **(B) Can you explain monkey testing?**

Random testing is sometimes called as monkey testing. In Random testing data is generated randomly often using tool. For instance below figure shows how randomly generated data is sent to the system. This data is generated either using tool or some automated mechanism. With this randomly generated input the system is then tested and results are observed accordingly.



**Figure: - Random / Monkey testing**

Random test has the following weakness:-

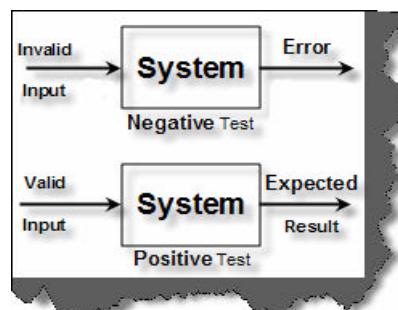
- They are not realistic.
- Many of the test are redundant and unrealistic.
- You will be spending more time in analyzing results.
- We can not recreate the test if we do not record what data was used for testing.

This kind of testing is really of no use and is normally performed by new comers. The best use it is to see if the system will maintain under adverse affect. Who knows we can be lucky to get some defects using the same....but that's luck and testing does not really work on luck, but works rather on planning.

### **(B) What is negative and positive testing?**

A negative test is when you put in an invalid input and expect get errors.

A positive test is when you put in a valid input and expect some action to be completed in accordance with the specification



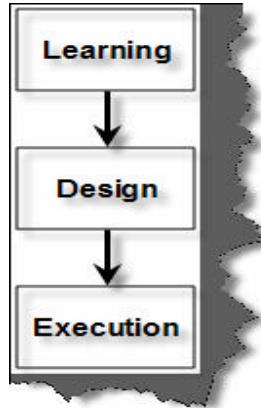
**Figure: - Negative and Positive testing**

### **(I) Can you explain exploratory testing?**

Exploratory testing is also called as adhoc testing , but in real its not completely adhoc.Just as it means, ad hoc testing is an unplanned, unstructured, maybe even impulsive journey through the system with the intent of finding bugs. Exploratory testing is simultaneous learning, test design, and test execution. In other words, exploratory testing is any testing to the extent that the tester proactively controls the design of the

tests as those tests are performed and uses information gained while testing to design better tests. Exploratory testers are not merely keying in random data, but rather testing areas that their experience (or imagination) tells them are important and then going where those tests take them.

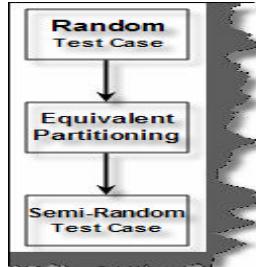
In one definition Exploratory testing is simultaneous learning, test design, and test execution.



**Figure: - Exploratory testing**

### **(A) What exactly are semi-random test cases?**

As the name specifies semi-random testing is nothing but controlling random testing and removing redundant test cases. So what we do is we have random test cases , we apply equivalence partitioning to those test cases , which in turn removes redundant test case thus giving us semi-random test cases.



**Figure: - Semi-random test cases**

### **(I) Can you explain the concept of orthogonal array?**

### **(I) Can you explain pair-wise defect fundamental?**

Orthogonal array is a two dimension array in which if we choose any two columns in the array, all the combinations of number will appear in those columns. Below figure shows a simple L<sub>9</sub> (3<sup>4</sup>) orthogonal array is shown. In this the 9 indicates that it has 9 rows. 4 indicate that it has 4 columns and 3 indicate that each cell contains a 1, 2 and 3. Choose any two columns. Let's choose column 1 and 2. It has (1,1), (1,2), (1,3), (2,1), (2,2),

(2,3), (3,1), (3,2), (3,3) combination values. If you see closely these values covers all the values in the array. Compare the values with combination column 3 and 4 and they will fall in some pair. This is applied in software testing which helps us eliminate duplicate test cases.

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>1</b>	1	1	1	1
<b>2</b>	1	2	2	2
<b>3</b>	1	3	3	3
<b>4</b>	2	1	2	3
<b>5</b>	2	2	3	1
<b>6</b>	2	3	1	2
<b>7</b>	3	1	3	2
<b>8</b>	3	2	1	3
<b>9</b>	3	3	2	1

**Figure: - Sample orthogonal array**

Now let's try to apply orthogonal array in actual testing field. Let's say we have a scenario in which we need to test mobile handset with different plan type, term and size. So below are the different situations:-

- Handset ( Nokia , 3G and Orange)
- Plan type ( 4x400 , 4x300 and 2x270)
- Term ( Long term , short term and mid term)
- Size ( 3 ,4 and 5 inch)

So we will have the following testing combinations.

- Each handset should be tested with every plan type, term and size.
- Each plan type should be tested with every Handset, term and size.
- Each size should be tested with every handset , plan type and term

So now you must be thinking that means we have 81 combinations, but we can test all these conditions with only 9 test cases. Below is the orthogonal array for the same.

<b>L<sub>9</sub>( 3<sup>4</sup>)</b>				
<b>Test Case</b>	<b>Handset</b>	<b>Plan Type</b>	<b>Term</b>	<b>Size</b>
1	Nokia	4 x 400	Long Term	3 inch
2	Nokia	4 x 300	Mid Term	4 inch
3	Nokia	2 x 270	Short Term	5 inch
4	3G	4 x 400	Mid Term	5 inch
5	3G	4 x 300	Short Term	3 inch
6	3G	2 x 270	Long Term	4 inch
7	Orange	4 x 400	Short Term	4 inch
8	Orange	4 x 300	Long Term	5 inch
9	Orange	2 x 270	Mid Term	3 inch

**L<sub>9</sub>( 3<sup>4</sup>)**

- 9 indicates it has 9 rows
- 4 indicates it has 4 columns
- 3 indicates each cell in the array contains 1, 2 or 3

**Figure: - Orthogonal array in actual testing**

Orthogonal array is very useful because most defects are pair wise defects and with orthogonal array we can reduce redundancy to a huge extent.

### **(I) Can you explain the concept of decision tables?**

As the name suggests they are tables that list all possible inputs and all possible outputs. A general form of decision table is as follows shown in the below figure. Condition1 through Condition N indicate various input conditions. Action1 through Condition N are actions that should be taken depending on various input combinations. Each rule defines unique combinations of conditions that results in actions associated with that rule.

	<b>Rule 1</b>	<b>Rule 2</b>	<b>Rule 3</b>
<b>Condition</b>			
Condition 1			
Condition 2			
⋮			
Condition n			
<b>Action</b>			
Action 1			
Action 1			
⋮			
Action n			

**Figure: - General decision tables**

Below is a sample decision table for discount which depends in age. Discounts are only allowed if you are married or a student. Below is the decision table accordingly. Using

the decision table we have also derived our test cases from the decision table. Because this is a sample example we can not get the importance of decision table. But just imagine when you have huge possible inputs and outputs. For such kind of scenario decision tables gives you a better view.

TC	Condition	Expected Result
TC 1	If married	get a discount
TC 2	If student	get a discount
TC 3	If not married	no discount
TC 4	If not student	no discount

**Figure: - Discount Decision table**

So below is the decision table for the scenarios described above. In the top part we have put the condition and the below part are the actions because of the result of the conditions. So read from the right and move to the left and then to the action. For instance Married → Yes → then discount. In the same way for student condition. Using decision table we can ensure to a good extent that we do not skip any validation in a project.

Condition	Rule 1	Rule 2
Married	Yes	No
Student	Yes	No
Action		
Discount	Yes	No

**Figure: - Test cases from the above decision tables**

### **(B) How did you define severity ratings in your project?**

Note :- Severity rating changes from organization to organization and project to project. But most of the organization have four kind of severity as shown below. We will try to answer this question from the below given four severity perspective.

There are four types of severity ratings as shown in the below table:-

- Severity 1 (Show stoppers):- Severity of these kinds of defects do not allow application to move ahead. So they are also called as Show stopper defects.
- Severity 2 (Application continues with severe defects):- Application continues working for these types of defects. But they can have high implications in later time of application which can be more difficult to remove.
- Severity 3 (Application with unexpected results):- In this scenario the application continues but shows unexpected results.

- Severity 4 (Suggestions):- Defects with these severities are suggestions given by customer to make the application better. These kind of defect have the least priority and are taken at the end of the project or during maintenance stage of the project.

Rating Severity	Description
1	Show Stoppers.
2	Application continues with severe defect.
3	Application continues with unexpected results.
4	Suggestions.

→ Changes from Organisation to organisation.  
→ Changes from Projects to Projects.

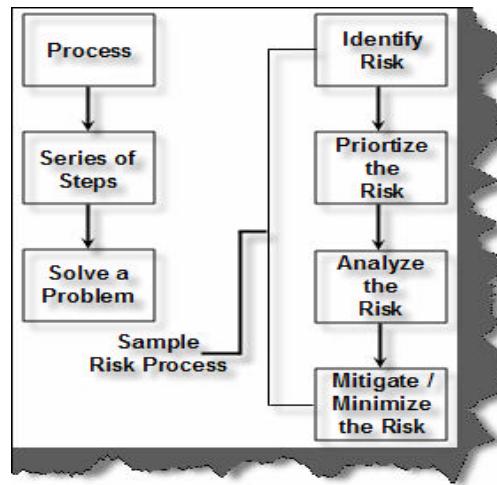
**Figure: - Severity rating in projects**

## Software process

### (B) What is a Software process?

A process is a series of step to solve a problem. Below figure shows a pictorial view of how an organization has defined a way to solve any risk problem. In the below diagram we have shown two branches one is what exactly is a process and the second branch shows a sample risk mitigation process for an organization. For instance the below risk mitigation process defines what step any department should follow to mitigate a risk.

- Identify the risk of the project by discussion, proper requirement gathering and forecasting.
- Once you have identified the risk prioritize which risk has the most impact and should be tackled on priority basis.
- Analyze how the risk can be solved by proper impact analysis and planning.
- Finally using the above analysis we mitigate the risk.

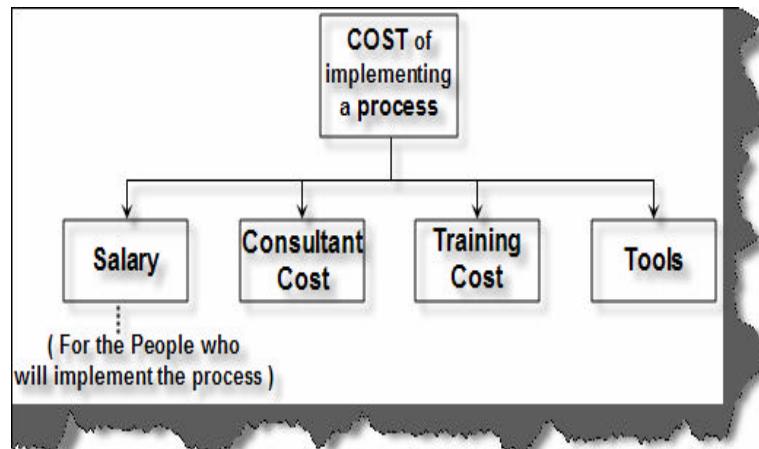


**Figure: - Software Process**

### **(I) what are the different cost element involved in implementing process in an organization?**

Below is some of the cost elements involved in implementing process:-

- Salary: - This forms the major component of implementing any process salary of the employees. Normally while implementing process in a company either organization can recruit full time guys or they can share a resource part time on implementing the process.
- Consultant: - If the process is new it can also involve in taking consultants which is again an added cost.
- Training Cost: - Employee of the company also have to undergo training in order to implement the new process.
- Tools: - In order to implement process organization will also need to buy tools which again need to be budgeted.

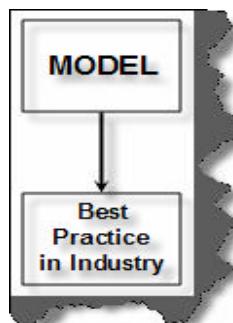


**Figure: - Cost of implementing process**

**Note:** - Implementing a process is not an easy job in any organization.  
More than financial commitment it requires commitment from people to follow the process.

### **(B) What is a model?**

Model is nothing but best practices followed in an industry to solve issues and problems. Models are not made in a day but are finalized and realized by years of experience and continuous improvements.

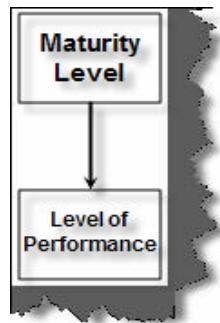


**Figure: - Model**

Many companies reinvent the wheel rather than following already time tested models in industry.

### **(B) What is maturity level?**

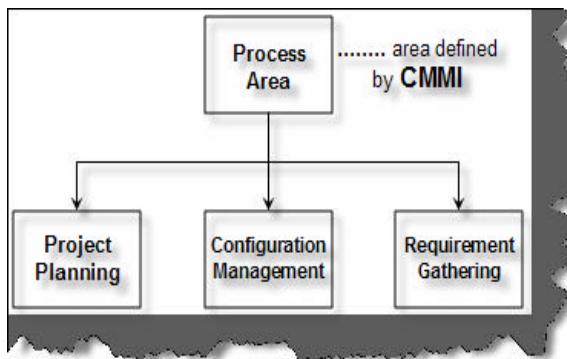
Maturity level specifies the level of performance expected from the organization.



**Figure: - Maturity level**

### **(B) Can you explain the concept of process area in CMMI?**

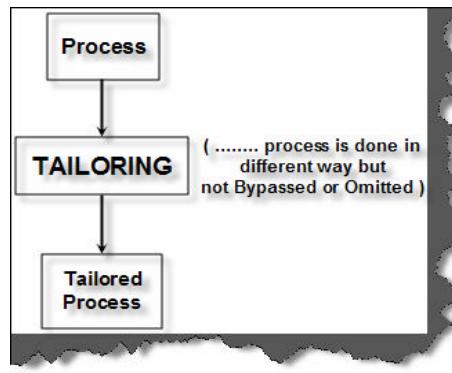
Process area is the area of improvement defined by CMMI. Every maturity level consists of Process Areas. Process Area is a group of practice or activities performed collectively to achieve specific objective. For instance you can look in to below figure we have process areas like Project Planning, Configuration Management and Requirement gathering.



**Figure: - Process Area in action**

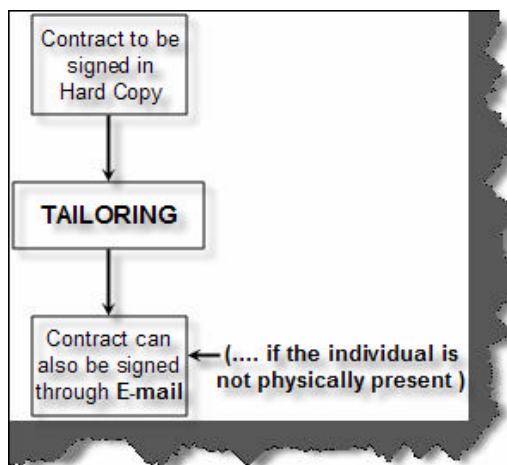
### **(B) Can you explain the concept of tailoring?**

As the name specifies tailoring is nothing but changing the action to achieve objective according to conditions. Whenever tailoring is done there should be adequate reasons for why tailoring is done for that process. Remember when a process is defined in an organization it should be followed properly. So even if tailoring is applied the process is not bypassed or omitted.



**Figure: - Tailoring**

Let's try to understand this by a simple example. Let's say in a organization there is process defined that every contract should have a hard copy signed. But there can be scenarios in the organization when the person is not present physically, so for those scenarios the contract should be signed through email. So in short the process for signing a contract is not bypassed only the process approach is tailored.



**Figure: - Example of tailoring**

## CMMI

### (B) What is CMMI and what's the advantage of implementing CMMI in an organization?

Note: - One of my seniors gave a very decent answer to what is CMMI in his own words. Here it goes how he explained me in his own words. There are two aspects of CMMI one is the capability and other is the maturity. He said it's possible that you are capable of drinking 10 bottles of wine, but after drinking 10 bottles of wine you fall sick. But it's your maturity that you can drink 10 bottle of wine, eat well and do not fall sick. I think this was the best answer I ever got about

capability and maturity. Same applies for organization its your capability that you can complete a project with out quality , but its your maturity that you can complete project with proper quality implementation. By the way my favorite is VODKA fuel with mirinda and two ice ☺ You know what guys I am matured enough so I eat a lot after drinking.

CMMI stands for Capability Maturity Model Integration. It is a process improvement approach that provides companies with the essential elements of effective process. CMMI can serve as a good guide for process improvement across a project, organization or division.

CMMI was formed by using multiple previous CMM process. Below are the areas which CMMI addresses because of integrating with CMM process:-

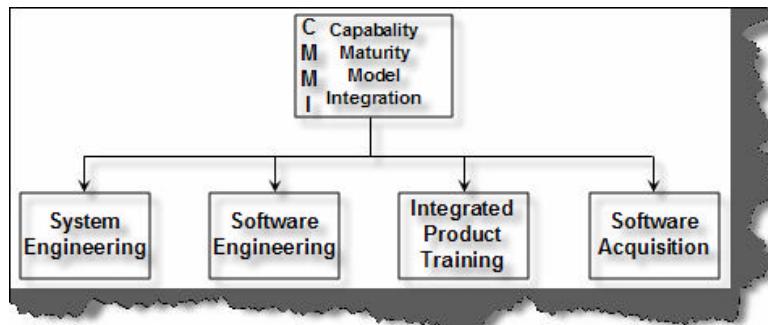
Systems engineering: - This covers development of total systems. System engineers concentrate on converting customer needs to product solution and support them through out the product life cycle.

Software Engineering: - Software engineers concentrate on the application of systematic, disciplined, and quantifiable approaches to the development, operation, and maintenance of software.

Integrated Product and Process Development:- Integrated Product and Process Development (IPPD) is a systematic approach that achieves a timely collaboration of relevant stakeholders throughout the life of the product to better satisfy customer needs, expectations, and requirements. This section mostly concentrates on the integration part of the project for different processes. For instance it's possible that your project is using services of some other third party component. In such situation the integration is a big task itself and if approached in a systematic manner can be handled with ease.

Software Acquisition: - Many times organization has to acquire products of other organization. Acquisition is itself a big step for any organization and if not handled in a proper manner means just calling for disaster.

Below is what CMMI call about.



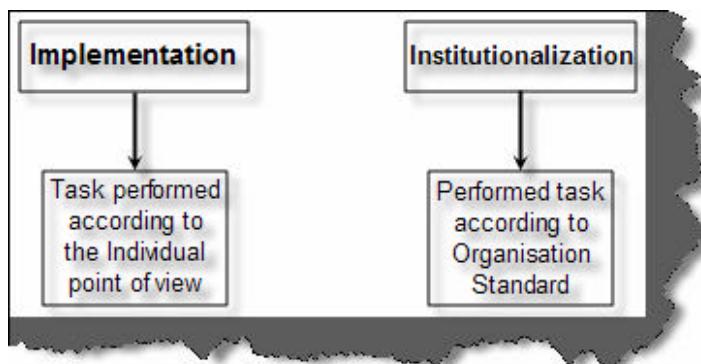
**Figure: - CMMI**

### **(I) what's the difference between implementation and Institutionalization?**

Both of these concepts are important while implementing process in any organization. Any new process implemented has to go through these two phases.

Implementation: - It is just performing task within a process area (for definition of process area look in to the same chapter). Task is performed according to a process but actions performed to complete the process are not ingrained in the organization. That means the process involved is according to individual point of view. When an organization starts to implement any process it first starts at this phase i.e. Implementation and then when this process sounds good it is raised to the organization level so that it can be implemented across organizations.

Institutionalization: - Institutionalization is the output of implementing the process again and again. The difference between implementation and institutionalization is in the implementation the person who implemented the process goes the process is not followed, but if the process is institutionalized then even if the person leaves the organization, the process is still followed.

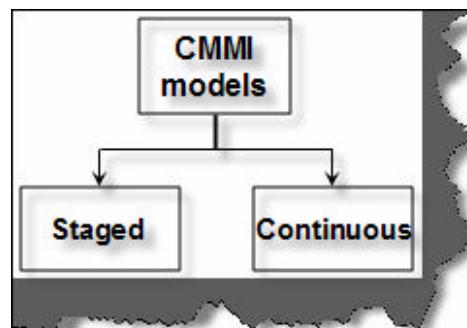


**Figure: - Implementation and Institutionalization**

## **(I) what are different models in CMMI?**

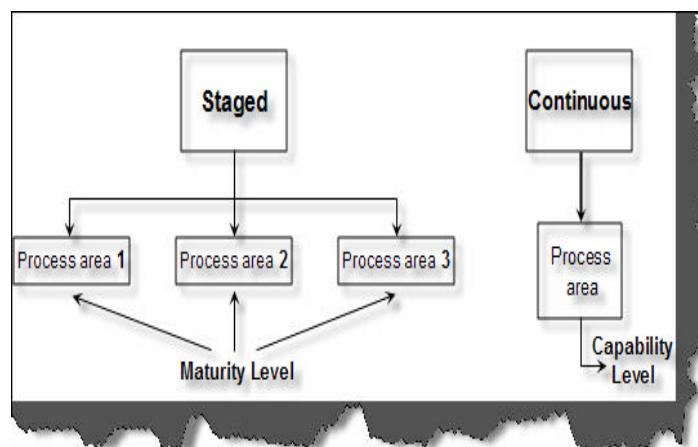
### **(I) Can you explain staged and continuous models in CMMI?**

There are two aspects in CMMI one is the capability and other is the maturity. Capability means the ability to perform task while maturity means to perform task in a matured fashion. Both the CMMI models lie in of the above category. There are two models in CMMI first is “staged” in which maturity level organizes the process areas, second is “continuous” in which the capability level organize the process area.



**Figure: - CMMI models**

Below figure shows how process areas are grouped in both models.



**Figure: - Staged and continuous models**

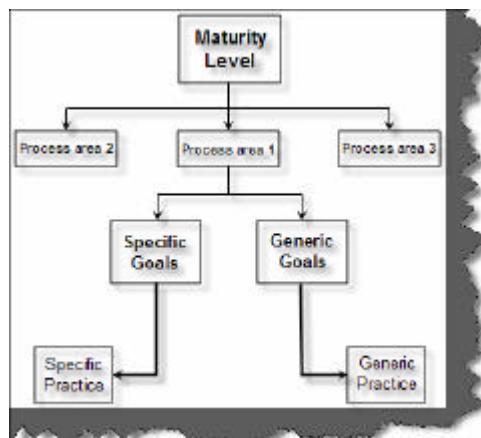
Let's try to understand both the models in a more detail manner. Before we move ahead deeper in differences of the two models lets understand the basic structure of CMMI process, goal and practices. A process area as said previously is a group of practices or activities performed to achieve specific objective. Every process area has specific as well as generic goal that should be satisfied to achieve that objective. To achieve those goals

we need to follow certain practices. So again to achieve those specific goals we have specific practices and to achieve generic goals we have generic practices.

In one of our previous questions we talked about implementation and Institutionalization. Implementation can be related to specific practice while Institutionalization can be related to generic practices. So this is what the common basic structure in both models

Process area → Specific / Generic goals → Specific / Generic practice.

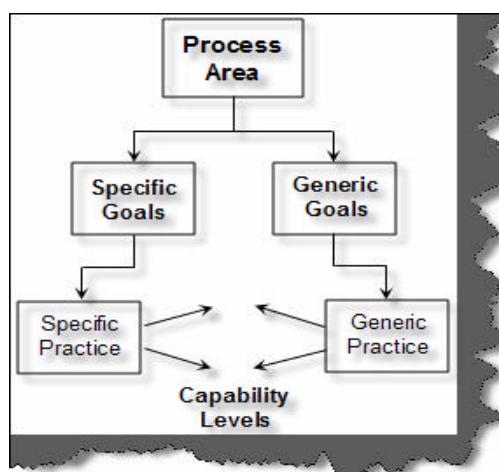
Now let's try to understand model structures with both types of representations. In staged representation we revolve around maturity level as shown in figure below. So all process have to be at one maturity level.



**Figure: - Staged representation**

While in continuous representation we try to achieve capability levels in those practices. Below diagram shows how continuous representation revolves around capability.

Continuous representation is used when the organization wants to mature and perform in one specific process area only. Let's say for instance in a non-it organization one wants to only improve its supplier agreement process. So that particular organization will only concentrate on SAM and try to achieve good capability level in that process area.



**Figure: - Continuous representation**

## **(I) Can you explain the different maturity levels in staged representation?**

There are five maturity levels in staged representation as shown in figure below.

Maturity Level 1(Initial):- In this level everything is adhoc. Development is completely chaotic with budget and schedules often exceeded. In this scenario we can never predict quality and the project are run by heroes'. If the heroes go off the whole project goes for a toss.

Maturity Level 2 (Managed):- In managed level basic project management are in place. But the basic project management and practices are followed only in the project level.

Maturity Level 3 (Defined):- To reach this level the organization should have achieved first level 2. In the previous level the good practice and process was only done at project level. But in this level all these good practice and process is brought at the organization level. There are set and standard practice defined at the organization level which every project should follow. Maturity Level 3 moves ahead with defining a strong, meaningful, organization view approach to developing products. An important distinction between Maturity Levels 2 and 3 is that at Level 3, processes are described in more detail and more rigorously than at Level 2 and are at organization level.

Maturity Level 4 (Quantitatively measured):- To start with this level organization should have achieved Level 2 and Level3. In this level more of statistics comes in to picture. Organization controls its project by statistical and other quantitative techniques. Product quality, process performance, and service quality are understood in statistical terms and are managed throughout the life of the processes. Maturity Level 4 concentrates on using metrics to make decisions and to truly measure whether progress is happening and the product is becoming better. The main difference between Levels 3 and 4 are that at Level 3, processes are qualitatively predictable. At Level 4, processes are quantitatively predictable. Level 4 addresses causes of process variation and takes corrective action.

Maturity Level 5 (Optimized):- The organization has achieved goals of Maturity Levels 2, 3, and 4. In this level Processes are continually improved, based on an understanding of common causes of variation within the processes. This is like the final level everyone in the team is a productive member, defects are minimized, and products are delivered on time and within the budget boundary.

Below figure shows in detail all the maturity levels in a pictorial fashion.

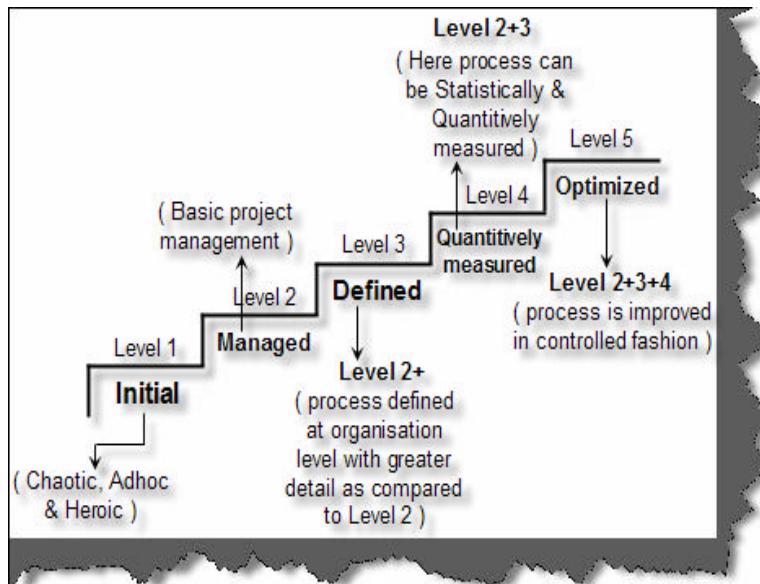


Figure: - Maturity level in staged model

### (I) Can you explain capability levels in continuous representation?

Continuous model is same as staged model only that the arrangement is bit different. Continuous representation/ model concentrate on the action or task to be completed within a process area. It focuses on maturing the organization ability to perform, control and improve the performance in that specific performance area.

#### Capability Level 0: Incomplete

This level means that any generic or specific practice of Capability level 1 is not performed.

#### Capability Level 1: Performed

Capability level 1 process is expected to perform all capability level 1 specific and generic practices for that process area. In this level performance may not be stable and probably does not meet objectives like quality, cost and schedule , but yes still the task can be done. It's a first step, it's like you are doing the process but you can not really prove it if it's the most effective.

#### Capability Level 2: Managed

A managed process planned properly, performed, monitored, and controlled to achieve a given purpose. Because the process is managed we achieve other objectives, such as cost, schedule, and quality. Because you are managing some metrics are consistently collected and applied to your management approach.

#### Capability Level 3: Defined

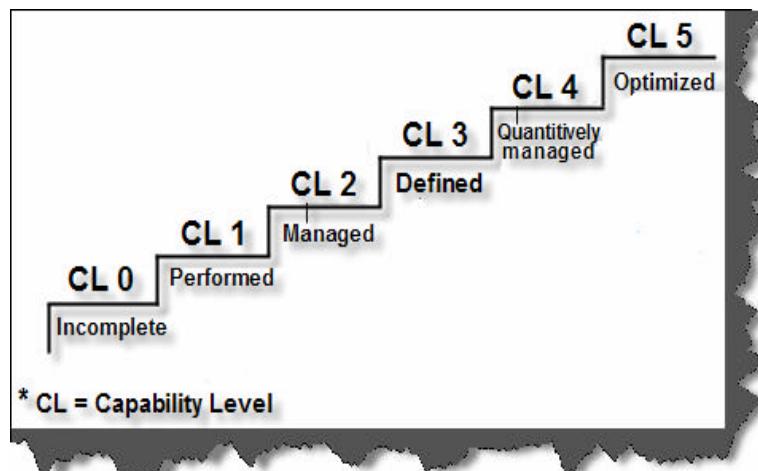
Defined process is a managed process that is tailored from organization standard. Tailoring is done by justification and documentation guidelines. So for instance your organization has a standard that we should take invoice from every supplier. But for any instance if the supplier is not able to supply the invoice then he should sign an agreement and give in place of the invoice. So here the invoice standard is not followed but the deviation is under control.

#### **Capability Level 4: Quantitatively Managed**

Quantitatively Managed process is a defined process which is controlled through statistical and quantitative information. So right from defect tracking, to project schedules are all statistically tracked and measured for that process.

#### **Capability Level 5: Optimizing**

Optimizing process is a quantitatively managed process where we increase process performance through incremental and innovative improvements.



**Figure: - Capability levels in continuous model**

If you really see continuous representation is same as the staged only that information is arranged in a different fashion. The biggest difference is one concentrates on a specific process while the other brings a groups of process to a certain mature levels.

#### **(I) which model should we use and under what scenarios?**

Staging defines an organization process implementation sequence. So staging is a sequence of targeted process areas that describe a path of process improvement the organization will take. For instance you can not do your project planning (Level 2) if you have not done requirements management (Level 2). While in continuous you select certain process area irrespective even if it's linked with other process area and mature in that.

So when you want that your organization should only concentrate on specific process areas you will like to go for continuous model. But if you want that you want to that your organization should have a specific plan and should not only achieve in the specific process but also any interlinked process with that process area you should go for staged.

### **(A) How many process areas are present in CMMI and in what classification do they fall in?**

All 25 process areas in CMMI are classified inside four major sections. Process management

This process areas contain the across project tasks related to defining, planning, executing, implementing, monitoring, controlling, measuring, and making better processes.

#### **Project management**

Project Management process areas cover the project management activities related to planning, monitoring, and controlling the project.

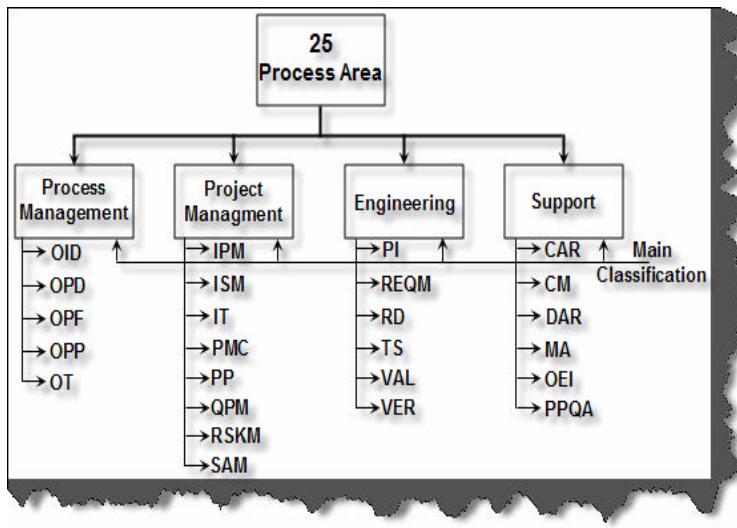
#### **Engineering**

The Engineering process areas were written using general engineering terminology so that any technical discipline involved in the product development process (e.g., software engineering or mechanical engineering) can use them for process improvement.

#### **Support**

The Support process areas address processes that are used in the context of performing other processes. In general, the Support process areas address processes that are targeted toward the project and may address processes that apply more generally to the organization. For example, Process and Product Quality Assurance can be used with all the process areas to provide an objective evaluation of the processes and work products described in all the process areas.

Below is the diagrammatic classification and representation of the process areas.



**Figure: - 25 Process Area**

Below table defines all the abbreviation of the process areas.

Abbreviation for 25 Process area : -	
<b>Process Management</b>	<b>Engineering</b>
OID Organisational Innovation & Deployment	PI Product Integration
OPD Organisational Process Definition	REQM Requirements Management
OPF Organisational Process Focus	RD Requirements Development
OPP Organisational Process Performance	TS Technical Solution
OT Organisational Training	VAL Validation
	VER Verification
<b>Project Management</b>	
IPM Integrated Project Management	<b>Support</b>
ISM Integrated Supplier Management	CAR Casual Analysis & Resolution
IT Integrated Teaming	CM Configuration Management
PMC Project Monitoring & Control	DAR Decision Analysis & Resolution
PP Project Planning	MA Measurement & Analysis
QPM Quantitative Project Management	OEI Organisational Environment for Integration
RSKM Risk Management	PPQA Process & Product Quality Assurance
SAM Supplier Management Agreement	

**Figure: - Abbreviation of all process areas**

## (B) What the difference between every level in CMMI?

Level 1 and Level 2:-

This is the biggest steps for any organization. Because the organization moves from a immature position to a more mature organization. Leve11 is adhoc process in which people have created personal process to accomplish certain task. With this approach there is lot of redundant work and people do not share their information also. This leads to

heroes' in the project, so when people out of the organization the knowledge also moves out and organization suffers.

In maturity level 2 individual share their lesson and best practices, which leads to devising preliminary process at project and in some cases it also moves to organization level. In level 2 we focus on project management issues that affect day to day routine. It has seven process areas as shown in figure below.

So in short difference between level 1 and level 2 is of immature and mature organization.

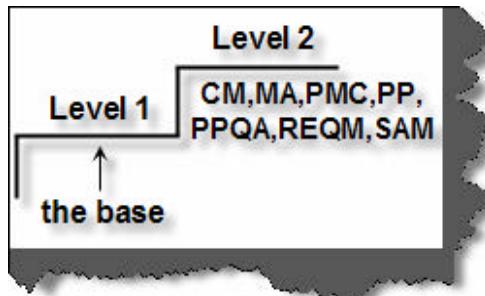


Figure: - From level 1 to Level 2

Level 2 to Level 3:-

Now that in Level 2 good practices are practiced at project level it is time to move these good practices to organization level so that every one is benefited from the same. So the biggest difference between Level 2 and Level 3 is good practices from the projects are bubbled up to organization level. Organization approach of doing business is documented. To perform Maturity level 3 first Maturity 2 should be achieved with the 14 process as shown in the given figure.

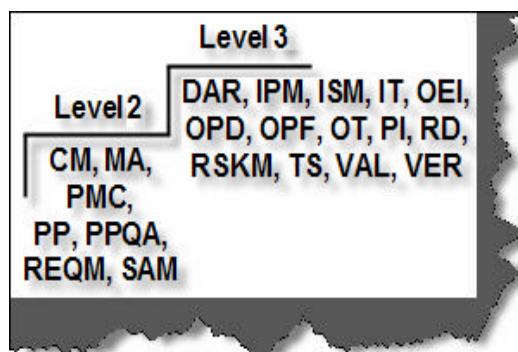
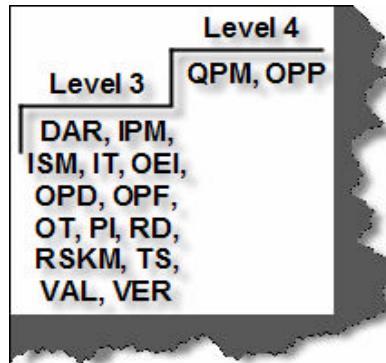


Figure: - Level 2 to Level 3

Level 3 to Level 4:-

Maturity level 4 is all about numbers and statistics. All aspects of the project are managed by numbers. All decisions are made by numbers. Product quality and process are measured by numbers. So in Level 3 we if we say this is good in quality, in Level 4 we

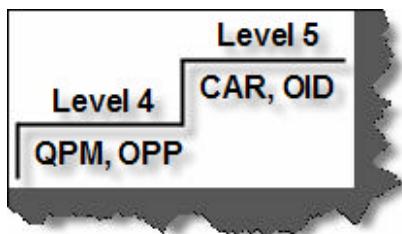
say this is good in quality because the defect ratio is less than 1 %. So there two process areas in Level 4 as shown below. In order to Level 4 you should have achieved all the PA's of Level 3 and also the below two process areas.



**Figure: - Level 3 to Level 4**

Level 4 to Level 5:-

Level 5 is all about improvement as compared to Level 4. Level 5 concentrates on improving quality of organization process by identifying variation, by looking at root causes of the conditions and incorporating improvements for improve process. Below are the two process areas in Level 5 as shown in figure below. In order to get level 5 all level 4 PA's should be satisfied. So the basic difference between level 4 and level 5 is in Level 4 we have already achieved a good level of quality, and in level 5 we are trying to improve the quality.



**Figure: - Level 4 to Level 5**

#### **(I) what different sources are needed to verify authenticity for CMMI implementation ?**

There are three different sources from which an appraiser can verify that did the organization follow process or not.

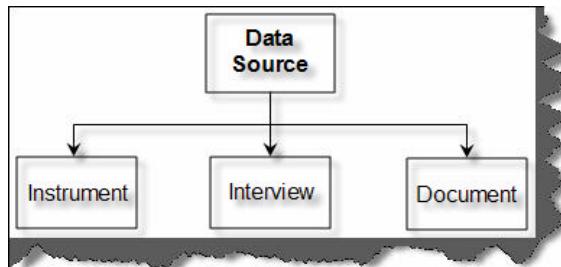
**Instruments:** - It is a survey or questionnaire provided to the organization, project or individuals before starting the assessment. So that before hand appraiser knows some basic details of the project.

**Interview:** - It's a formal meeting between one or more members of the organization in which they are asked some questions and the appraiser makes some judgments based on

those interviews. During the interview the member represents some process areas or role which he performs in context of those process areas. For instance the appraiser may interview a tester or programmer asking him indirectly what metrics he has submitted to his project manager. By this the appraiser gets a fair idea of CMMI implementation in that organization.

Documents: - It's a written work or product which serves as an evidence that a process is followed. It can be hard copy, word document, email or any type of written official proof.

Below is the pictorial view of sources to verify how much compliant the organization is with CMMI.

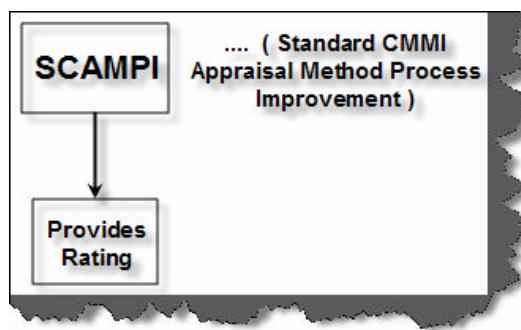


**Figure: - Different data source for verification**

### **(I) Can you explain SCAMPI process?**

### **(I) How is appraisal done in CMMI?**

SCAMPI stands for Standard CMMI Appraisal Method for Process Improvement. SCAMPI is an assessment process to get be CMMI certified for a organization. There are three classes of CMMI appraisal methods class A, class B and class C. Class A is the most aggressive, while Class B is less aggressive and Class C is the least aggressive.



**Figure: - SCAMPI**

Let's discuss all these appraisal methods in more detail.

Class A: - This is the only method that can provide rating and get you a CMMI certificate. It requires all three sources of data instruments, interview and documents.

Class B: - This requires only two sources of data (interviews and either documents or instruments). But please note you do not get rated with Class B appraisals. Class B is just a warm up that if the organization is ready for Class A. With less verification the appraisal takes less time. In this data sufficiency and draft presentation are optional.

Class C: - It requires only one source of data (interview, instruments or documents). Team consensus, validation; observation, data sufficiency, and draft presentation are optional.

Below table shows the characteristic features with proper comparison.

<b>Characteristic</b>	<b>Class A</b>	<b>Class B</b>	<b>Class C</b>
Amount of objective evidence gathered (relative)	High	Medium	Low
Rating generated	Yes	No	No
Resource needs ( relative )	High	Medium	Low
Team size ( relative )	Large	Medium	Small
Data sources ( instruments, interview, & documents )	Requires all 3 Data sources	Requires 2 Data sources one must be Interview	Requires only 1 Data sources
Appraisal Team Leader requirement	Authorized Lead Appraiser	Authorized Lead Appraiser or person trained & experienced	Person trained & experienced

\* **Source:** adapted from Appraisal Requirement for CMMI Version 1.1

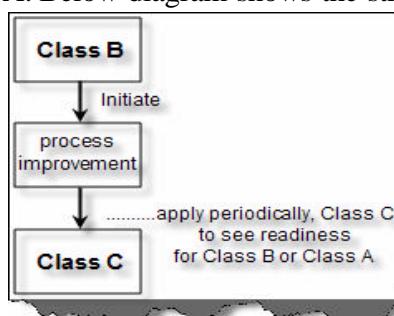
**Figure: - Comparison between Class A, B and C**

### **(I) which appraisal method class is the best?**

Normally organizations use mix breed of the classes to achieve process improvement. Below are some of the strategies which organization use:-

#### **First Strategy**

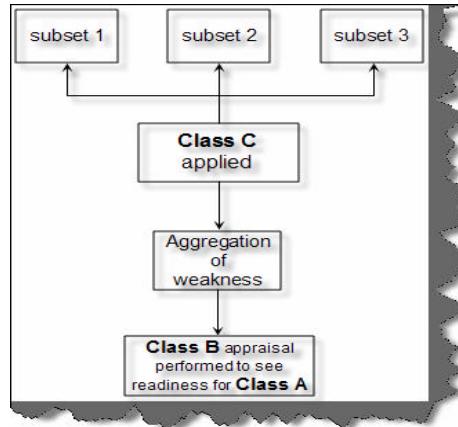
Use class B to initiate process improvement plan. After that apply Class C to see readiness for Class B or Class A. Below diagram shows the strategy.



**Figure: - Strategy one**

#### **Second strategy**

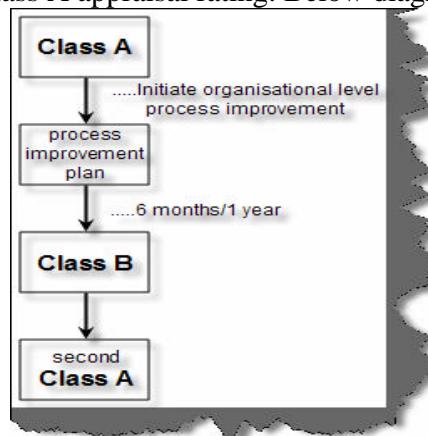
Class C appraisal is used on subset of organization. From this we get aggregation of weakness across organization. From this we can prepare process improvement plan. We can then apply Class B appraisal to see that are we ready for Class A appraisal. Below diagram shows the strategy.



**Figure: - Second strategy**

### **Third Strategy**

Class A is used to initiate organization level process. The process improvement plan is based on identified weakness. Class B appraisal should be performed after six months to see the readiness for second class A appraisal rating. Below diagram shows the strategy.



**Figure: - Third Strategy**

### **(I) Can you explain the importance of PII in SCAMPI?**

Using PII i.e. Practice implementation indicators we take information about the organization. PII gives us a compliance matrix showing how practices are performed in organization. PII basically consists of three types of information direct work product, indirect work product and affirmations. Direct work product and indirect work product

come from document while affirmations come from interviews. The below table shows a sample PIID information for process SAM and for one of the key process areas.

SG 1:- Establish Supplier Agreement			
PII Type	Direct work products	Indirect work products	Affirmation
Organisation Evidence	signed supplier agreement copy found	supplier agreement document was used to pass invoices	supplier has to sign supplier agreement
Notes	supplier agreement found	invoices passed with supplier agreement	

**Figure: - Sample PIID**

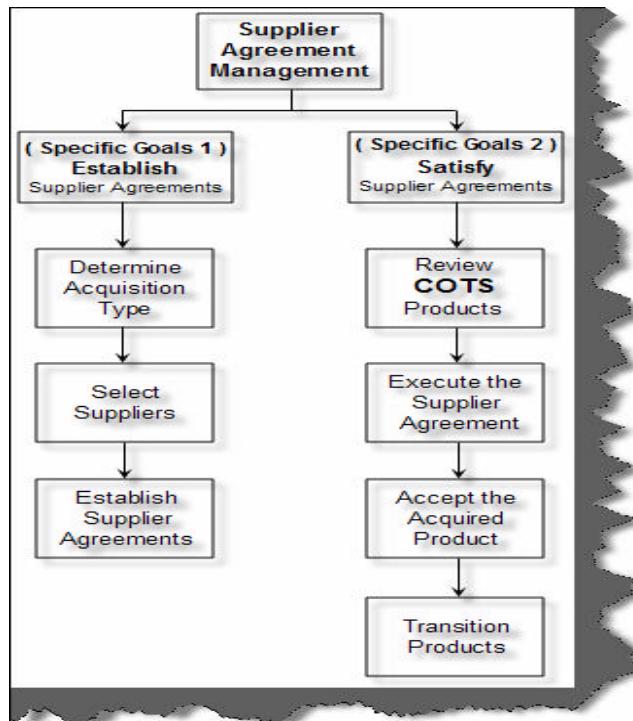
Once the PIID are filled we can rate saying is the organization compliant or not. So below are the steps to be followed during the SCAMPI:-

- Gather documentation.
- Conduct interviews.
- Discover and document strengths and weaknesses.
- Communicate / present findings.

#### **(A) Can you explain implementation of CMMI in one of the Key process areas?**

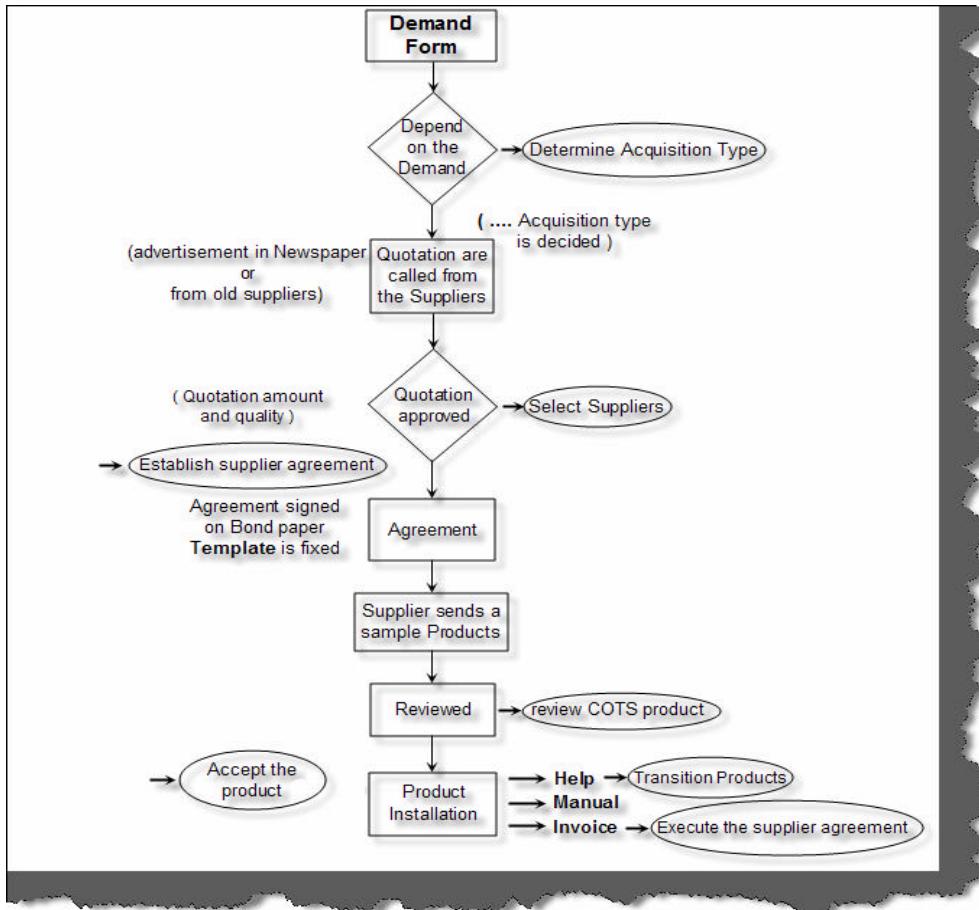
Note: - This question will be asked to judge whether you have actually implemented CMMI in a proper fashion in your organization or not. For answering this question we will be using SAM as the process area. But you can answer with whatever process area you have implemented in your organization.

For SAM below are the two SG1 and SG2 practice which needs to be implemented to satisfy the process area. SAM helps us to define our agreement with Supplier while procuring products in the company. Let's see in the next step how we have mapped our existing process with SAM practices defined in CMMI.



**Figure: - SAM process area**

In order to specify SAM below is a process adopted by the company. If any body wants to demand any product he has to first raise demand for the item by using the demand form which is defined by the company. Depending on demand the supervisor defines which acquisition type is this demand. For instance is it a production acquisition type, office material acquisition type or others. Once the acquisition type is decided the organization places an advertisement in the news paper to ask suppliers for quotation. Once all quotations are received depending on cost, quality and other factors final supplier is decided. Supplier is then called to the office and he has to sign an agreement with the organization for the delivery of the product. Once the agreement is signed supplier sends a sample product which is analyzed by the organization practically. Finally the product is accepted and supplier is then asked to send the complete delivery of all products. The product is accepted in the organization by issuing the supplier a proper invoice. The invoice document says that the product is accepted by the organization officially. When the product is installed in the organization then either someone from the supplier side comes for the demo or a help brochure is shipped with the product.



**Figure: - SAM process area mapped with actual world**

Ok now the above explanation was from the perspective of the how the organization managed its transaction with the suppliers. Now let's try to map how the above process fits in CMMI model. In the above diagram all the circled description is nothing but process areas of CMMI.

CMMI process	Organization process
Determine Acquisition type	In the above process Demand form decides what the Acquisition type of the product is.
Select suppliers	Looking at the quotation the supplier is review and the selection is done.
Establish Supplier agreements	In the above process we have a step when we sign agreement with the supplier which establishes all the terms and conditions for the supplier agreement.
Review Product	One of the step of the process is that supplier has to send a sample which is reviewed by the organization.
Execute Supplier agreements	Supplier agreement is executed by accepting invoice.
Accept Acquired product	Invoice is the proof for acceptance of the product.

Transition products	In the above process the transition of the product either happens through help brochures or when the demo person visits he gives a KT.
---------------------	----------------------------------------------------------------------------------------------------------------------------------------

## (B) Explanation of all process areas with goals and practices?

### (A) Can you explain the process areas?

**Note:** - No one is going to ask such a question. But they would like to know at least the purpose of each KPA. Second they would like to know what you did to attain compatibility to these process areas. For instance you say that you did Organizational Process Definition. They would like to know how you did it. For instance you can justify it by saying that you made standard documents for coding standards which was then followed at the organization level for reference. Normally everyone follows process it's only that they do not know. So try to map the KPA to the process what you follow. The only purpose to paste all the KPA is if in case you are looking for some higher positions in big companies they really expect you to speak in term of KPA rather than generic term. This whole stuff can be like a quick reference for you before entering the interview room.

Each process area is defined by a set of goals and practices. There are two categories of goals and practices: generic and specific. Generic goals and practices are a part of every process area. Specific goals and practices are specific to a given process area. A process area is satisfied when company processes cover all of the generic and specific goals and practices for that process area.

Generic goals and practices

Generic goals and practices are a part of every process area.

GG 1 Achieve Specific Goals

GP 1.1 Perform Base Practices

GG 2 Institutionalize a Managed Process

GP 2.1 Establish an Organizational Policy

GP 2.2 Plan the Process

GP 2.3 Provide Resources

GP 2.4 Assign Responsibility

GP 2.5 Train People

GP 2.6 Manage Configurations

GP 2.7 Identify and Involve Relevant Stakeholders

GP 2.8 Monitor and Control the Process

GP 2.9 Objectively Evaluate Adherence

GP 2.10 Review Status with Higher Level Management  
GG 3 Institutionalize a Defined Process  
GP 3.1 Establish a Defined Process  
GP 3.2 Collect Improvement Information  
GG 4 Institutionalize a Quantitatively Managed Process  
GP 4.1 Establish Quantitative Objectives for the Process  
GP 4.2 Stabilize Sub process Performance  
GG 5 Institutionalize an Optimizing Process  
GP 5.1 Ensure Continuous Process Improvement  
GP 5.2 Correct Root Causes of Problems

## Process areas

The CMMI contains 25 key process areas indicating the aspects of product development that are to be covered by company processes.

### **Causal Analysis and Resolution (CAR)**

A Support process area at Maturity Level 5

#### Purpose

The purpose of Causal Analysis and Resolution (CAR) is to identify causes of defects and other problems and take action to prevent them from occurring in the future.

#### Specific Practices by Goal

SG 1 Determine Causes of Defects  
SP 1.1-1 Select Defect Data for Analysis  
SP 1.2-1 Analyze Causes  
SG 2 Address Causes of Defects  
SP 2.1-1 Implement the Action Proposals  
SP 2.2-1 Evaluate the Effect of Changes  
SP 2.3-1 Record Data

### **Configuration Management (CM)**

A Support process area at Maturity Level 2

#### Purpose

The purpose of Configuration Management (CM) is to establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.

#### Specific Practices by Goal

SG 1 Establish Baselines  
SP 1.1-1 Identify Configuration Items  
SP 1.2-1 Establish a Configuration Management System  
SP 1.3-1 Create or Release Baselines  
SG 2 Track and Control Changes  
SP 2.1-1 Track Change Requests  
SP 2.2-1 Control Configuration Items  
SG 3 Establish Integrity  
SP 3.1-1 Establish Configuration Management Records  
SP 3.2-1 Perform Configuration Audits

### **Decision Analysis and Resolution (DAR)**

A Support process area at Maturity Level 3

#### Purpose

The purpose of Decision Analysis and Resolution (DAR) is to analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

#### Specific Practices by Goal

SG 1 Evaluate Alternatives  
SP 1.1-1 Establish Guidelines for Decision Analysis  
SP 1.2-1 Establish Evaluation Criteria  
SP 1.3-1 Identify Alternative Solutions  
SP 1.4-1 Select Evaluation Methods  
SP 1.5-1 Evaluate Alternatives  
SP 1.6-1 Select Solutions

### **Integrated Project Management (IPM)**

A Project Management process area at Maturity Level 3

#### Purpose

The purpose of Integrated Project Management (IPM) is to establish and manage the project and the involvement of the relevant stakeholders according to an integrated and defined process that is tailored from the organization's set of standard processes.

#### Specific Practices by Goal

SG 1 Use the Project's Defined Process  
SP 1.1-1 Establish the Project's Defined Process  
SP 1.2-1 Use Organizational Process Assets for Planning Project Activities

SP 1.3-1 Integrate Plans  
SP 1.4-1 Manage the Project Using the Integrated Plans  
SP 1.5-1 Contribute to the Organizational Process Assets  
SG 2 Coordinate and Collaborate with Relevant Stakeholders  
SP 2.1-1 Manage Stakeholder Involvement  
SP 2.2-1 Manage Dependencies  
SP 2.3-1 Resolve Coordination Issues  
SG 3 Use the Project's Shared Vision for IPPD  
SP 3.1-1 Define Project's Shared Vision for IPPD  
SP 3.2-1 Establish the Project's Shared Vision  
SG 4 Organize Integrated Teams for IPPD  
SP 4.1-1 Determine Integrated Team Structure for the Project  
SP 4.2-1 Develop a Preliminary Distribution of Requirements to Integrated Teams  
SP 4.3-1 Establish Integrated Teams

### **Integrated Supplier Management (ISM)**

A Project Management process area at Maturity Level 3

#### Purpose

The purpose of Integrated Supplier Management (ISM) is to proactively identify sources of products that may be used to satisfy the project's requirements and to manage selected suppliers while maintaining a cooperative project-supplier relationship.

#### Specific Practices by Goal

SG 1 Analyze and Select Sources of Products  
SP 1.1-1 Analyze Potential Sources of Products  
SP 1.2-1 Evaluate and Determine Sources of Products  
SG 2 Coordinate Work with Suppliers  
SP 2.1-1 Monitor Selected Supplier Processes  
SP 2.2-1 Evaluate Selected Supplier Work Products  
SP 2.3-1 Revise the Supplier Agreement or Relationship

### **Integrated Teaming (IT)**

A Project Management process area at Maturity Level 3

#### Purpose

The purpose of Integrated Teaming (IT) is to form and sustain an integrated team for the development of work products.

#### Specific Practices by Goal

SG 1 Establish Team Composition  
SP 1.1-1 Identify Team Tasks

SP 1.2-1 Identify Needed Knowledge and Skills  
SP 1.3-1 Assign Appropriate Team Members  
SG 2 Govern Team Operation  
SP 2.1-1 Establish a Shared Vision  
SP 2.2-1 Establish a Team Charter  
SP 2.3-1 Define Roles and Responsibilities  
SP 2.4-1 Establish Operating Procedures  
SP 2.5-1 Collaborate among Interfacing Teams

### **Measurement and Analysis (MA)**

A Support process area at Maturity Level 2

#### Purpose

The purpose of Measurement and Analysis (MA) is to develop and sustain a measurement capability that is used to support management information needs.

#### Specific Practices by Goal

SG 1 Align Measurement and Analysis Activities  
SP 1.1-1 Establish Measurement Objectives  
SP 1.2-1 Specify Measures SP 1.3-1 Specify Data Collection and Storage Procedures  
SP 1.4-1 Specify Analysis Procedures  
SG 2 Provide Measurement Results  
SP 2.1-1 Collect Measurement Data  
SP 2.2-1 Analyze Measurement Data  
SP 2.3-1 Store Data and Results  
SP 2.4-1 Communicate Results

### **Organizational Environment for Integration (OEI)**

A Support process area at Maturity Level 3

#### Purpose

The purpose of Organizational Environment for Integration (OEI) is to provide an Integrated Product and Process Development (IPPD) infrastructure and manage people for integration.

#### Specific Practices by Goal

SG 1 Provide IPPD Infrastructure  
SP 1.1-1 Establish the Organization's Shared Vision  
SP 1.2-1 Establish an Integrated Work Environment  
SP 1.3-1 Identify IPPD-Unique Skill Requirements  
SG 2 Manage People for Integration  
SP 2.1-1 Establish Leadership Mechanisms

SP 2.2-1 Establish Incentives for Integration  
SP 2.3-1 Establish Mechanisms to Balance Team and Home Organization Responsibilities

### **Organizational Innovation and Deployment (OID)**

A Process Management process area at Maturity Level 5

#### Purpose

The purpose of Organizational Innovation and Deployment (OID) is to select and deploy incremental and innovative improvements that measurably improve the organization's processes and technologies. The improvements support the organization's quality and process-performance objectives as derived from the organization's business objectives.

#### Specific Practices by Goal

SG 1 Select Improvements  
SP 1.1-1 Collect and Analyze Improvement Proposals  
SP 1.2-1 Identify and Analyze Innovations  
SP 1.3-1 Pilot Improvements  
SP 1.4-1 Select Improvements for Deployment  
SG 2 Deploy Improvements  
SP 2.1-1 Plan the Deployment areas  
SP 2.2-1 Manage the Deployment  
SP 2.3-1 Measure Improvement Effects

### **Organizational Process Definition (OPD)**

A Process Management process area at Maturity Level 3

#### Purpose

The purpose of Organizational Process Definition (OPD) is to establish and maintain a usable set of organizational process assets.

#### Specific Practices by Goal

SG 1 Establish Organizational Process Assets  
SP 1.1-1 Establish Standard Processes  
SP 1.2-1 Establish Life-Cycle Model Descriptions  
SP 1.3-1 Establish Tailoring Criteria and Guidelines  
SP 1.4-1 Establish the Organization's Measurement Repository  
SP 1.5-1 Establish the Organization's Process Asset Library

### **Organizational Process Focus (OPF)**

A Process Management process area at Maturity Level 3

### Purpose

The purpose of Organizational Process Focus (OPF) is to plan and implement organizational process improvement based on a thorough understanding of the current strengths and weaknesses of the organization's processes and process assets.

### Specific Practices by Goal

SG 1 Determine Process Improvement Opportunities

SP 1.1-1 Establish Organizational Process Needs

SP 1.2-1 Appraise the Organization's Processes

SP 1.3-1 Identify the Organization's Process Improvements

SG 2 Plan and Implement Process Improvement Activities

SP 2.1-1 Establish Process Action Plans

SP 2.2-1 Implement Process Action Plans

SP 2.3-1 Deploy Organizational Process Assets

SP 2.4-1 Incorporate Process-Related Experiences into the Organizational Process Assets

## **Organizational Process Performance (OPP)**

A Process Management process area at Maturity Level 4

### Purpose

The purpose of Organizational Process Performance (OPP) is to establish and maintain a quantitative understanding of the performance of the organization's set of standard processes in support of quality and process-performance objectives, and to provide the process performance data, baselines, and models to quantitatively manage the organization's projects.

### Specific Practices by Goal

SG 1 Establish Performance Baselines and Models

SP 1.1-1 Select Processes

SP 1.2-1 Establish Process Performance Measures

SP 1.3-1 Establish Quality and Process Performance Objectives

SP 1.4-1 Establish Process Performance Baselines

SP 1.5-1 Establish Process Performance Models

## **Organizational Training (OT)**

A Process Management process area at Maturity Level 3

### Purpose

The purpose of Organizational Training (OT) is to develop the skills and knowledge of people so that they can perform their roles effectively and efficiently.

### Specific Practices by Goal

SG 1 Establish an Organizational Training Capability

SP 1.1-1 Establish the Strategic Training Needs

SP 1.2-1 Determine Which Training Needs Are the Responsibility of the Organization  
SP 1.3-1 Establish an Organizational Training Tactical Plan  
SP 1.4-1 Establish Training Capability SG 2 Provide Necessary Training  
SP 2.1-1 Deliver Training  
SP 2.2-1 Establish Training Records  
SP 2.3-1 Assess Training Effectiveness

### **Product Integration (PI)**

An Engineering process area at Maturity Level 3

#### Purpose

The purpose of Product Integration (PI) is to assemble the product from the product components, ensure that the product, as integrated, functions properly and deliver the product.

#### Specific Practices by Goal

SG 1 Prepare for Product Integration  
SP 1.1-1 Determine Integration Sequence  
SP 1.2-1 Establish the Product Integration Environment  
SP 1.3-1 Establish Product Integration Procedures and Criteria  
SG 2 Ensure Interface Compatibility  
SP 2.1-1 Review Interface Descriptions for Completeness  
SP 2.2-1 Manage Interfaces  
SG 3 Assemble Product Components and Deliver the Product  
SP 3.1-1 Confirm Readiness of Product Components for Integration  
SP 3.2-1 Assemble Product Components  
SP 3.3-1 Evaluate Assembled Product Components  
SP 3.4-1 Package and Deliver the Product or Product Component

### **Project Monitoring and Control (PMC)**

A Project Management process area at Maturity Level 2

#### Purpose

The purpose of Project Monitoring and Control (PMC) is to provide an understanding of the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan.

#### Specific Practices by Goals

SG 1 Monitor Project against Plan  
SP 1.1-1 Monitor Project Planning Parameters  
SP 1.2-1 Monitor Commitments  
SP 1.3-1 Monitor Project Risks

SP 1.4-1 Monitor Data Management  
SP 1.5-1 Monitor Stakeholder Involvement  
SP 1.6-1 Conduct Progress Reviews  
SP 1.7-1 Conduct Milestone Reviews  
SG 2 Manage Corrective Action to Closure  
SP 2.1-1 Analyze Issues SP 2.2-1 Take Corrective Action  
SP 2.3-1 Manage Corrective Action

### **Project Planning (PP)**

A Project Management process area at Maturity Level 2

#### Purpose

The purpose of Project Planning (PP) is to establish and maintain plans that define project activities.

#### Specific Practices by Goal

SG 1 Establish Estimates  
SP 1.1-1 Estimate the Scope of the Project  
SP 1.2-1 Establish Estimates of Work Product and Task Attributes  
SP 1.3-1 Define Project Life Cycle  
SP 1.4-1 Determine Estimates of Effort and Cost  
SG 2 Develop a Project Plan  
SP 2.1-1 Establish the Budget and Schedule  
SP 2.2-1 Identify Project Risks  
SP 2.3-1 Plan for Data Management  
SP 2.4-1 Plan for Project Resources  
SP 2.5-1 Plan for Needed Knowledge and Skills  
SP 2.6-1 Plan Stakeholder Involvement  
SP 2.7-1 Establish the Project Plan  
SG 3 Obtain Commitment to the Plan  
SP 3.1-1 Review Plans that Affect the Project  
SP 3.2-1 Reconcile Work and Resource Levels  
SP 3.3-1 Obtain Plan Commitment

### **Process and Product Quality Assurance (PPQA)**

A Support process area at Maturity Level 2

#### Purpose

The purpose of Process and Product Quality Assurance (PPQA) is to provide staff and management with objective insight into processes and associated work products.

#### Specific Practices by Goal

SG 1 Objectively Evaluate Processes and Work Products  
SP 1.1-1 Objectively Evaluate Processes  
SP 1.2-1 Objectively Evaluate Work Products and Services  
SG 2 Provide Objective Insight  
SP 2.1-1 Communicate and Ensure Resolution of Noncompliance Issues  
SP 2.2-1 Establish Records

### **Quantitative Project Management (QPM)**

A Project Management process area at Maturity Level 4

#### Purpose

The purpose of the Quantitative Project Management (QPM) process area is to quantitatively manage the project's defined process to achieve the project's established quality and process-performance objectives.

#### Specific Practices by Goal

SG 1 Quantitatively Manage the Project  
SP 1.1-1 Establish the Project's Objectives  
SP 1.2-1 Compose the Defined Processes  
SP 1.3-1 Select the Sub processes that Will Be Statistically Managed  
SP 1.4-1 Manage Project Performance  
SG 2 Statistically Manage Sub process Performance  
SP 2.1-1 Select Measures and Analytic Techniques  
SP 2.2-1 Apply Statistical Methods to Understand Variation  
SP 2.3-1 Monitor Performance of the Selected Sub processes  
SP 2.4-1 Record Statistical Management Data

### **Requirements Development (RD)**

An Engineering process area at Maturity Level 3

#### Purpose

The purpose of Requirements Development (RD) is to produce and analyze customer, product, and product-component requirements.

#### Specific Practices by Goal

SG 1 Develop Customer Requirements  
SP 1.1-1 Collect Stakeholder Needs  
SP 1.1-2 Elicit Needs  
SP 1.2-1 Develop the Customer Requirements  
SG 2 Develop Product Requirements  
SP 2.1-1 Establish Product and Product-Component Requirements  
SP 2.2-1 Allocate Product-Component Requirements

SP 2.3-1 Identify Interface Requirements  
SG 3 Analyze and Validate Requirements  
SP 3.1-1 Establish Operational Concepts and Scenarios  
SP 3.2-1 Establish a Definition of Required Functionality  
SP 3.3-1 Analyze Requirements  
SP 3.4-3 Analyze Requirements to Achieve Balance  
SP 3.5-1 Validate Requirements  
SP 3.5-2 Validate Requirements with Comprehensive Methods

### **Requirements Management (REQM)**

An Engineering process area at Maturity Level 2

#### Purpose

The purpose of Requirements Management (REQM) is to manage the requirements of the project's products and product components and to identify inconsistencies between those requirements and the project's plans and work products.

#### Specific Practices by Goal

SG 1 Manage Requirements  
SP 1.1-1 Obtain an Understanding of Requirements  
SP 1.2-2 Obtain Commitment to Requirements SP 1.3-1 Manage Requirements Changes  
SP 1.4-2 Maintain Bidirectional Traceability of Requirements  
SP 1.5-1 Identify Inconsistencies between Project Work and Requirements

### **Risk Management (RSKM)**

A Project Management process area at Maturity Level 3

#### Purpose

The purpose of Risk Management (RSKM) is to identify potential problems before they occur so that risk-handling activities can be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives.

#### Specific Practices by Goal

SG 1 Prepare for Risk Management  
SP 1.1-1 Determine Risk Sources and Categories  
SP 1.2-1 Define Risk Parameters  
SP 1.3-1 Establish a Risk Management Strategy  
SG 2 Identify and Analyze Risks  
SP 2.1-1 Identify Risks  
SP 2.2-1 Evaluate, Categorize, and Prioritize Risks  
SG 3 Mitigate Risks  
SP 3.1-1 Develop Risk Mitigation Plans  
SP 3.2-1 Implement Risk Mitigation Plans

## **Supplier Agreement Management (SAM)**

A Project Management process area at Maturity Level 2

### Purpose

The purpose of Supplier Agreement Management (SAM) is to manage the acquisition of products from suppliers for which there exists a formal agreement.

### Specific Practices by Goal

- SG 1 Establish Supplier Agreements
  - SP 1.1-1 Determine Acquisition Type
  - SP 1.2-1 Select Suppliers
  - SP 1.3-1 Establish Supplier Agreements
- SG 2 Satisfy Supplier Agreements
  - SP 2.1-1 Review COTS Products
  - SP 2.2-1 Execute the Supplier Agreement
  - SP 2.3-1 Accept the Acquired Product
  - SP 2.4-1 Transition Products

## **Technical Solution (TS)**

An Engineering process area at Maturity Level 3

### Purpose

The purpose of Technical Solution (TS) is to design, develop, and implement solutions to requirements. Solutions, designs, and implementations encompass products, product components, and product-related life-cycle processes either alone or in appropriate combination.

### Specific Practices by Goal

- SG 1 Select Product-Component Solutions
  - SP 1.1-1 Develop Alternative Solutions and Selection Criteria
  - SP 1.1-2 Develop Detailed Alternative Solutions and Selection Criteria
  - SP 1.2-2 Evolve Operational Concepts and Scenarios
  - SP 1.3-1 Select Product-Component Solutions
- SG 2 Develop the Design
  - SP 2.1-1 Design the Product or Product Component
  - SP 2.2-3 Establish a Technical Data Package
  - SP 2.3-1 Establish Interface Descriptions
  - SP 2.3-3 Design Interfaces Using Criteria
  - SP 2.4-3 Perform Make, Buy, or Reuse Analyses
- SG 3 Implement the Product Design
  - SP 3.1-1 Implement the Design

## SP 3.2-1 Develop Product Support

### **Documentation Validation (VAL)**

An Engineering process area at Maturity Level 3

#### Purpose

The purpose of Validation (VAL) is to demonstrate that a product or product component fulfills its intended use when placed in its intended environment.

#### Specific Practices by Goal

SG 1 Prepare for Validation

SP 1.1-1 Select Products for Validation

SP 1.2-2 Establish the Validation Environment

SP 1.3-3 Establish Valid ation Procedures and Criteria

SG 2 Validate Product or Product Components

SP 2.1-1 Perform Validation

SP 2.2-1 Analyze Validation Results

### **Verification (VER)**

An Engineering process area at Maturity Level 3

#### Purpose

The purpose of Verification (VER) is to ensure that a selected work product meets their specified requirements.

#### Specific Practices by Goal

SG 1 Prepare for Verification

SP 1.1-1 Select Work Products for Verification

SP 1.2-2 Establish the Verification Environment

SP 1.3-3 Establish Verification Procedures and Criteria

SG 2 Perform Peer Reviews

SP 2.1-1 Prepare for Peer Reviews

SP 2.2-1 Conduct Peer Reviews

SP 2.3-2 Analyze Peer Review Data

SG 3 Verify Selected Work Products

SP 3.1-1 Perform Verification

SP 3.2-2 Analyze Verification Results and Identify Corrective Action.

## ***Six Sigma***

### **(B) What is six sigma?**

Sigma is a statistical measure of variation in a process. We say a process has achieved six sigma if the quality is 3.4 DPMO (Defect per Million opportunities). It's a problem solving methodology that can be applied to a process to eliminate the root cause of defects and costs associated with the same.

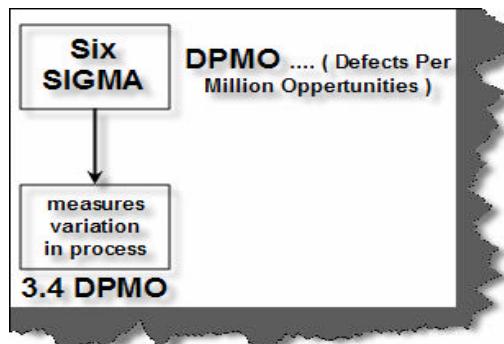


Figure: - Six Sigma.

### (I) Can you explain the different methodology for execution and design process in SIX sigma?

The main focus of SIX sigma is on reducing defects and variations in the processes. DMAIC and DMADV are the models used in most SIX sigma initiatives. DMADV is model for designing process while DMAIC is for improving the process.

DMADV model has the below five steps:-

- Define: - Determine the project goals and the requirements of customers (external and internal).
- Measure: - Assess customer needs and specifications.
- Analyze: - Examine process options to meet customer requirements.
- Design: - Develop the process to meet the customer requirements.
- Verify: - Check the design to ensure that it's meeting customer requirements

DMAIC model has the below five steps:-

- Define the projects, the goals, and the deliverables to customers (internal and external). Describe and quantify both the defect and the expected improvement.
- Measure the current performance of the process. Validate data to make sure it is credible and set the baselines.
- Analyze and determine the root cause(s) of the defects. Narrow the causal factors to the vital few.
- Improve the process to eliminate defects. Optimize the vital few and their interrelationships.
- Control the performance of the process. Lock down the gains.

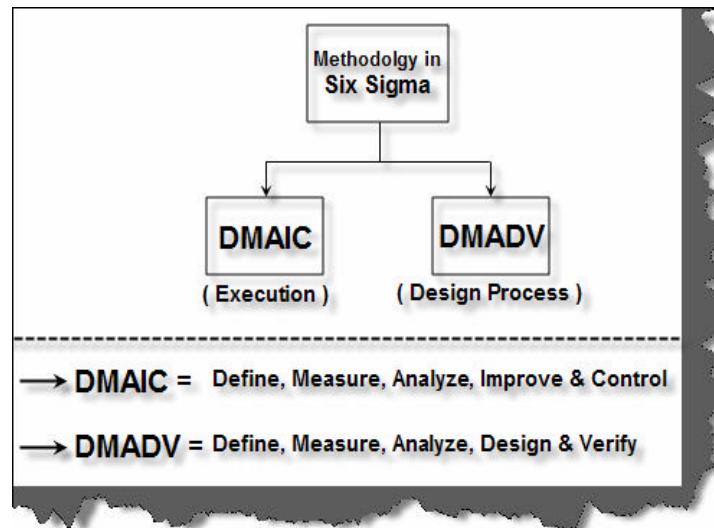


Figure: - Methodology in SIX Sigma

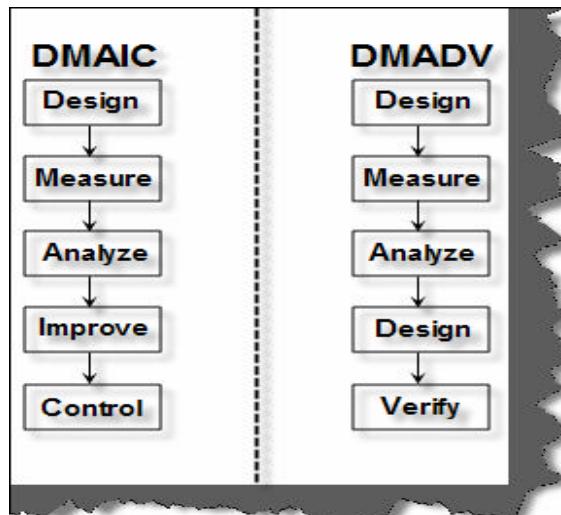


Figure: - DMAIC and DMADV

### (I) What does executive leaders, champions, Master Black belt, green belts and black belts mean?

SIX sigma is not only about techniques, tools and statistics, but the main thing depends upon people. In SIX sigma there five key players:-

- Executive leaders
- Champions
- Master black belt
- Black belts
- Green belts

Let's try to understand all the role of players step by step.

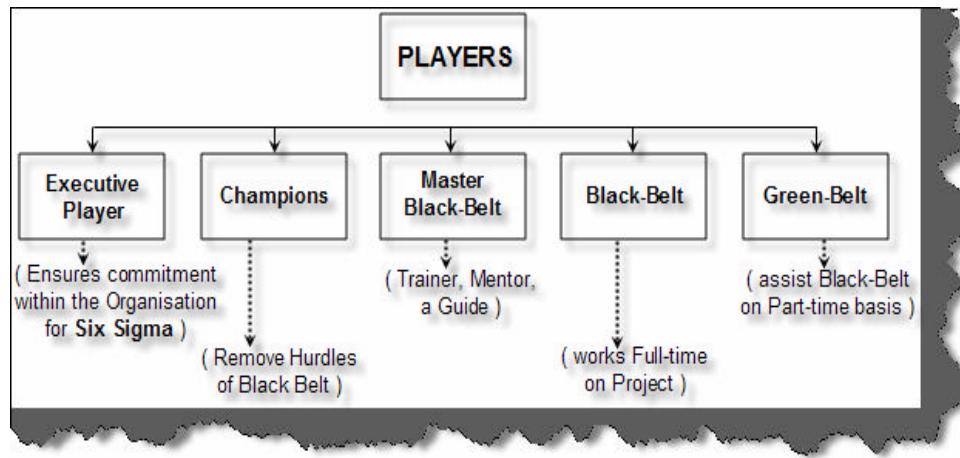
**Executive leaders:** - They are the main person who actually decides that we need to do SIX sigma. They promote it throughout organization and ensure commitment of the organization in SIX sigma. Executive leaders are the guys who are mainly either CEO or from the board of directors. So in short they are the guys who fund the SIX sigma initiative. They should believe that SIX sigma will improve the organization process and that they will succeed. They should be determined that they ensure resources get proper training on SIX sigma, understand how it will benefit the organization and track the metrics.

**Champions** :- Champion is a normally a senior manager of the company. He promotes SIX sigma mainly between the business users. He understand SIX sigma thoroughly , serves as a coach and mentor , selects project , decides objectives , dedicates resource to black belts and removes obstacles which come across black belt players. Historically Champions always fight for a cause. In SIX sigma they fight to remove black belt hurdles.

**Master Black-Belt:** - This role requires highest level of technical capability in SIX sigma. Normally organizations that are just starting up with SIX sigma will not have the same. So normally outsiders are recruited for the same. The main role of Master Black belt is to train, mentor and guide. He helps the executive leaders in selecting candidates, right project, teach the basic and train resources. They regularly meet with black belt and green belt training and mentor them.

**Black-Belt:** - Black belt leads a team on a selected project which has to be show cased for SIX sigma. They are mainly responsible to find out variations and see how these variations can be minimized. Mast black belt basically selects a project and train resources, but black belt are the guys who actually implement it. Black belt normally works in projects as team leads or project manager. They are central to SIX sigma as they are actually implementing SIX sigma in the organization.

**Green Belt:** - Green belt assist black belt in their functional areas. They are mainly in projects and work part time on SIX sigma implementation. They apply SIX sigma methodologies to solve problems and improve process at the bottom level. They have just enough knowledge of SIX sigma and they help to define the base of SIX sigma implementation in the organization. They assist black belt in SIX sigma implementation actually.

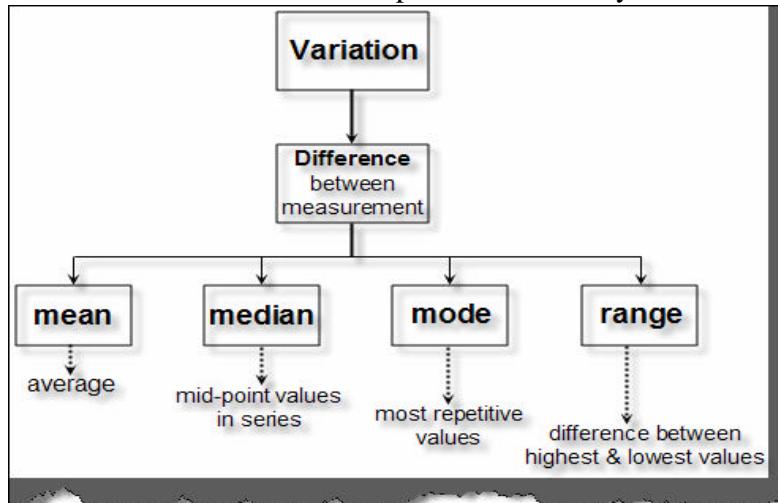


**Figure: - SIX key players**

### (I) what are the different kinds of variations used in six sigma?

Variation is the basis of six sigma. It defines how much changes are happening in an output of a process. So if a process is improved then this should reduce variations. In six sigma we identify variations in the process, control them and reduce or eliminate defects. Now let's understand how we can measure variations.

There are four basic ways of measuring variations Mean, Median, Mode and Range. Let's understand each of these variations in more depth for better analysis.



**Figure: - Different variations in Six sigma**

**Mean:** - In mean the variations are measured and compared using math's averaging techniques. For instance you can see the below figure which shows two weekly measures of how many computers are manufactured. So for that we have tracked two weeks one we have named as Week 1 and the other as Week 2. So to calculate variation by using mean we calculate the mean of week1 and week2. You can see from the calculations below we have got 5.083 for week and 2.85 for week2. So we have a variation of 2.23.

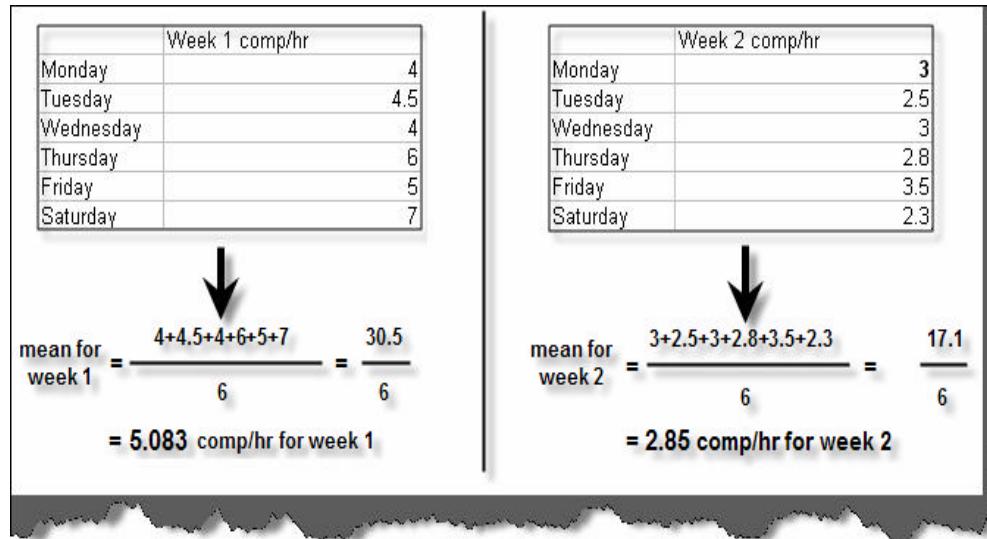


Figure: - Measuring variations by using Mean

**Median:** - Median value is a mid point in our range of data. Mid point can be found out using by finding the difference between highest and lowest value then divide it by two and finally add the lowest value to the same. For instance for the below figure in week1 we have 4 as the lowest value and 7 as the highest value. So first we subtract the lowest value from the highest value i.e. 7 - 4. Then we divide it by two and add the lowest value. So for week1 the median is 5.5 and for week2 the median is 2.9. So the variation is 5.5 – 2.9.

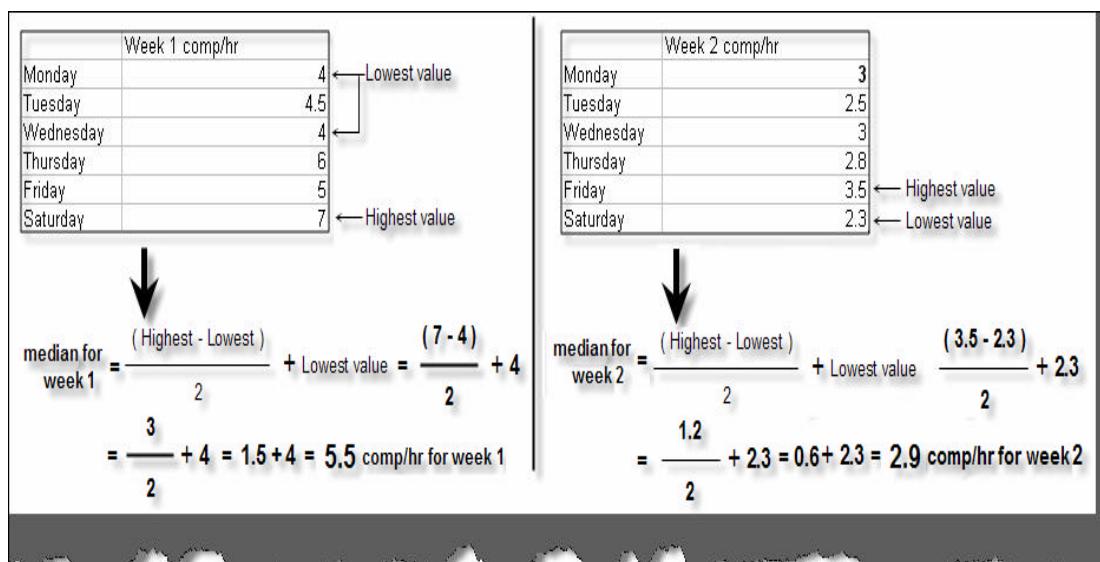
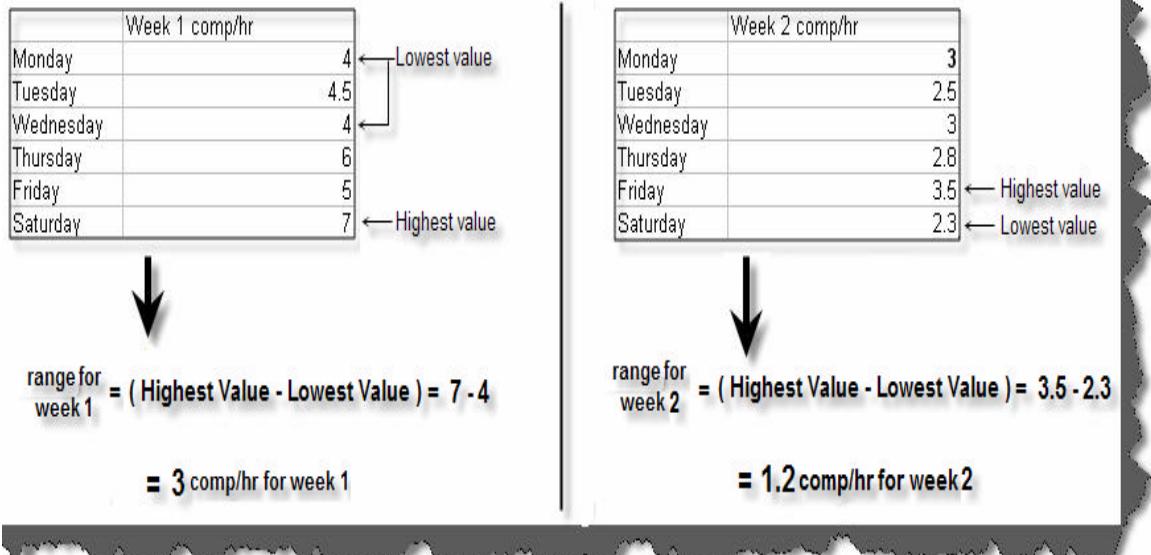


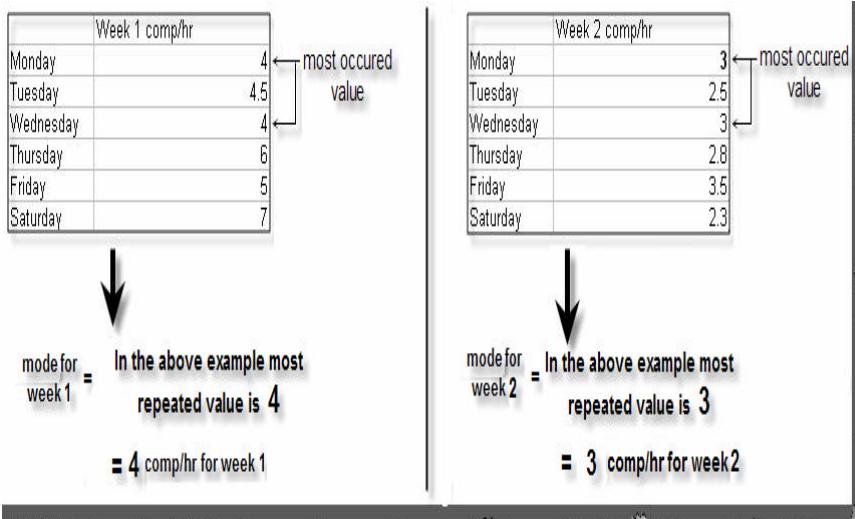
Figure: - Median for calculating variations

**Range:** - Range is nothing but spread of value for a particular data range. In short it is the difference between highest and lowest values in particular data range. For instance you can see for recorded computer data of two week we have found out the range values by subtracting the highest value from the lowest.



**Figure: - Range for calculating variations**

**Mode:** - Mode is nothing but the most occurred values in a data range. For instance in our computer manufacturing data range 4 is the most occurred value in Week1 and 3 is the most occurred value in week 2. So the variation is 1 between these data ranges.



**Figure: - Mode for calculating variations**

#### **(A) Can you explain the concept of standard deviation?**

The most accurate method of quantifying variation is by using standard deviation. It indicates the degree of variation in a set of measurement or a process by measuring the

average spread of data around the mean. It's but complicated than the deviation process discussed in the previous question, but it does give accurate information.

**Note:** - To understand standard deviation we will be going through a bit of maths so please co-operate and keep your head cool. In the below steps we will go step by step and understand how we can implement standard deviation.

Below is the formula for Standard deviation. “s” symbol stands for standard deviation. X is the observed values;  $\bar{X}$  (with the top bar) is the arithmetic mean and n is the number of observations. The formulae must be looking complicated by but let's break up in to steps and understand it better.

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n}}$$

**X** = Observed Value  
 **$\bar{X}$**  = Mean of all Observed Values  $\left[ \frac{(x_1+x_2+\dots+x_n)}{\text{no. of Observed Values}} \right]$   
**n** = number of Observation  
 **$\sum$**  = Sum

**Figure: - Standard deviation formulae**

The first step is to calculate the mean. This can be calculated by adding all the observed values and dividing the same by the number of observed values.

### **Step 1 :**

$x = x_1, x_2 \text{ & } x_3$  are Observed Values  
 $x = 5, 2 \text{ & } 4$  are Observed Values

$$\text{To Calculate Mean Value } \bar{x} = \frac{x_1+x_2+x_3}{\text{no. of Observed Values}}$$

**number of Observed Values = 3** (as we have 3 value under Observation)

$$\bar{x} = \frac{5+2+4}{3} = 3.666667$$

**Figure: - Step 1 Standard deviation**

The second step is to subtract the average from each observation, square them and then sum them. Because we square them we will not get negative values. Below figure indicates the same in very detail manner.

### **Step 2:**

$$\begin{aligned}\text{To Calculate } \sum (x - \bar{x})^2 &= (x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + (x_3 - \bar{x})^2 \\ &= (5 - 3.666667)^2 + (2 - 3.666667)^2 + (4 - 3.666667)^2 \\ &= 1.777778 + 2.777778 + 0.111111 \\ &= 4.666667\end{aligned}$$

**Figure: - Step 2 Standard deviation**

In the third step we divide the same with the number of observations as shown the figure.

### **Step 3:**

Now divide with the number of Observation ( n ) = 3

According to Formula,

$$\sigma = \sqrt{\frac{\sum (x - \bar{x})^2}{n}} = \sqrt{\frac{4.666667}{3}}$$

$$\sigma = \sqrt{1.555556}$$

**Figure: - Step 3 Standard deviation**

In the final step we take the square root which gives the standard deviation.

### **Step 4:**

$$\sigma = \sqrt{1.555556}$$

Now taking the Square root of the above step as follows

$$\sigma = 1.247219$$

**Figure: - Step 4 standard deviation**

Note: - Below are some questions which we have not answered and left it as an exercise to the readers. We will definitely try to cover the same in the coming second edition.

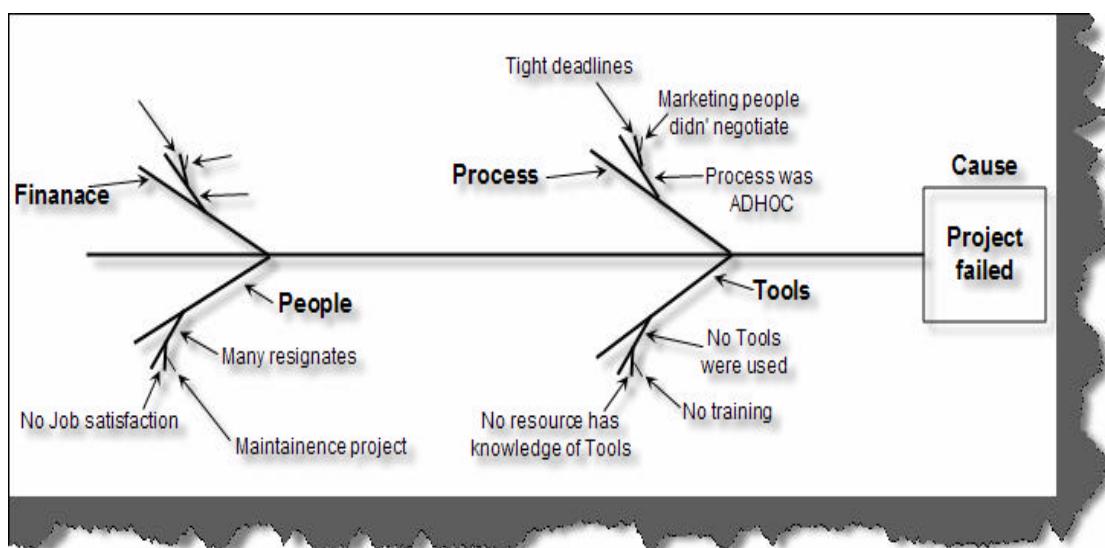
### **(B) Can you explain the concept of fish bone/ Ishikawa diagram?**

There are situations where we need to analyze what caused the failure or problem in a project. Fish bone or Ishikawa diagram is one of the important concept which can help you list down your root cause of the problem. Fish bone was conceptualized by Ishikawa, so in the honor of its inventor this concept was named as Ishikawa diagram. Inputs to conduct a fish bone diagram comes from discussion and brain storming with people who were involved in the project. Below figure shows how the structure of the Ishikawa diagram is.

Below is a sample fish bone diagram. The main bone is the problem which we need to address and to know what caused the failure. For instance the below fish bone is constructed to know what caused the project failure. To know this cause we have taken four main bones as inputs Finance, Process, People and Tools. For instance on the people front there are many resignations → this was caused because there was no job satisfaction → this was caused because the project was a maintenance project. In the same way causes are analyzed on the Tools front also. In tools → No tools were used in the project → because no resource had enough knowledge about the same → this happened because of lack of planning. In process front the process was adhoc → this was because of tight dead lines → this was caused because marketing people over promised and did not negotiate properly with the end customer.

Now once the diagram is drawn the end bones of the fish bone signify the main cause of project failure. From the below diagram here's a list:-

- No training was provided for the resources regarding tool.
- Marketing people over promised with customer which lead to tight dead lines.
- Resources resigned because it's a maintenance project.



**Figure: - Fish bone / Ishikawa diagram**

**(A) Can you explain QFD?**

**(A) Can you explain FMEA?**

**(A) Can you explain X bar charts?**

**(A) Can you explain Flow charting and brain storming?**

The above questions are left for the second edition.

## **Metrics**

**(B) What is meant by measure and metrics?**

Measures are quantitatively unit defined elements for instance Hours, Km etc. Metrics comprises of more than one measure for instance, we can have metrics like Km/Hr, M/S etc.

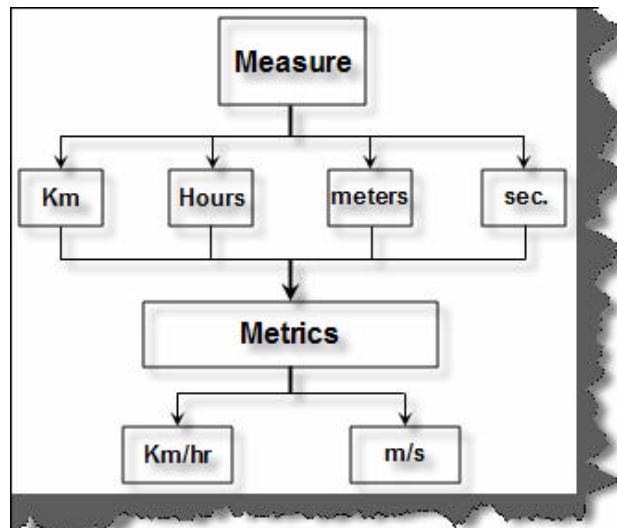


Figure: - Measure and Metrics

**(I) Can you explain Number of defects measure?**

Number of defects is one of the measures used to measure test effectiveness. One of the side effects of number of defects is that all bugs are not equal. So it becomes necessary to weight bugs according to there criticality level. If we using Number of defects as the metric measurement following are the issues:-

- Number of bugs that originally existed significantly impacts the number of bugs discovered, which in turns gives a wrong measure of the software quality.
- All defects are not equal so defect should be numbered with criticality level to get the right software quality measure.

Below are three simple tables which show number of defects SDLC phase wise , module wise and developer wise.

Phase	Number of Defects		
	High	Medium	Low
Requirement	10	6	20
Design	7	8	9
Execution	4	3	2
Production	10	12	6

Figure: - Number of defects phase wise

Modules	Number of Defects		
	High	Low	Medium
Cash Screen	7	5	4
Reports	10	12	8
Voucher Module	6	8	10
Login screen	12	3	4

Figure: - Number of defects module wise.

Engineer	Number of Defects		
	High	Medium	Low
Vinod	15	9	4
Ravi	8	5	2
Ankit	6	3	1
Pradeep	11	7	6

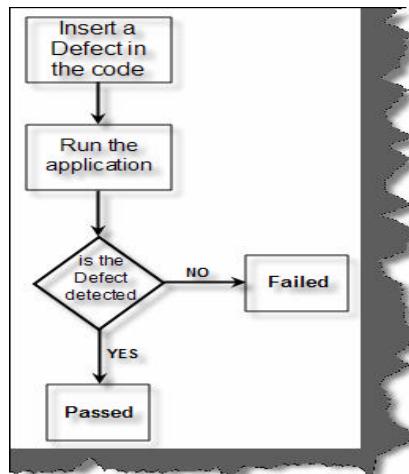
Figure: - Number of defects

### (I) Can you explain number of production defects measure?

This is one of the most effective measure. Number of defects found in production or the customer is recorded. The only issue with this measure is it can have latent and masked defects which can give us wrong value regarding software quality.

### (I) Can you explain defect seeding?

Defect seeding is a technique that was developed to estimate the number of defects resident in a piece of software. It's a bit offline technique and should not be used by every one. The process is the following we inject the application with defects and see if the defect is found or not. So for instance if we have injected 100 defects we try to get three values first how many seeded defects were discovered, how many were not discovered and how many new defects (unseeded) are discovered. By using defect seeding we can predict the number of defect remaining in the system.

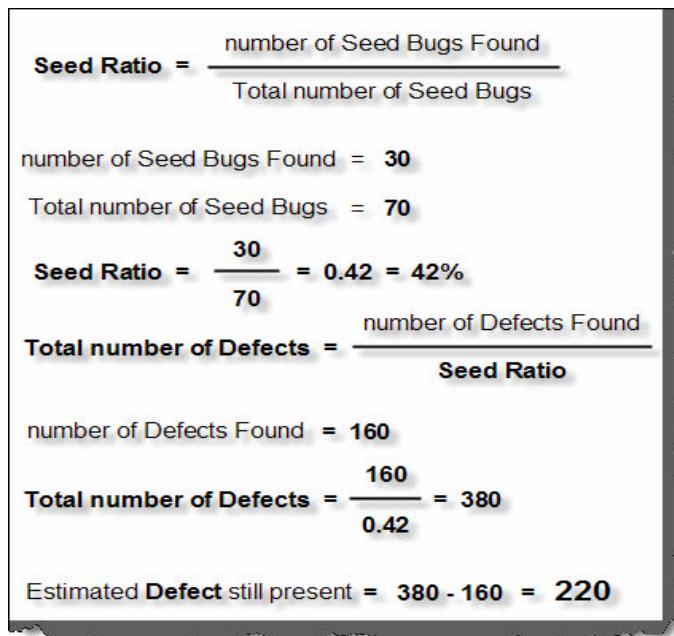


**Figure: - Defect seeding**

Let's understand the concept of defect seeding by doing some detail calculation and also try to understand how we can predict the number of defects remaining in a system. Below is the calculation for the same.

- First calculate the seed ratio using the below given formulae i.e. Number of seed bugs found divided by total number of seeded bugs.
- After that we need to calculate the total number of defect by using the formulae Number of defects divided by seed ratio.
- Finally we can know the estimated defects by using the formulae Total number of defects – Number of defect calculated by step 3.

Below figure shows a sample with step by step calculation. You can see first we calculate the seed ratio, then total number of defects and finally we get the estimated defects.



**Figure: - Seed calculation**

### **(I) Can you explain DRE?**

DRE(defect removal efficiency) is a powerful metric to measure test effectiveness. From this metric we come to know how many bugs we found out from the set of bugs which we could have found. Below is the formula for calculating DRE. So we need two inputs for calculating this metric number of bugs found during development and number of defects detected at the end user.

$$DRE = \frac{\text{Number of Bugs while Testing}}{\text{Number of Bugs while Testing} + \text{Number of Bugs found by User}}$$

**Number of Bugs while Testing** = Bugs found during Development process while testing it.  
**Number of Bugs found by User** = These are the Defect detected by the end-user.

**Figure:-DRE formulae**

But success of DRE depends on lot of factors. Below are listed some factors:-

- Severity and distribution of bugs must be taken in to account.
- Second how do we confirm when the customer has found all the bugs. This is normally achieved by looking at the past history of the customer.

### **(B) Can you explain Unit and system test DRE?**

DRE is also useful to measure effectiveness of a particular test like acceptance, unit or system testing. Below figure shows defect numbers at various software cycle level. The + indicates that defects are input to the phase and – indicates that these many defects were removed from that particular phase. For instance in requirement phase 100 defects were present, but 20 defects are removed from the requirement phase due to code review. So if 20 defects are removed then 80 defects get carried to the new phase (design) and so on.

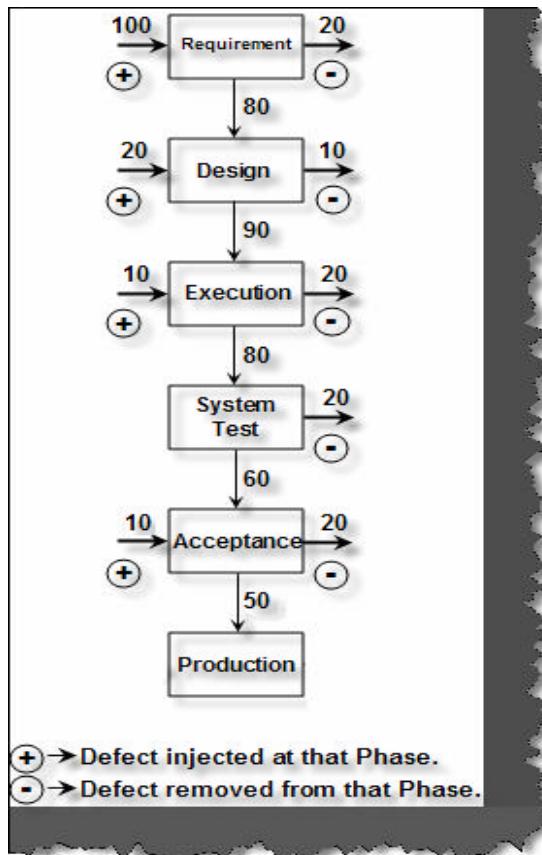


Figure: - Defect injected and removed per phase

First let's calculate simple DRE of the above diagram DRE will be total bugs found in testing divided by total bugs found in testing plus total bugs found by user that is during acceptance testing. So below diagram gives the DRE for the above values.

$$\begin{aligned}
 \text{DRE} &= \frac{\text{Number of Bugs while Testing}}{\text{Number of Bugs while Testing} + \text{Number of Bugs found by User}} \\
 &= \frac{(20 + 10 + 20 + 20 + 20)}{(20 + 10 + 20 + 20 + 20) + 50} \\
 &= \frac{90}{90 + 50} \\
 &= \frac{90}{140} = 0.64\%
 \end{aligned}$$

Figure: - DRE calculation

Now lets calculate system DRE of the above given project. In order to calculate the system DRE we need to take number of defects found during system divided by defects found during system testing plus defects found during acceptance testing. Below figure shows the System DRE calculation in a step by step fashion.

$$\begin{aligned}
 \text{System Test DRE} &= \frac{\text{Number of Bugs during System Testing}}{\text{Number of Bugs during System Testing} + \text{Number of Bugs found during Acceptance Testing}} \\
 &= \frac{20}{20 + 20} \\
 &= \frac{20}{40} \\
 \text{System Test DRE} &= 0.5 \%
 \end{aligned}$$

**Figure: - System test DRE calculation**

Unit testing DRE calculation will be similar to system testing DRE. As you can see from the below figure its nothing but Number of defects found during Unit testing divided by Number of defects found during unit testing plus Number of defects found during system testing.

$$\begin{aligned}
 \text{Unit Test DRE} &= \frac{\text{Number of Bugs during Unit Testing}}{\text{Number of Bugs during Unit Testing} + \text{Number of Bugs found during System Testing}} \\
 &= \frac{20}{20 + 20} \\
 &= \frac{20}{40} \\
 \text{Unit Test DRE} &= 0.5 \%
 \end{aligned}$$

**Figure: - Unit test DRE calculation**

One of the important factors to be noted while calculating unit test DRE is that we need to exclude those defects which can not produced due to limitation of unit testing. For instance passing of data between components to other. In unit testing because we test it as a single unit we can never reproduce defects which involves interaction. So such kind of defects which can not be produced due to the nature of the testing itself should be removed to get accurate test results.

## (I) How do you measure test effectiveness?

Test effectiveness is measure of the bug finding ability of our tests. In short it measures how good the tests were?. So effectiveness is the ratio of measure of bugs found during testing to total bugs found. Total bugs are the sum of new defects found by user + bugs found in test. Below figure explains the calculation in a more pictorial format.

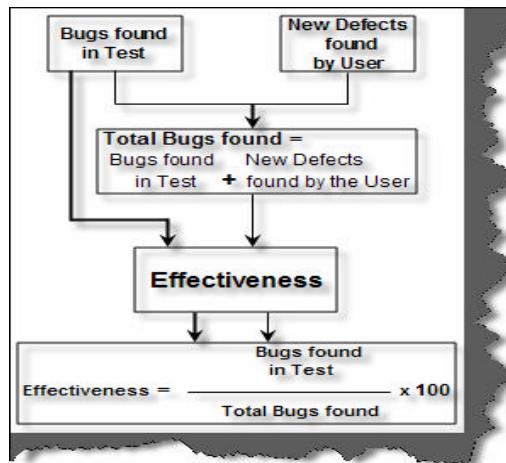


Figure: - Measure test effectiveness

## (B) Can you explain Defect age and Defect spoilage?

Defect age is also called as Phase Age or Phage. One of the most important things to remember in testing is later we find a defect more it costs to fix. Defect age and Defects spoilage metrics works on the same fundamental i.e. how late you found the defect? So the first thing we need to define is what is the scale of the defect age according to phases. For instance the below table defines the scale according to the Phases. So for instance requirement defects if found in design phase has a scale of 1 and the same defect if propagated till the production phase goes up to a scale of 4.

Phase created	Requirement	Design	Execution	Testing	Production
Requirement	0	1	2	3	4
Design	0	0	1	2	3
Execution	0	0	0	1	2

Figure: - Scale of Defect Age

Once the scale is decided now we can find the defect spoilage. Defect spoilage is defects from the previous phase multiplied by the scale. For instance in the below figure we have found 8 defects in the design phase from which 4 defects are propagated from the requirement phase. So we multiply the 4 defects with the scale defined in the previous

table, so we get the value of 4. In the same fashion we calculate for all the phases. Below given is the spoilage formula. It's the ratio of sum of defects passed from the previous phase multiplied by the discovered phase then finally divided by the total number of defects. For instance the first row shows that total defects are 27 and sum of passed on defects multiplied by their factor is 8 ( $4 \times 1 = 4 + 2 \times 2 = 4$ ). In this way we calculate for all phases and finally the total. The optimal value is 1. Lower value of spoilage indicates more effective defect discovery process.

<b>Phase Created</b>	Requirement	Design	Execution	Testing	Production	<b>Total</b>
Requirement	<b>0</b>	Def= 8 (1) Req Def = 4 $4 \times 1 = 4$	Def = 10 (2) Req Def = 2 $2 \times 2 = 4$	Def = 9 (3) Req Def = 0	-- (4)	$\frac{8}{27} = 0.29$
Design	<b>0</b>	<b>0</b>	Def = 4 (1) Des. Def = 5 $5 \times 1 = 5$	Def = 2 (2) Des. Def = 3 $3 \times 2 = 6$	Def = 0 (3) Des. Def = 1 $1 \times 3 = 3$	$\frac{14}{6} = 2.33$
Execution	<b>0</b>	<b>0</b>	<b>0</b>	Def = 4 (1) Exec.Def= 2 $2 \times 1 = 2$	Def = 0 (2) Exec.Def= 0	$\frac{2}{4} = 0.5$
<b>Main Total</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	$\frac{24}{37} = 0.64$

Figure: - Defect Spoilage

$$\text{Spoilage} = \frac{\text{sum of number of Defects} \times \text{Discovered Phase}}{\text{Total number of Defects}}$$

Figure: - Spoilage formulae

## Automated Testing

**(B) What are good candidate for automation in testing?**

**(B) Does automation replace manual testing?**

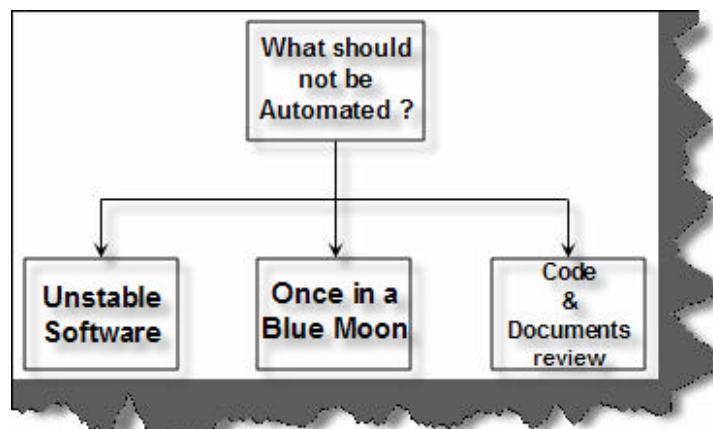
**Note:** - This question is normally asked to judge whether you think automation is a silver bullet. The time you say everything can be automated you have already lost the job.

Automation is integration of testing tools into the test environment in such a manner that the test execution, logging, and comparison of results are done with little human intervention. A testing tool is a software application which helps automate testing process. But testing tool is not the complete answer for automation. One of the huge mistakes done in testing automation is automating the wrong things during development. Many of the testers learn the hard way that every thing can not be automated. The best component to automate is repetitive task. So some companies first start with manual testing and then see which tests are the most repetitive ones and only those are then automated. Before doing testing automation try to judge is it really worth of the automation, probably manual testing can be better.

So as thumb rule do not try to automate:

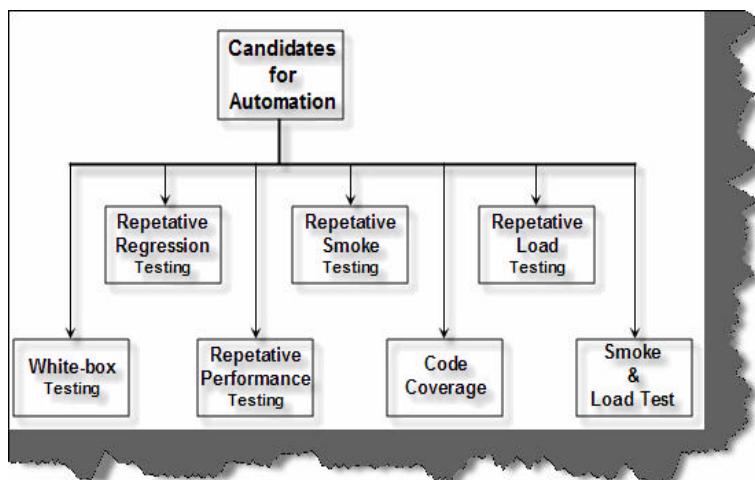
- Unstable software: If the software is still under development and undergoing lot of changes automation testing will not be that effective.
- Once in a blue moon test scripts: - Do not automate test script which will be run once in a while.
- Code and document review: - Do not try to automate code and documents reviews they will just add to your trouble.

Below figure shows what should not be automated.



**Figure: - What should not be automated**

All Repetitive tasks which are frequently used should be automated. For instance regression tests are prime candidates for automation because they're typically executed many times. Smoke, load, and performance tests are other examples of repetitive tasks that are suitable for automation. White box also can be automated using various unit testing tools. Code coverage can also be a good candidate for automation. Below figure shows in general the type of test which can be automated.



**Figure: - candidates for automation**

**(I) which automation tool have you worked and can you explain them in brief?**

Note: - For this book we are using AutomatedQA as the tool for testing automation. So this answer we will answer from the point of view of AutomatedQA tool. You can install the AutomationQA tool and practice for yourself to see how it really works.

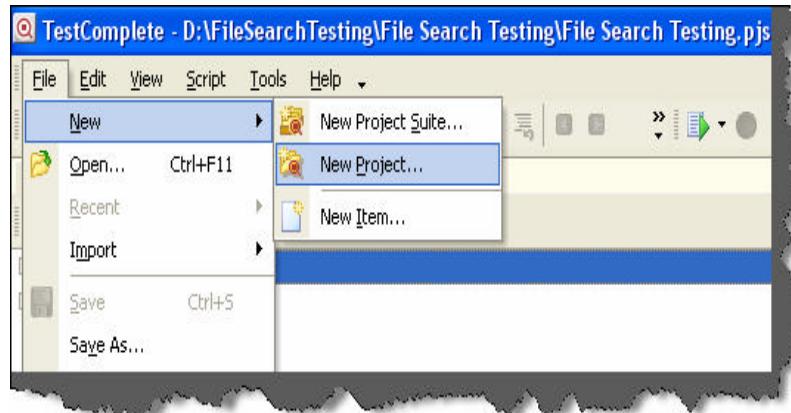
In this answer we will be testing a tool called as “WindowsFileSearch”. This tool does the following functionality:-

- This tool basically searches file by name and internal content of the file.
- It also has facility of wildcard as well as the extension search. Which means we can search the file by extension for instance \*.doc , \*.exe etc.

Note :- To answer this answer in a detail manner we have used the FileSearch application. You can experiment with any other application installed in your system for instance a messenger or office applications.

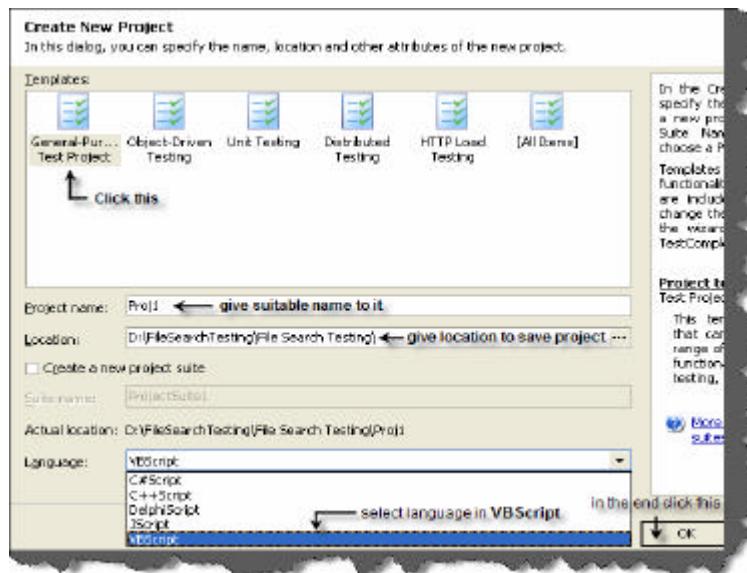
So let start step by step how we can use the automatedQA tool to automate our testing process. First start the tool by clicking all programs → AutomatedQA → TestComplete 5 → TestComplete 5. Once the tool is started you will get a screen as shown below. We

first need to create a new project by using the new project menu as shown in the below figure.



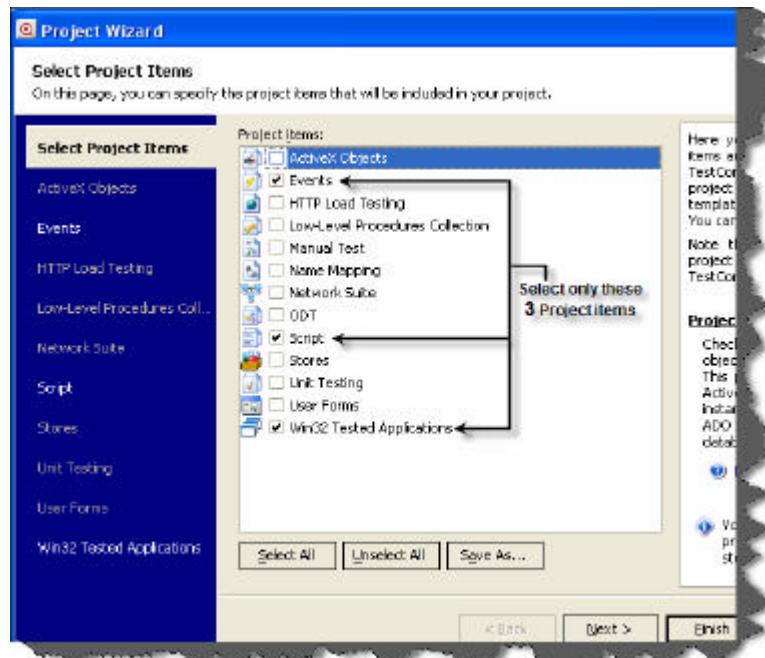
**Figure : - Create a new project**

After clicking on the new project we will be popped with what kind of testing are we looking at. i.e. Load testing , General testing etc. Currently we will select only General-Purpose Test project. At this moment you can also specify the project name , location and the language for scripting ( Select VBscript currently).



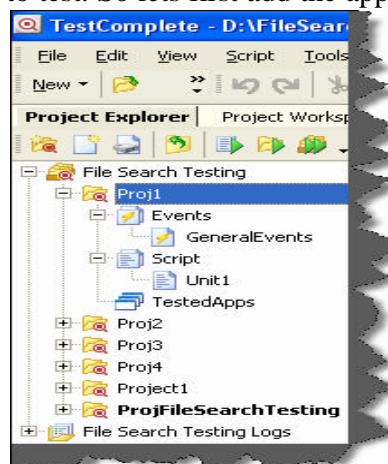
**Figure: - Select the type of project**

Once the project name and path is given you will be then popped with a screen as shown below. These are project items which we need to include in our project depending on testing types. Because currently we are doing a windows application testing we need to select the below project items as shown in figure. Please note events have to be selected compulsorily.



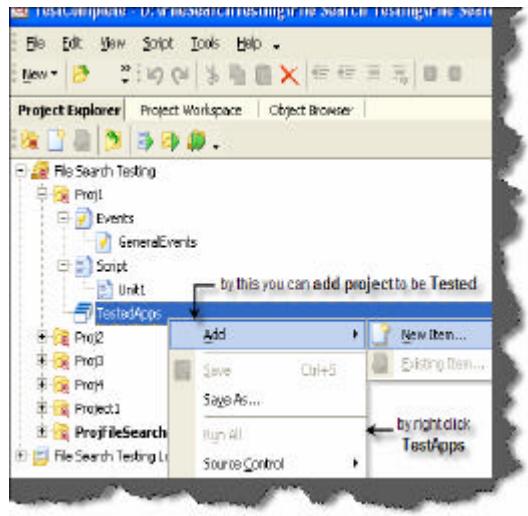
**Figure: - Select project items**

Once you have clicked finished you will get the test complete project explorer as shown below. Test complete project explorer is divided in to three main parts Events, Script and TestedApps. Script is where all the programming logic is present. In TestedApps we add the applications which we want to test. So lets first add the application in TestedApps.



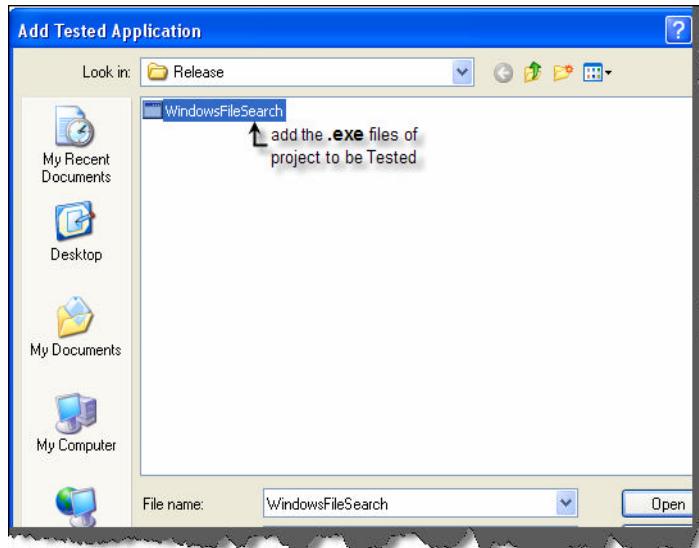
**Figure: - Project explorer**

In order to add the application EXE in TestedApps we need to right click on TestedApps folder and click on New Item.



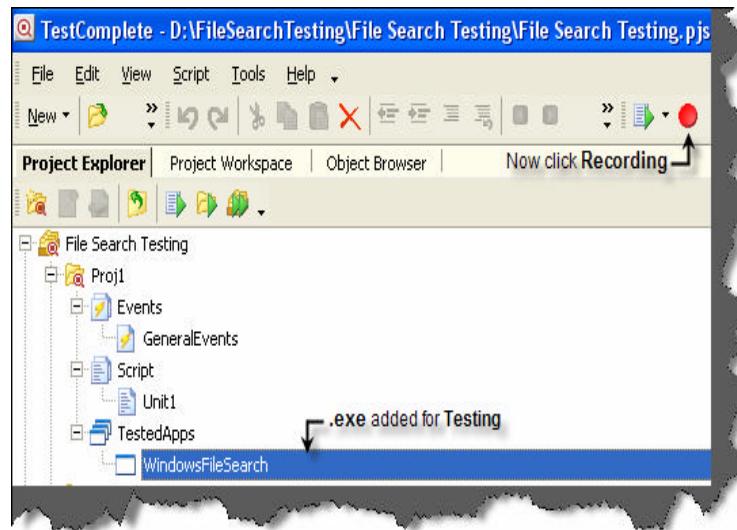
**Figure: - Add new applications to the project**

You will then be popped with a screen as shown below. Browse to your application EXE file and add the same in the TestedApps folder.



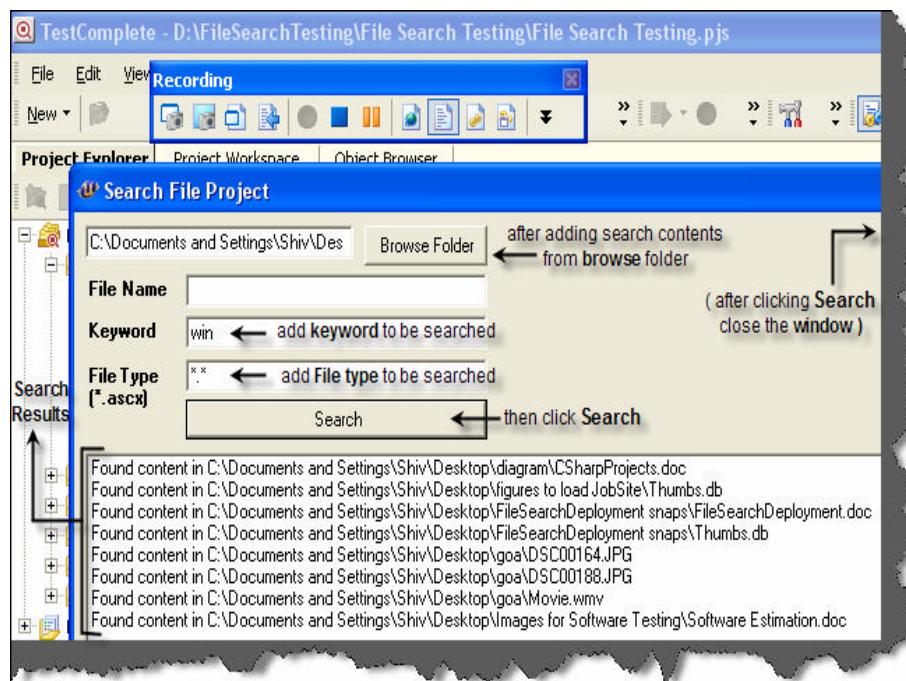
**Figure: - Add the EXE to your TestedApps folder**

Once the EXE is added to the you can see the Application added below TestedApps folder as shown in the below figure. Currently we have added the WindowsFileSearch application. Now that your application is added we need to start recording our test. In order to start recording click on the RED button shown in the below figure or click SHIFT + F1.



**Figure: - EXE see once added successfully**

Once the recording tool bar is seen right click on the Application added and run your test. In this scenario you can see the windows file search application running. In this we have recorded a complete test in which we gave the folder name , keyword and then tried to see if we are getting proper results. You application under test can be something different , so your steps can vary.



**Figure: - Recording**

Once the test is complete you can stop the recording using the BLUE button on the recording toolbar. Once you stop the recording tool will generate script of all your actions done as shown the figure below. You can view the programming script as shown below.

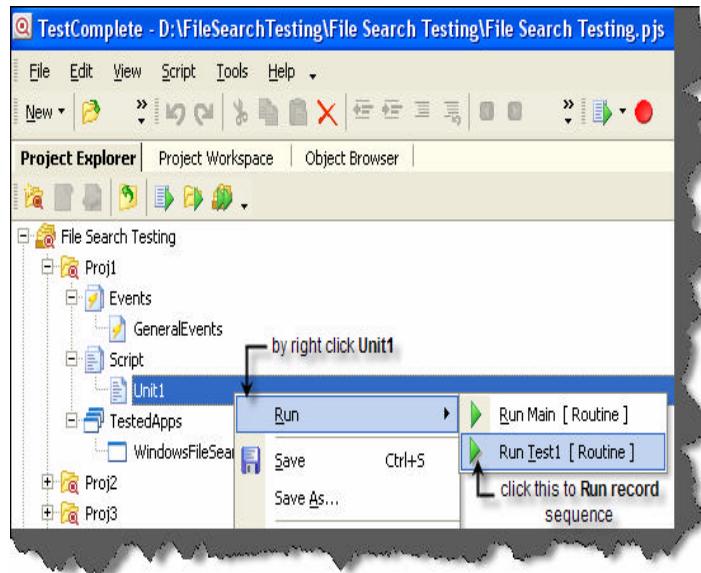
```

203 Call w9.Close
204 Call w1.CheckItem("TestComplete - D:\FileSearchTesting\File Search Testing.pjs")
205 End Sub
206
207 Sub Test2 ← can be renamed
208 Dim p1
209 Dim w1
210 Dim w2
211 Call Sys.Process("Explorer").Window("Shell_TrayWnd").Window
212 TestedApps.WindowsFileSearch.Run
213 Set p1 = Sys.Process("WindowsFileSearch")
214 Set w1 = p1frmFileSearch
215 Call w1.WinFormsObject("btnBrowseFolder").ClickButton

```

**Figure: - Script generated for the recording**

Once the script is recorded you can run the script by right clicking and running the same. Once you run the script tool will playback all the test steps which you had recorded.



**Figure: - Running the recorded test**

If everything goes proper you can see the test log in green color as shown below which signifies that your script had run successfully.

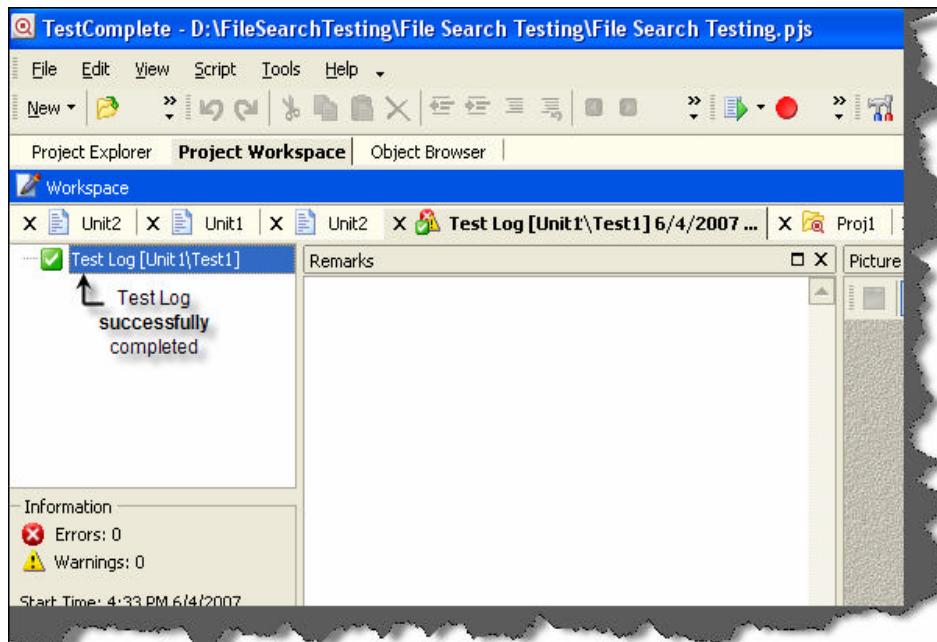
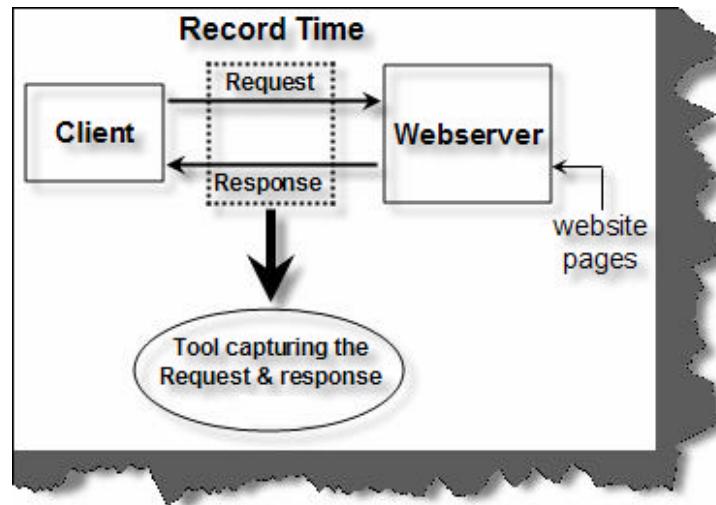


Figure:-Successful execution of the scripts

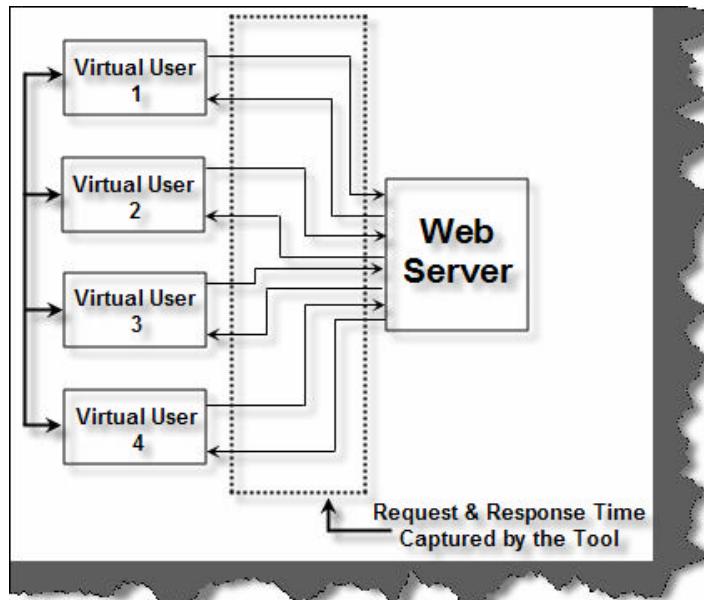
**(I) Can you explain how does load testing conceptually work for websites?**

In order to understand this we need to first understand the concept of how actually websites work. Websites have software called as Web server installed on the server. User request to the web server and receives a response. So for instance when you type <http://www.questpond.com> (well that's my official website) web server senses it and sends you the home page as a response. This happens each time either when you click on the links, do a submit etc. So if we want to do load testing you need to just multiply these request and response "N" times. This is what exactly an automation tool does. It first captures the request and response and then just multiplies it by "N" times and shoots it on the web server, which results in load simulation.



**Figure: - Concept of load testing**

So once the tool captures the request and response, we just need to multiply the request and response with the virtual user. Virtual users are logical user which actually simulates the actual physical user by sending in the same request and response. If you want to do load testing with 10000 users on an application it's practically impossible. But by using the load test tool you only need to create 1000 virtual users.



**Figure: - Load testing simulation by virtual user**

**(A) Can you explain how did you perform load testing using tool?**

Note: - As said previously we will be using automatedQA tool for automation in this book. So let's try to answer this question from the

same perspective. You can get the tool from the CD provided in the book.

The first step is to open a new project using the test complete.

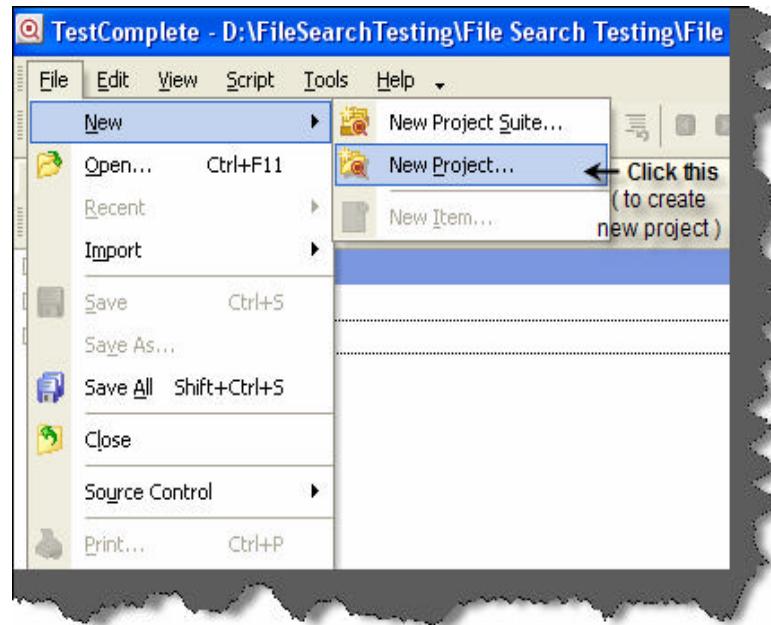
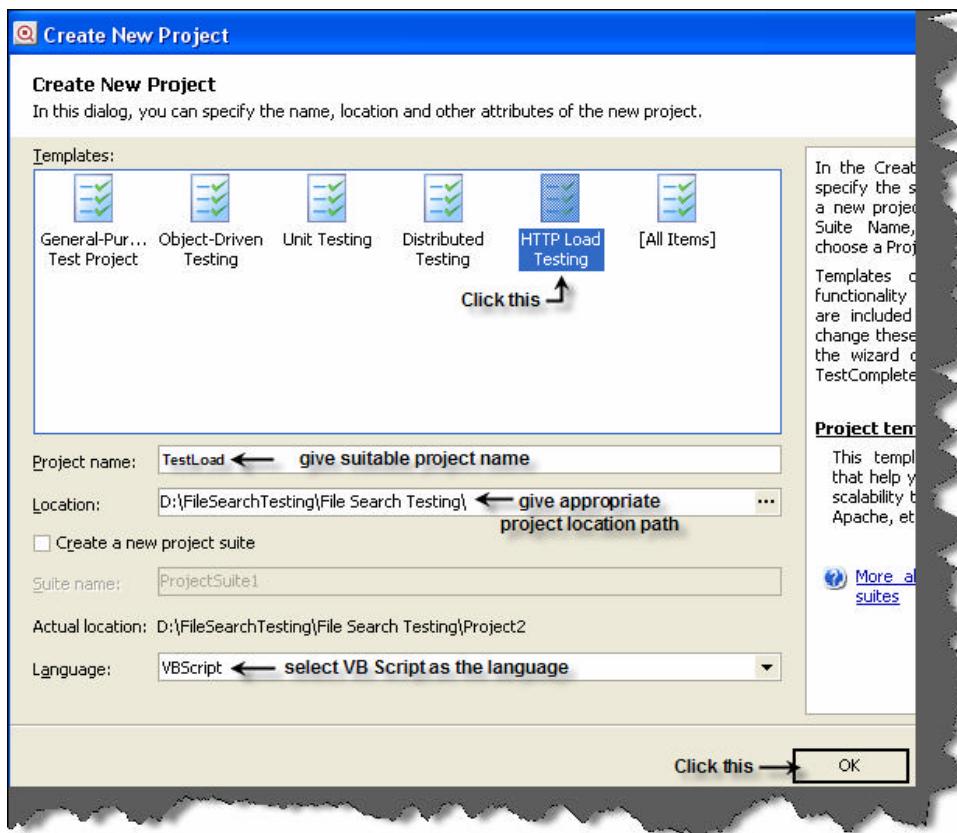


Figure: - Create new project

After than select HTTP load testing from the project types.



**Figure: - Select HTTP load testing**

Once you click “Ok” you will get different project items which you need for the project. For load testing only select the three i.e. Events, HTTP load testing and Script as shown below.

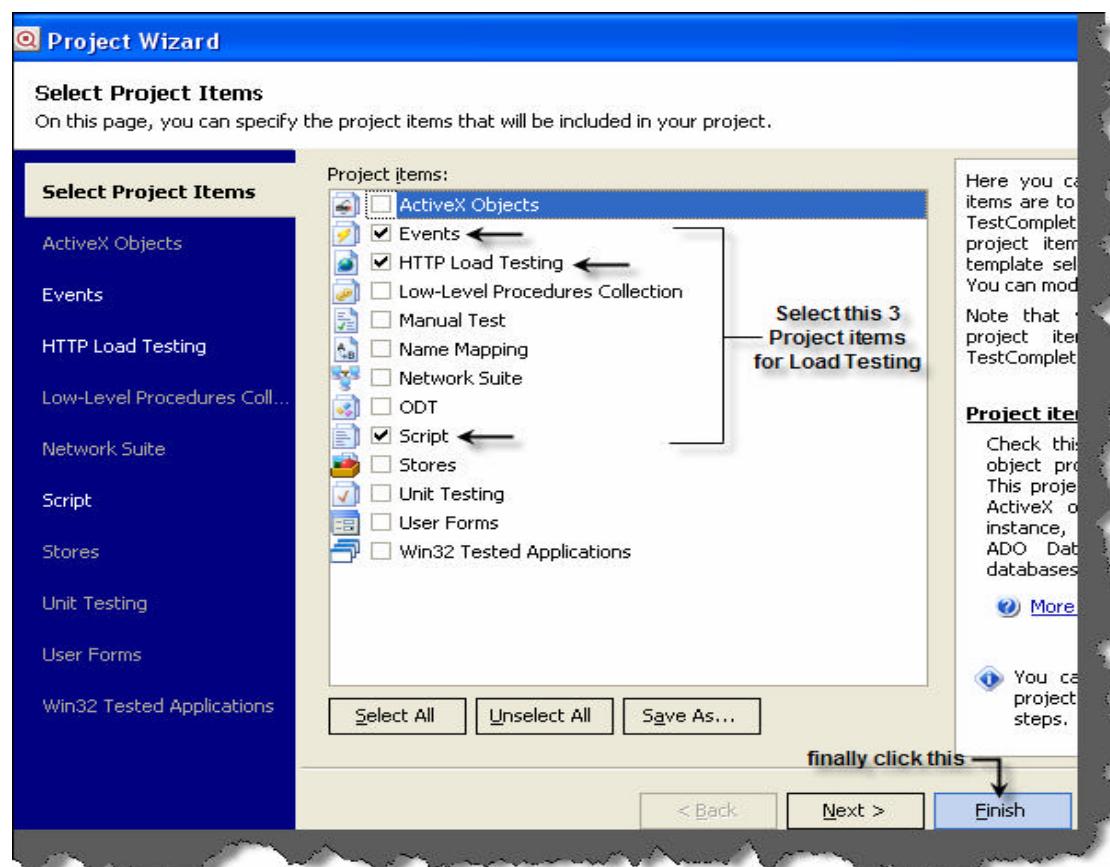


Figure: - Select the three items in load testing

Project has the following items Stations, tasks, tests and scripts. Stations basically define how much number of users the load testing will be performed for. Task is the one which has the request and response captured. Tests and script has the script which is generated when we record the automated test.

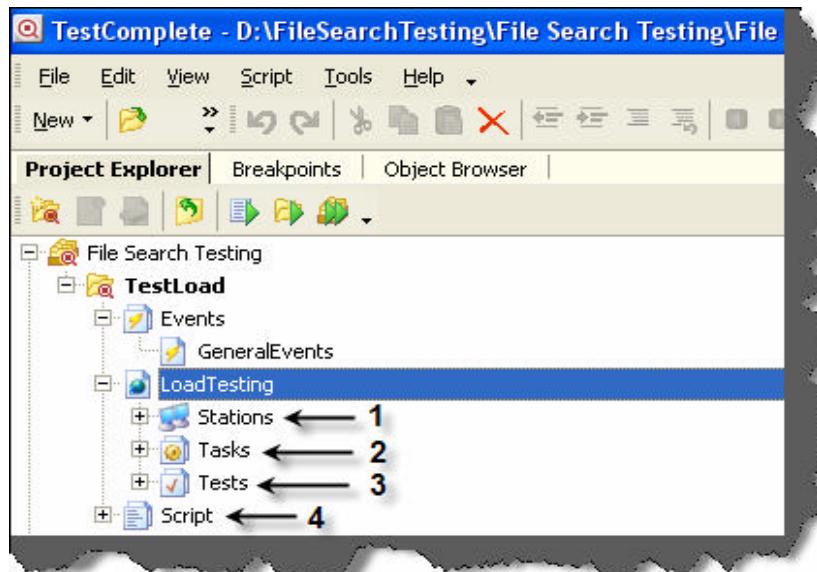


Figure: - Load testing explorer

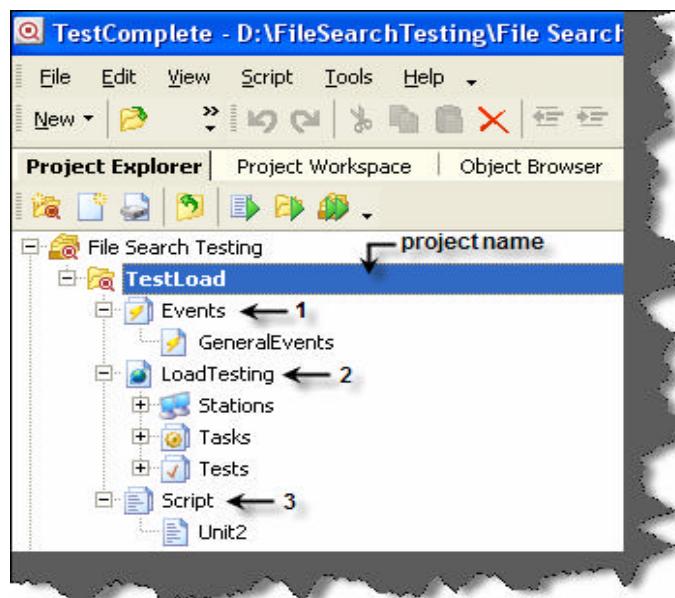


Figure: - Project items

You need to specify the number of virtual users, task and the browser type like internet explorer, opera etc.

Virtual Users						
select the browser						
User Name	User Count	Task	Workstation	Browser	Start Delay	Connection Speed
[Default]	4 virtual users ← keep 4 users	Task ← select	Master ← select	Internet Explorer 6, 0 ms		Maximum speed

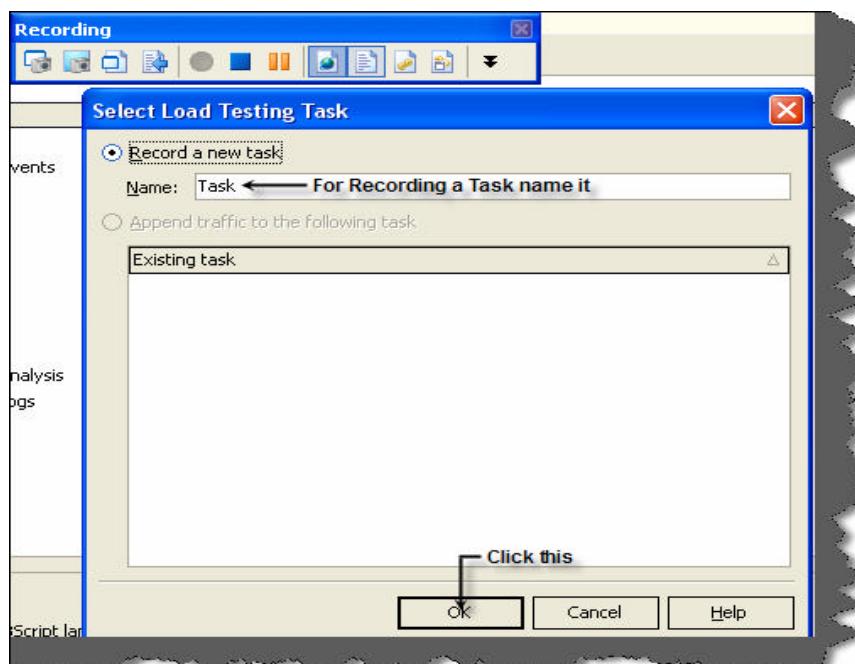
**Figure: - Assign number of virtual user and browser**

As said previously the basic thing in load testing is the request and response which needs to be recorded. That can be done by using the recording task bar and click the icon below.



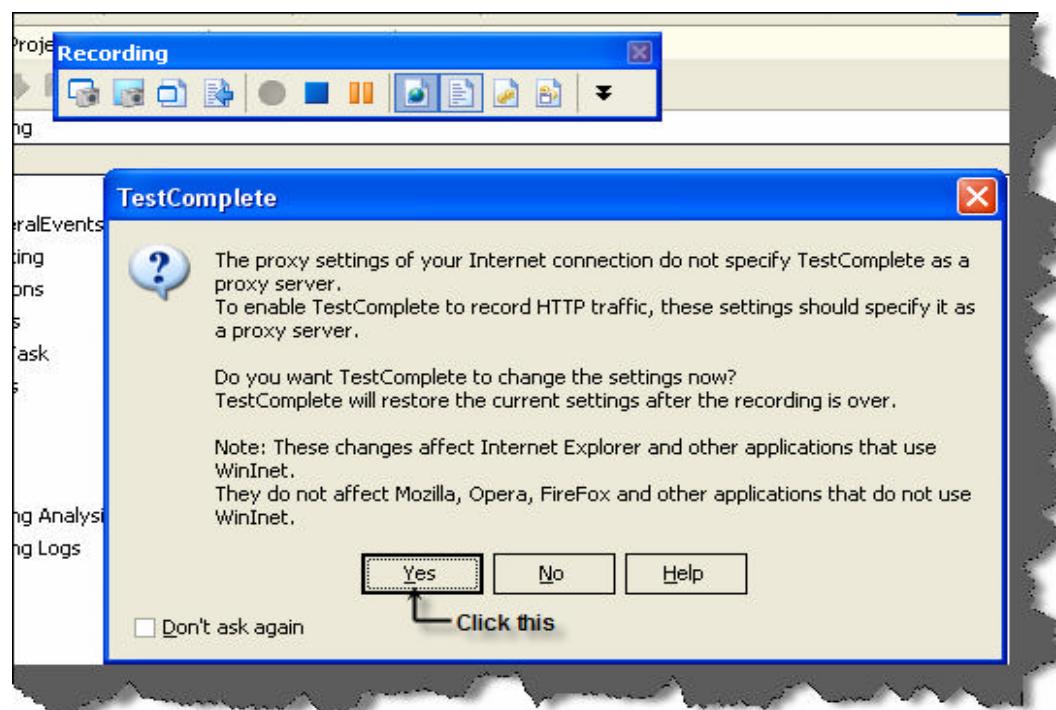
**Figure: - Record HTTP task**

Once you click on the icon you need to enter the task name for the same.

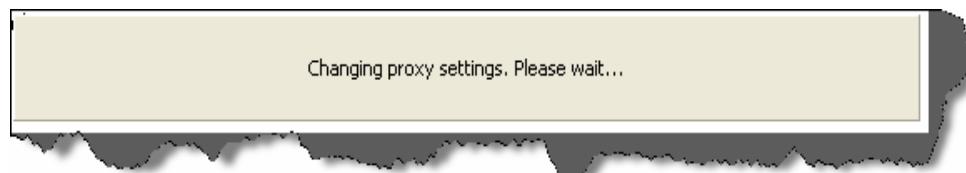


**Figure: - Specify task name**

In order to record the request and response tool changes the proxy setting of the browser. So you will see the below screen just click yes and let the next screen (change proxy settings) after it complete.



**Figure: - Prompting to change proxy setting**



**Figure: - Changing proxy settings**

Once the setting is changed you can then start your browser and make some request and response. Once that is done click on the stop to stop the recording.



**Figure: - Stop the task once done**

Tool actually generates script for task recorded. You can see the script and the code generated as shown in the figure below. To view the code you can double click on the Test2 script (here we have named it test2 script).

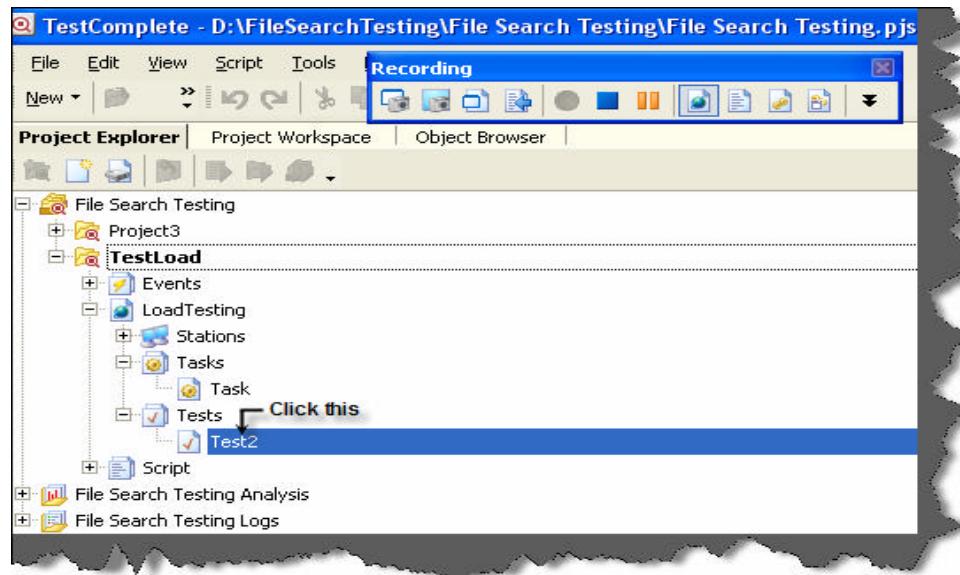


Figure: - Test2 created

If you double click the test you can see the code below.

A screenshot of the TestComplete workspace. The title bar is the same as the previous image. The workspace shows a code editor with several tabs: "Unit2 \*", "Test2", "Unit1 \*", and "Load Testing Log 6/10/2007 2:26:...". The "Test2" tab is active and contains the following VBA code:

```
Sub Main
    ' Enter your code here.
End Sub

Sub Test1
    Dim p1
    Dim w1
    Dim p2
    Dim w2
    Dim w3
    Dim w4
    Dim w5
    Dim w6
    Dim w7
    Dim w8
    Dim w9

```

The code editor has a status bar at the bottom with "Description" and "Line" fields.

Figure: - Code generated for test

Right click on the task and run the same you should be popped up with summary report as shown in the figure below.

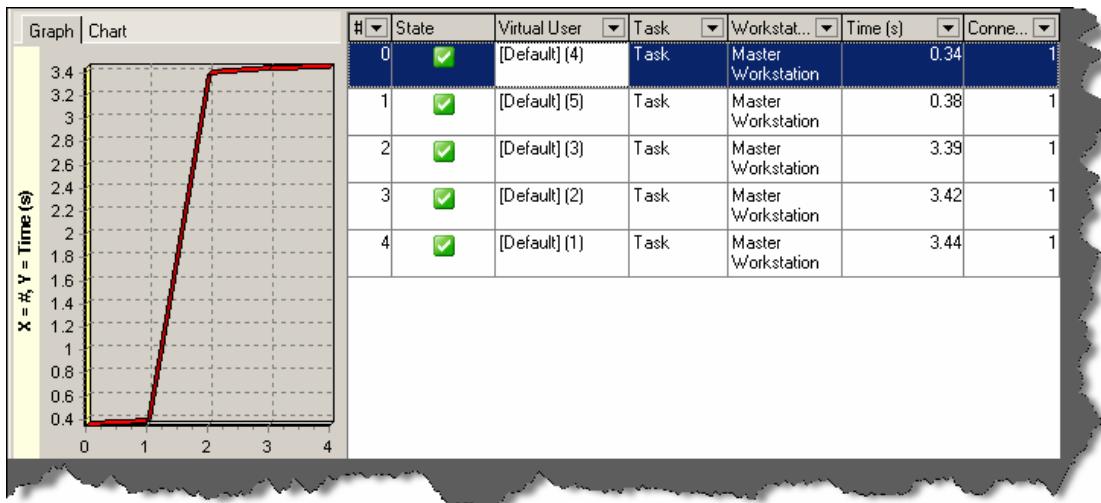


Figure: - Load test Summary report

### (I) What does load test summary report contain?

The above figure explains everything.

### (I) Can you explain the concept of data-driven testing?

Normally application has to be tested with multiple set of data. For instance a simple login screen depending on user type will give different rights. For example if he is a admin he will have full rights , while a user will have limited rights and support will only have read-only support rights. In this scenario the testing steps are same but with different user id and passwords. In data-driven testing inputs to the system are read from data file like excel, CSV (comma separated values), ODBC etc etc. So the values are read from these sources in to variables and then test steps are executed by automated testing.

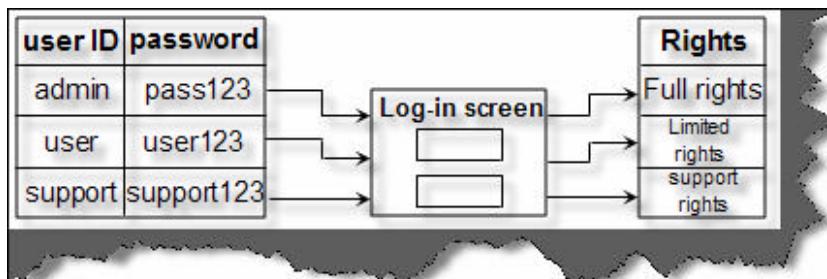


Figure: - Data driven testing

### (I) Can you explain table-driven testing?

Left to the readers

## **(I) How can you perform data-driven testing using Automated QA?**

This question is left to the user. Please install the tool and try for yourself. In case of issues you can mail to [shiv\\_koirala@yahoo.com](mailto:shiv_koirala@yahoo.com).

## **Testing Estimation**

### **(B) What are the different ways of doing black box testing?**

**Note:** - Below we have listed the most used estimation methodologies in testing. As this is an interview question book we only limit ourselves to TPA which is the most preferred estimation methodology for black box testing.

There are five methodologies which are most frequently used:-

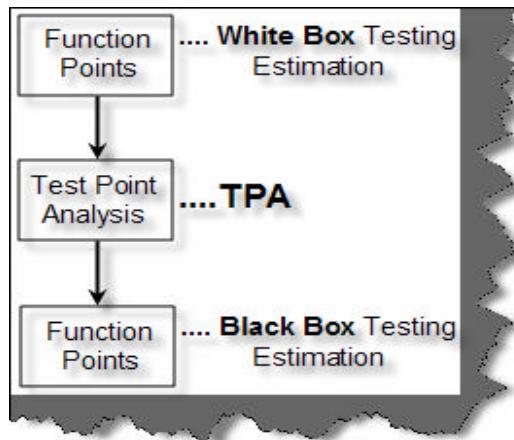
- Top down according to budget
- WBS ( Work break down structure )
- Guess and gut feeling
- Early project data
- TPA (test point analysis)

### **(B) Can you explain TPA analysis?**

TPA is a technique to estimate test effort for black box testing. Inputs for TPA are the counts which are derived from function points (function points will be discussed in more detail in the next sections).

Below are the features of TPA:-

- Used to estimate only black box testing.
- Requires function points as an input.



**Figure: - Inputs for TPA comes from Function points**

**Note:** - In the coming section we will look in to deep how to estimate using function points. Because the main input for TPA is the function point count.

### (A) Can you explain in brief Function points?

**Note:** - It's rare that some one will ask you to say full details of function points in one shot. They will rather ask specific sections like GSC, ILF etc. The main interest of the interviewer will be how you used the function point value in TPA analysis. Function point analysis is mainly done by the development team so from testing perspective you only need to get the function point value and then use TPA to get the black box testing estimates.

## Introduction to Function Points

"This document contains material which has been extracted from the IFPUG Counting Practices Manual. It is reproduced in this document with the permission of IFPUG."

Function Point Analysis was developed first by Allan J. Albrecht in the mid 1970s. It was an attempt to overcome difficulties associated with lines of code as a measure of software size, and to assist in developing a mechanism to predict effort associated with software development. The method was first published in 1979, then later in 1983. In 1984 Albrecht refined the method and since 1986, when the International Function Point User Group (IFPUG) was set up, several versions of the Function Point Counting Practices Manual

have been coming out.

"The best way to understand any complicated system is breaking the system in to smaller subsystem and try to understand those smaller subsystems . In Function Point you break complicated huge system into smaller systems and estimate those smaller pieces, then total up all the subsystem estimate to come up with final estimate."

## Basics of Function Points

Following are some terms used in FPA [Function Point analysis].

### (B) Can you explain the concept Application boundary?

#### Application Boundary

The first step in FPA is defining boundary. There are two types of major boundaries:

- Internal Application Boundary
- External Application Boundary

We will state features of external application boundary, so that internal application boundary would be self explained.

External Application Boundary can be identified using following litmus test:

- Does it have or will have any other interface to maintain its data, which is not Developed by you. Example: Your Company is developing an "Accounts Application" and at the end of accounting year, you have to report to tax Department. Tax department has his own website where companies can connect and report there Tax transaction. Tax department application has other Maintenance and reporting screens been developed by tax software department. These maintenance screens are used internally by the Tax department. So Tax Online interface has other interface to maintain its data which is not your scope, thus we can identify Tax website reporting as External Application.
- Does your program have to go through a third party API or layer? In order your application interacts with Tax Department Application probably your code have to interact through Tax Department API.
- The best litmus test is to ask yourself do you have full access over the system. If you have full rights or command to change then its internal application boundary or else external application boundary.

**(B) Can you explain the concept of elementary process?**

**(B) Can you explain the concept of static and dynamic elementary process?**

## **Elementary Process**

As said in introduction FPA is breaking huge systems in to smaller pieces and analyzing them. Software application is combination of set of elementary processes.

EP is smallest unit of activity that is meaningful to the user. EP must be self contained and leave the application in a consistent state.

When elementary processes come together they form a software application.

**Note:-Elementary process is not necessarily completely independent or can exist by itself. So, we can define elementary process as small units of self contained functionality from user perspective.**

## **Dynamic and static elementary process**

There are two types of elementary process: -

- Dynamic Elementary process.
- Static Elementary process.

Dynamic elementary process moves data from internal application boundary to external Application boundary or vice-versa.

Examples of dynamic elementary process: -

- Input data screen where user inputs data in to application. Data moves from the input screen inside application.
- Transaction exported in export files in XML or any other standard.
- Display reports which can come from external application boundary and internal application boundary.

Examples of static elementary process: -

- Static elementary process maintains data of application either inside application boundary or in external application boundary.

For instance in a customer maintenance screen maintaining customer data is static elementary process.

### (I) Can you explain concept of FTR, ILF, EIF, EI, EO , EQ and GSC ?

#### Elements of Function Points

Following are the elements of FPA.

#### Internal Logical Files (ILF)

Following are points to be noted for ILF: -

- ILF are logically related data from user point of view.
- They reside in Internal Application boundary and are maintained through Elementary process of application.
- ILF can have maintenance screen or probably not.

Caution: - Do not make a mistake of mapping one to one relationship between ILF and technical database design, then FPA can go very misleading. The main difference between ILF and technical database is ILF is logical view and database is physical structure (Technical Design). Example Supplier database design will have tables like Supplier, Supplier Address, SupplierPhonenumbers, but from ILF point of view its only Supplier. As logically they are all Supplier details.

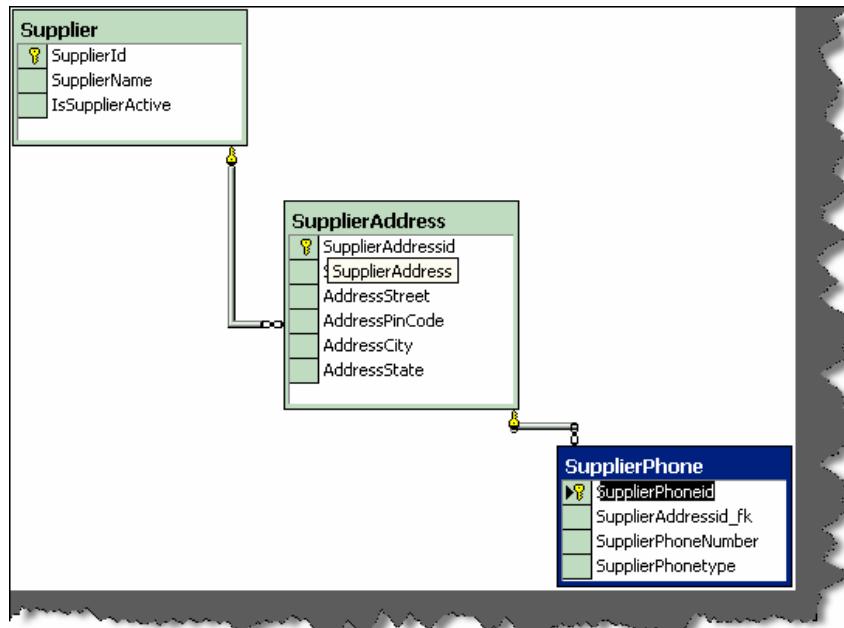


Figure: - ILF example

## External Interface File (EIF)

- They are logically related data from user point of view.
- EIF reside in external application boundary.
- EIF is used only for reference purpose and are not maintained by internal application.
- EIF is maintained by external application.

## Record Element Type (RET)

Following are points to be noted for RET

- RET are sub-group element data of ILF or EIF.
- If there is no sub-group of ILF then count the ILF itself as one RET.
- A group of RET's within ILF are logically related. Most probably with a parent child relationship. Example: - Supplier had multiple addresses and every address can have multiple phone numbers (See detail image below which shows database diagrams). So Supplier, Supplier Address and Supplier phone numbers are RET's.

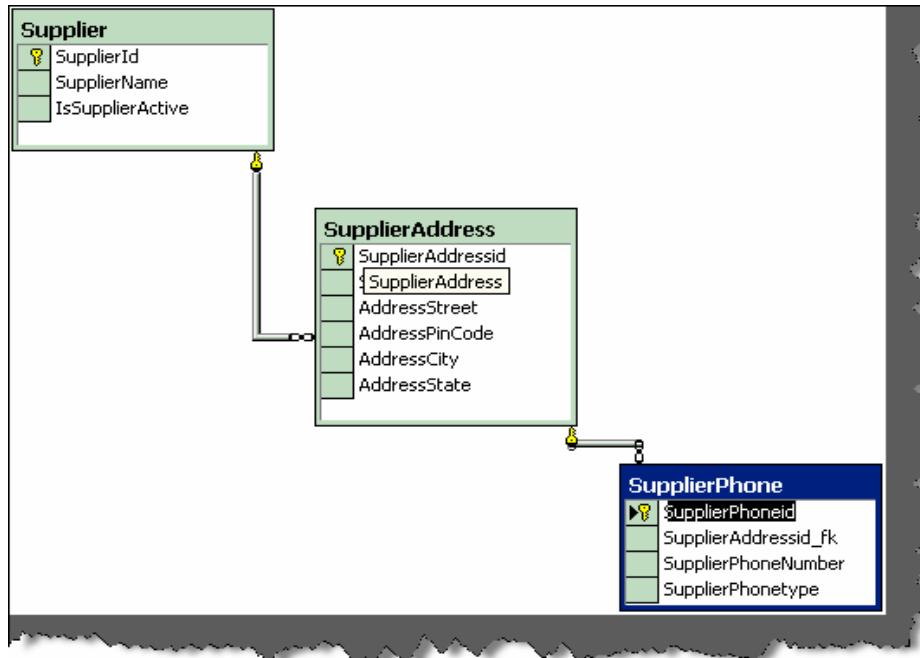


Figure : - RET

Please note the whole database is one supplier ILF as all belong to one logical section. RET quantifies the relationship complexity of ILF and EIF.

## **DET (Data element types)**

Following are the points to be noted for DET counting: -

- Each DET should be User recognizable. Example in the above given figure we have kept auto increment field (Supplierid) for primary key. Supplierid field from user point of view never exists at all , its only from software designing aspect, so does not qualifies for DET.
- DET should be non-recursive field in ILF. DET should not repeat in the same ILF again, it should be counted only once.
- Count foreign keys as one DET. “Supplierid” does not qualifies as DET but its relationship in “supplieraddress” table is counted as DET. So “Supplierid\_fk” in supplieraddress table is counted as DET. Same folds true for “Supplieraddressid\_fk”.

## **File Type Reference (FTR)**

Following are points to be noted for FTR: -

- FTR is files or data referenced by a transaction.
- FTR should be ILF or EIF. So count each ILF or EIF read during process.
- If the EP is maintaining an ILF then count that as FTR. So by default you will always have one FTR in any EP.

## **External Input (EI)**

Following are points to be noted for EI: -

- It's a dynamic elementary process [For definition see “Dynamic and Static Elementary Process” Section] in which data is received from external application boundary.  
Example: - User Interaction Screens, when data comes from User Interface to Internal Application.
- EI may maintain ILF of the application, but it's not compulsory rule.  
Example: - A calculator application does not maintain any data, but still the screen of calculator will be counted as EI.
- Most of time User Screens will be EI, again no hard and fast rule. Example: - An import batch process running from command line does not have screen, but still should be counted as EI as it helps passing data from External Application Boundary to Internal Application Boundary.

## **External Inquiry (EQ)**

Following are points to be noted for EQ: -

- It's a dynamic elementary process in which result data is retrieved from one or more ILF or EIF.
- In this EP some input request has to enter the application boundary.
- Output results exits the application boundary.

- EQ does not contain any derived data. Derived data means any complex calculated data. Derived data is not just mere retrieval but are combined with additional formulae to generate results. Derived data is not part of ILF or EIF, they are generated on fly.
- EQ does not update any ILF or EIF.
- EQ activity should be meaningful from user perspective.
- EP is self contained and leaves the business in consistent state.
- DET and processing logic is different from other EQ's.
- Simple reports form good base as EQ.

**Note:- No hard and fast rules that only simple reports are EQ's. Simple view functionality can also be counted as EQ.**

### **External Output (EO)**

Following are points to be noted for EO: -

- It's a dynamic elementary process in which derived data crosses from Internal Application Boundary to External Application Boundary.
- EO can update an ILF or EIF.
- Process should be the smallest unit of activity that is meaningful to end user in business.
- EP is self contained and leaves the business in a consistent state.
- DET is different from other EO's. So this ensures to us that we do not count EO's twice.
- They have derived data or formulae calculated data.

Major difference between EO and EQ is that data passes across application boundary.

Example: - Exporting Accounts transaction to some external file format like XML or some other format. Which later the external accounting software can import. Second important difference is in EQ its non-derived data and EO has derived data.

### **General System Characteristic Section (GSC)**

This section is the most important section. All the above discussed sections are counting sections. They relate only to application. But there are other things also to be considered while making software, like are you going to make it an N-Tier application, what's the performance level the user is expecting etc these other factors are called GSC. These are external factors which affect the software a lot and also the cost of it. When you submit a function point to a client, he normally will skip everything and come to GSC first. GSC gives us something called as VAF (Value Added Factor).

There are 14 points considered to come out with VAF (Value Added factor) and its associated rating table.

## **Data Communications**

How many communication facilities are there to aid in the transfer or exchange of information with the application or system?

<b>Rating</b>	<b>Description</b>
0	Application is pure batch processing or a standalone PC.
1	Application is batch but has remote data entry or remote Printing.
2	Application is batch but has remote data entry and remote Printing.
3	Application includes online data collection or TP (Teleprocessing) front end to a batch process or query system.
4	Application is more than a front-end, but supports only one Type of TP communications protocol.
5	Application is more than a front-end, and supports more than One type of TP communications protocol.

**Table : - Data Communication**

## **Distributed data processing**

How are distributed data and processing functions handled?

<b>Rating</b>	<b>Description</b>
0	Application does not aid the transfer of data or processing Function between components of the system.
1	Application prepares data for end user processing on another component of the system such as PC spreadsheets and PC DBMS
2	Data is prepared for transfer, then is transferred and processed on another component of the system (not for end-user Processing).
3	Distributed processing and data transfer are online and in One direction only.
4	Distributed processing and data transfer are online and in Both directions.
5	Processing functions are dynamically performed on the most Appropriate component of the system

**Table : - Distributed data processing**

## **Performance**

Did the user require response time or throughput?

Rating	Description
0	No special performance requirements were stated by the User.
1	Performance and design requirements were stated and Reviewed but no special actions were required.
2	Response time or throughput is critical during peak hours. No special design for CPU utilization was required. Processing deadline is for the next business day.
3	Response time or throughput is critical during all business hours. No special design for CPU utilization was required. Processing deadline requirements with interfacing systems are constraining.
4	In addition, stated user performance requirements are stringent enough to require performance analysis tasks in the Design phase.
5	In addition, performance analysis tools were used in the design, development, and/or implementation phases to meet the stated user performance requirements.

**Table :- Performance**

## **Heavily used configuration**

How heavily used is the current hardware platform where the application will be executed?

Rating	Description
0	No explicit or implicit operational restrictions are included.
1	Operational restrictions do exist, but are less restrictive than a typical application. No special effort is needed to meet the Restrictions.
2	Some security or timing considerations are included.
3	Specific processor requirement for a specific piece of the Application is included.
4	Stated operation restrictions require special constraints on the application in the central processor or a dedicated Processor.
5	In addition, there are special constraints on the application in the distributed components of the system.

**Table :- Heavily used configuration**

## **Transaction rate**

How frequently are transactions executed; daily, weekly, monthly, etc.?

Rating	Description
0	No peak transaction period is anticipated.
1	Peak transaction period (e.g., monthly, quarterly, seasonally, Annually) is anticipated.
2	Weekly peak transaction period is anticipated.
3	Daily peak transaction period is anticipated.
4	High transaction rate(s) stated by the user in the application requirements or service level agreements are high enough to require performance analysis tasks in the design phase.
5	High transaction rate(s) stated by the user in the application requirements or service level agreements are high enough to require performance analysis tasks and, in addition, require the use of performance analysis tools in the design, Development, and/or installation phases.

**Table :- Transaction rate**

### **On-Line data entry**

What percentage of the information is entered On-Line?

Rating	Description
0	All transactions are processed in batch mode.
1	1% to7% of transactions is interactive data entry.
2	8% to15% of transactions is interactive data entry.
3	16% to23% of transactions is interactive data entry.
4	24% to30% of transactions is interactive data entry.
5	More than30% of transactions is interactive data entry.

**Table :- Online data entry**

### **End-user efficiency**

Was the application designed for end-user efficiency? There are seven end-user efficiency factors which govern how this point is rated.

Sr no	End-user Efficiency Factor
1	Navigational aids(for example, function keys, jumps, dynamically generated menus)
2	Menus
3	Online help and documents

4	Automated curs or movement
5	Scrolling
6	Remote printing(via online transactions)
7	Preassigned function keys
8	Batch jobs submitted from online transactions
9	Cursor selection of screen data
10	Heavy use of reverse video, highlighting, colors underlining, and other indicators
11	Hard copy user documentation of online transactions
12	Mouse interface
13	Pop-up windows
14	.As few screens as possible to accomplish a business function
15	Bilingual support(supports two languages; count as four items)
16	Multilingual support (supports more than two languages; count as six items).

**Table: - End user efficiency factor**

Rating	Description
0	None of the above.
1	One to three of the above.
2	Four to five of the above.
3	Six or more of the above, but there are no specific user Requirements related to efficiency.
4	Six or more of the above, and stated requirements for end-user efficiency are strong enough to require design tasks for human factors to be included (for example, minimize keystrokes, maximize defaults, use of templates).
5	Six or more of the above, and stated requirements for end-user efficiency are strong enough to require use of special tools and processes to demonstrate that the objectives have been achieved.

**Table : End user efficiency**

### **On-Line update**

How many ILF's are updated by On-Line transaction?

Rating	Description
0	None of the above.
1	Online update of one to three control files is included. Volume of updating I slow and recovery is easy.
2	Online update off our or more control files is included. Volume of updating is low and recovery easy.
3	Online update of major internal logical files is included.
4	In addition, protection against data lost is essential and has been

	specially designed and programmed in the system.
5	In addition, high volumes bring cost considerations into the Recovery process. Highly automated recovery procedures With minimum operator intervention are included.

**Table :- Online update**

### **Complex processing**

Does the application have extensive logical or mathematical processing?

S r no	Complex Processing Factor
1	Sensitive control(for example, special audit processing)and/or application specific security Processing
2	Extensive logical processing
3	Extensive mathematical processing
4	Much exception processing resulting in incomplete transactions that must be processed again, for example, incomplete ATM transactions caused by TP interruption, missing data values, or failed edits
5	Complex processing to handle multiple input/output possibilities, for example, multimedia, or device independence

**Table :- Complex processing factor**

Rating	Description
0	None of the above.
1	Any one of the above.
2	Any two of the above.
3	Any three of the above.
4	Any four of the above.
5	All five of the above

**Table : - Complex processing**

### **Reusability**

Was the application developed to meet one or many user's needs?

Rating	Description
0	No reusable code.
1	Reusable code is used within the application.
2	Less than 10% of the application considered more than one user's needs.
3	Ten percent (10%) or more of the application

	considered more than one user's needs.
4	The application was specifically packaged and/or documented to ease re-use, and the application is customized by the user at source code level.
5	The application was specifically packaged and/or documented to ease re-use, and the application is customized for use by means of user parameter maintenance.

**Table :- reusability**

### **Installation ease**

How difficult is conversion and installation

Description	Rating
0	No special considerations were stated by the user, and no special setup is required for installation.
1	No special considerations were stated by the user but special setup is required for installation.
2	Conversion and installation requirements were stated by the user and conversion and installation guides were provided and tested. The impact of conversion on the project is not considered to be important.
3	Conversion and installation requirements were stated by the user, and conversion and installation guides were provided And tested. The impact of conversion on the project is Considered to be important.
4	In addition to 2 above, automated conversion and installation Tools were provided and tested.
5	In addition to 3 above, automated conversion and installation Tools were provided and tested.

**Table : Installation ease**

### **Operational ease**

How effective and/or automated are start-up, back up, and recovery procedures?

Rating	Description
0	No special operational considerations so other than the normal Back- up procedures were stated by the user.
1-4	One, some, or all of the following items apply to the Application. Select all that apply. Each item has a point Value of one, except as noted otherwise.

	Effective start-up, back-up, and recovery processes were provided, but operator intervention is required.
	Effective start-up, back-up, and recovery processes were provided, but no operator intervention is required(count as Two items).
	The application minimizes the need for tape mounts.
	The application minimizes the need for paper handling.
5	The application is designed for unattended operation. Unattended operation means no operator intervention is required to operate the system other than to startup or shutdown the application. Automatic error recovery is a feature Of the application.

**Table: - operational ease**

### **Multiple sites**

Was the application specifically designed, developed, and supported to be installed at multiple sites for multiple organizations?

Description	Rating
0	User requirements do not require considering the needs of More than one user/installation site.
1	Needs of multiple sites were considered in the design, and the application is designed to operate only under identical Hardware and software environments.
2	Needs of multiple sites were considered in the design, and the application is designed to operate only under similar Hardware and or software environments.
3	Needs of multiple sites were considered in the design, and the application is designed to operate under different Hardware and or software environments.
4	Documentation and support plan are provided and tested to support the application at multiple sites and the application is as described by 1 or 2.
5	Documentation and support plan are provided and tested to support the application at multiple sites and the application is as described by 3.

**Table : - Multiple sites**

### **Facilitate change**

Was the application specifically designed, developed, and supported to facilitate change?.

The following characteristics can apply for the application

Sr no	Facilitate factors
0	None of above

1	Flexible query and report facility is provided that can handle simple requests; for example, and/or logic applied to only one internal logical file (count as one item).
2	Flexible query and report facility is provided that can handle requests of average complexity for example, and/or logic applied to more than one internal logical file (count as two items).
3	Flexible query and report facility is provided that can handle complex requests, for example, and/or logic combinations on one or more internal logical files (count as three items).
4	Business control data is kept in tables that are maintained by the user with online interactive Processes, but changes take effect only on the next business day.
5	Business control data is kept in tables that are maintained by the user with online interactive Processes and the changes take effect immediately (count as two items)

**Table : Facilitate change factors**

<b>Rating</b>	<b>Description</b>
0	None of the above.
1	Any one of the above.
2	Any two of the above.
3	Any three of the above.
4	Any four of the above.
5	All five of the above

**Table: - Facilitate change**

All the above GSC are rated from 0-5. Then VAF is calculated from the equation below:-

$$\text{VAF} = 0.65 + ((\text{sum of all GSC factor})/100).$$

Note: - GSC has not been accepted in software industry widely. Many software companies use Unadjusted Function point rather than adjusted. ISO has also removed GSC from its books and only kept unadjusted function points as the base for measurement. Read GSC acceptance in software industry Rating Tables for All elements of Function Points.

Below shown are look up tables which will be referred during counting.

<b>EI Rating Table</b>			
	<b>Data Elements</b>		
<b>FTR</b>	<b>1to 4</b>	<b>5 to 15</b>	<b>Greater than 15</b>
Less than 2	3	3	4

Equal to 2	3	4	6
Greater than 2	4	4	6

**Table :- EI rating table**

This table says that in any EI (External Input), if your DET count (Data Element) and FTR (File Type Reference) exceed these limits, then this should be the FP (Function Point). Example, if your DET (data element) exceeds >15 and FTR (File Type Reference) is greater than 2, then the Function Point count is 6. The rest down tables also show the same things. These tables will be there before us when we are doing function point count. The best is put these values in Excel with formulae so that you have to only put quantity in the appropriate section and you get the final value.

<b>EO Rating Table</b>			
	<b>Data Elements</b>		
<b>FTR</b>	<b>1 to 5</b>	<b>6 to 19</b>	<b>Greater than 19</b>
Less than 2	4	4	5
2 or 3	4	5	7
Greater than 2	5	7	7

**Table :- EO rating table**

<b>EQ Rating Table</b>			
	<b>Data Elements</b>		
<b>FTR</b>	<b>1 to 5</b>	<b>6 to 19</b>	<b>Greater than 19</b>
Less than 2	3	3	4
2 or 3	3	4	6
Greater than 2	4	6	6

**Table :- EQ rating table**

<b>ILF Rating Table</b>			
	<b>Data Elements</b>		
<b>RET</b>	<b>1 to 19</b>	<b>20 to 50</b>	<b>51 or more</b>
1 RET	7	7	10
2 to 5	7	10	15
Greater than 6	10	15	15

<b>EIF Rating Table</b>			
	<b>Data Elements</b>		
<b>RET</b>	<b>1 to 19</b>	<b>20 to 50</b>	<b>51 or more</b>
1 RET	5	5	7

2 to 5	5	7	10
Greater than 6	7	10	10

**Table :- ILF rating table.**

### **Steps to Count Function Points**

This section will discuss the practical way of counting the FP and coming out with a Man/Days on a project.

- Counting the ILF, EIF, EI, EQ, RET, DET, FTR (this is basically all sections discussed above): This whole FP count will be called as "unadjusted function point".
- Then put rating values 0 to 5 to all 14 GSC. Adding total of all 14 GSC to come out with total VAF. Formula for VAF =  $0.65 + (\text{sum of all GSC factor} / 100)$ .
- Finally, make the calculation of adjusted function point. Formula: Total function point = VAF \* Unadjusted function point.
- Make estimation how many function points you will do per day. This is also called as "Performance factor".
- On basis of performance factor, you can calculate Man/Days  
]

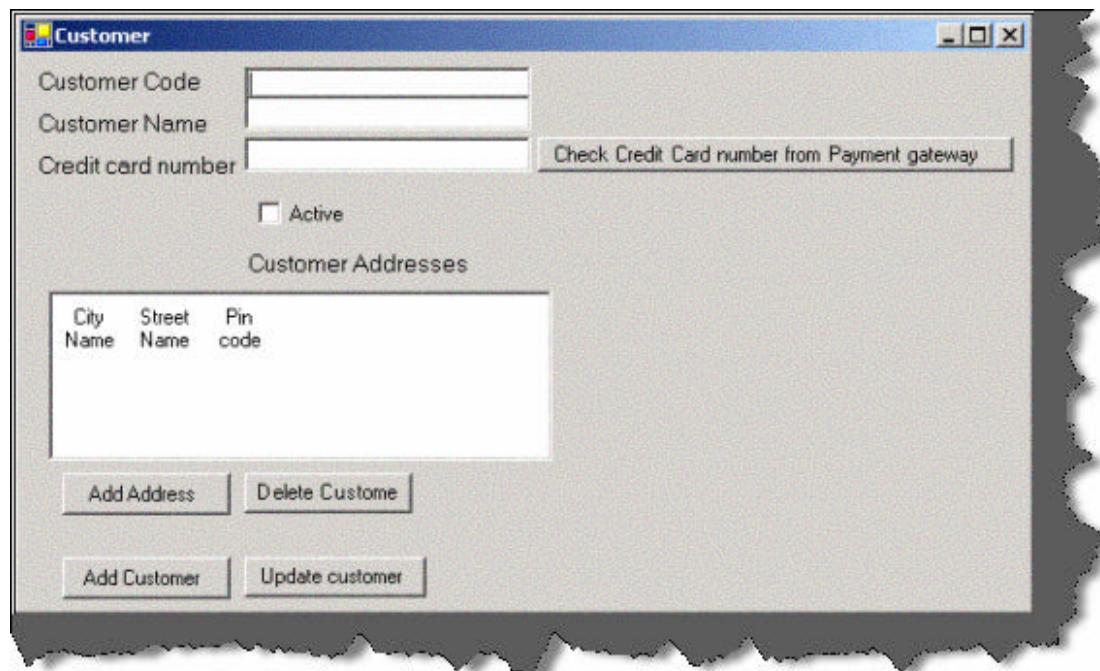
Let's try to implement these details in a sample customer project.

### **Sample Customer Project**

We will be evaluating the customer GUI. So we will just scope what the customer GUI is all about.

Following is the scope of the customer screen:-

- Customer screen will be as shown below.
- After putting the customer code and Customer name. They will be verified credit card check.
- Credit Card check is a external system.
- Every Customer can have multiple addresses.
- Customer will have add, update functionality.



**Figure:- 1.22 Custom screen**

There is one ILF in the above screen:

- The customer ILF.

There is one EIF in the above form.

- Credit Card System

Following the ILF counting rules

- ILF are logically related data from user point of view. Customer and Customer addresses belong logically to customer category.
- ILF reside in Internal Application boundary and are maintained through Elementary process of application. Customer resides in inside application boundary as we have full access over it.

So hence goes the counting below for ILF

<b>ILF Customer</b>		
<b>Description</b>	<b>Number of DET</b>	<b>Number of RET</b>
There are total 9 DETs, all add and update buttons, even the credit check button, the address list box, check box active, all text boxes. There is only one RET, the	9	1

customer addresses. So according to the above ILF ranking table	<b>Total function</b>	7
--------------------------------------------------------------------	-----------------------	---

**Table :- ILF for the customer**

EIF lie outside the application boundary.

<b>EI Credit Card Information</b>	<b>Number of DET</b>	<b>Number of RET</b>
Description		
The credit card information referenced is EIF. Note this file is only referenced for credit card check. There's only one textbox credit card number and hence one DET is put in the side column. And RET 0. Looking at the above rating table the total FP is 5.	1	1
So according to the above ranking table	Total function	5

**Table :- EI for the customer**

Following EIF rules define in the previous sections:

- It's a dynamic elementary process [For definition see "Dynamic and Static Elementary Process" Section] in which data is received from external application boundary. Customer detail is received from external boundary that is customer input screen.
- EIF may maintain ILF of the application, but it's not compulsory rule. In this sample project Customer ILF is maintained.
- So there are two EI one for Add and one from update.

It is two because processing logic for add and update is different.

<b>EI Add Customer</b>	<b>Number of DET</b>	<b>Number of FTR</b>
Description  There are total 9 DETs, all add and update buttons, even the credit check button, the address list box, check box active, all text boxes.  There are 3 FTRs, one is the address and the second is the credit card information	9	3

and third is customer himself.		
So according to the above ranking table	Total function	6

**Table :- EI for the add customer**

<b>EI Update Customer</b>		
<b>Description</b>	<b>Number of DET</b>	<b>Number of RET</b>
There are total 9 DETs, all add and update buttons, even the credit check button, the address list box, check box active, all text boxes. There are 3 FTRs, one is the address and the second is the credit card information and third is customer himself.	9	3
So according to the above ranking table	Total function	6

**Table :- EI for the update customer**

While counting EI I have seen many people multiplying it by 3. That means we are going to do all CRUD functionality (ADD, UPDATE, and DELETE). This is not fair as it just shows laziness of the Cost estimation team. Here the customer screen has add and update. I can say the  $2 * 6$  that's = 12 FP for this EI customer. But later when some refers to your FP sheet he will be completely lost.

Following are rules to recognize EO :-

- Data should cross application boundary and it should involve complex logic.

Credit card check process can be complex as the credit card API complexity is still not known. Data that is credit card information crosses from credit card system to Customer system.

<b>EO check credit card</b>		
<b>Description</b>	<b>Number of DET</b>	<b>Number of RET</b>

One DET Credit Card number and one RET credit card itself. Note if there are no RET we count default as one. Look for RET counting rules defined in previous section.	1	1
So according to the above ranking table	Total function	4

**Table :- EO to check the credit card**

Following are rules to recognize EQ: -

- It's a dynamic elementary process in which result data is retrieved from one or more ILF or EIF. For editing the customer we will need to retrieve the customer details.
- In this EP some input request has to enter the application boundary. The customer code is inputted from the same screen.
- Output results exits the application boundary. The customer details is displayed while the customer is editing the customer data.
- EQ does not contain any derived data. The above customer data which is displayed does not contain any complex calculations.

<b>EQ Display Customer Edit Information</b>		
<b>Description</b>	<b>Number of DET</b>	<b>Number of FTR</b>
There are 5 DETs to be retrieved Customer Code, Customer Name, Credit Card number, Active, Customer Address. Only customer details and customer address will be referenced.	5	2
So according to the above ranking table	Total function	3

**Table :- EQ to display customer edit**

So now, let's add the total function point got from above tables:

Function Point	Section Name Counted
ILF Customer	
EO Credit Card check system	4
EIF credit card information	5

EI Customer (Add and update)	12
EQ display customer edit information	3
Total Unadjusted Function Points	31

**Table :- Total of all function point**

So unadjusted function point comes to 31. Please note I have said this as Unadjusted function as we have not accounted other variance factor of project (Programmers leaving job, Language we will use, what architecture etc etc).

In order to make it adjusted function point, we have to calculate and tabulate the GSC and come out with the VAF.

GSC	Value(0-5)
Data communications	1
Distributed data processing	1
Performance	4
Heavily used configuration	0
Transaction rate	1
On-Line data entry	0
End-user efficiency	4
On-Line update	0
Complex processing	0
Reusability	3
Installation ease	4
Operational ease	4
Multiple sites	0
Facilitate change	0
<b>Total</b>	<b>22</b>

**Table :- GSC**

$$VAF = 0.65 + ((\text{sum of all GSC factor})/100). = 0.65 + (22/100) = 0.87.$$

This factor affects the whole FP like anything, be very particular with this factor. So now, calculating the

$$\text{Adjusted FP} = \text{VAF} * \text{Total unadjusted}$$

$$FP = 0.87 * 31 = 26.97 = \text{rounded to } 27 \text{ FP.}$$

Now we know that the complete FP for the customer GUI is 27 FP. Now calculating the

efficiency factor, we say that we will complete 3 FP per day that is 9 working days. So, the whole customer GUI is of 9 working days (Note do not consider Saturday and Sundays in this). I know upper manager people will say make it 7 FP per day and over load the programmer. That's why programmer works at night.

## **Considering SDLC (System Development Life Cycle)**

Before reading this section please refer to different SDLC cycles in previous chapters.

The main intention of introducing this section is because quotations are heavily affected by which software life cycle you follow. Because deliverables change according to SLDC model the project manager chooses for the project. Example for waterfall model we will have Requirement documents, Design documents, Source code and testing plans. But for prototyping models in addition to the documents above we will also need to deliver the rough prototype. For build and fix model we will not deliver any of the documents and the only document delivered will be source code. So according to SDLC model deliverables change and hence the quotation. We will divide the estimation across requirement, design, implementation (coding) and testing .In what way the estimation has to divide across all deliverables is all up to the project manager and his plans.

Phase Requirements	Percentage distribution effort 10% of total effort
Design Phase	20% of total effort
Coding	100 % of total effort
Testing	10% of total effort

**Table :- Phase wise distribution of effort**

The above sample is total 100 % distribution of effort across various phases. But note function point or any other estimation methodology only gives you total execution estimation. So you can see in the above distribution we have given coding as 100 %. But as said it up to the project manager to change according to scenarios .Ok now from the above function point estimation the estimation is 7 days let's try to divide it across all phases.

Phase	Percentage distribution effort	Distribution of man/days across phases
Requirements	10 % of total effort	0.9 days
Design Phase	20 % of total effort	1.8 days

Coding	60 % of total effort	7 days
Testing	10 % of total effort	0.9 days
Total		10.6 days

**Table :- Phase wise effort distribution of man days**

The above table shows the division of project man/days across project. Now let's put down the final quotation. Just a small comment about test cases.

Total number of Test Cases = (Function Point) raised to power of 1.2. This is as suggested from caper Jones.

#### **(A) How can you estimate number of acceptance test cases in a project?**

Number of Acceptance Test Cases = 1.2 \* Function Points

20-25 % of total effort can be allocated to testing phase. Test cases are non-deterministic. That means if test passes it takes "X" amount of time and if it does not then to amend it take "Y" amount of time.

#### **Final Quotation**

One programmer will sit on the project with around 1000 \$ salary / Month. So his 10.6 days salary comes to 318 dollars approx. The upper quotation format is in its simplest format. Every company has his quotation format accordingly. So no hard and fast rule of quotation template. But still if interested <http://www.microsoft.com/mac/resources/templates.aspx?pid=templates> has good collection of decent templates.

<b>XYZ SOFTWARE COMPANY</b>				
To:				
TNC Limited, Western road 17, California.				
Quotation number: 90				
Date: 1/1/2004				
Customer ID: Z- 20090DATAENTRY				
Quantity	Description	Discount	Taxable	Total
1	Customer Project	0%	0%	318 dollars

Quotation Valid for 100 days
Goods delivery date within 25 days of half payment
Quotation Prepared by: - XYZ estimation department
Approved by :- SPEG department XYZ

### **Table – Final bill**

CustomerSampleFP.xls is provided with the CD which has all estimation details which you can refer for practical approach. If you have downloaded e-book then you will need to download cddata.zip for all files.

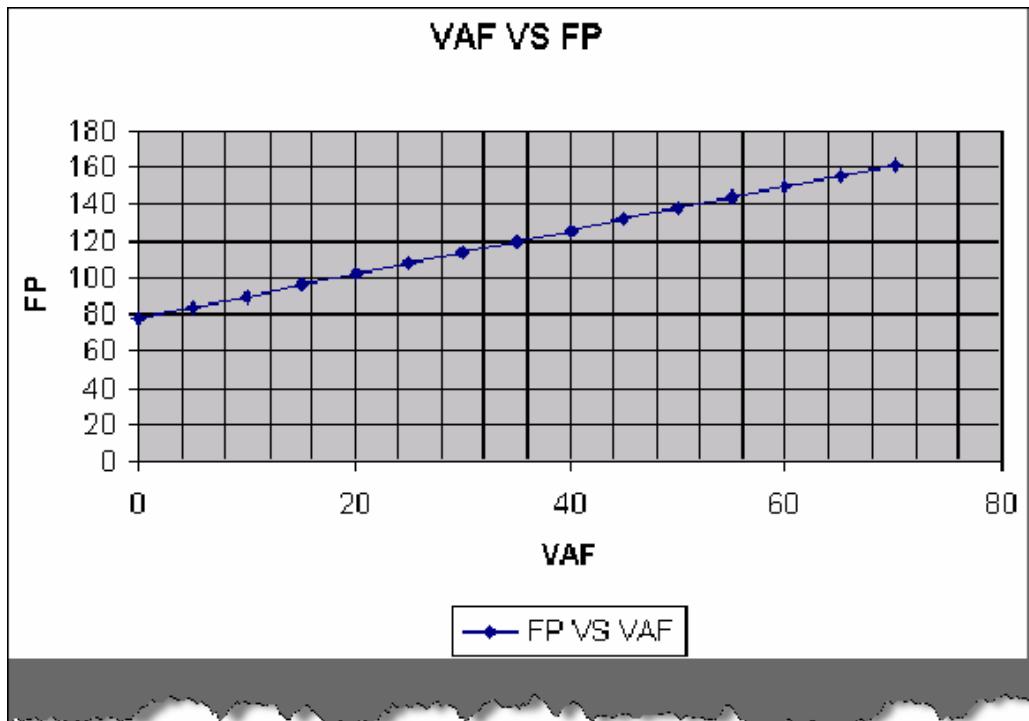
### **GSC Acceptance in Software industry**

GSC factors have been always a controversial topic. Most of the software companies do not use GSC, rather than they base line UAFP or construct their own table depending on company project history. ISO has also adopted function point as unit of measurement, but they also use UAFP rather than AFP. Let's do a small experiment to view relationship between FP, AFP, GSC and VAF. In this experiment we will assume UAFP = 120 and then plot graph with GSC increment of five. So the formulae is VAF =  $0.65 + (GS/100)$ .

Here's the table with every five incremental values in formulae and plot.

<b>FP</b>	<b>GSC</b>
78	0
84	5
90	10
96	15
102	20
108	25
114	30
120	35
126	40
132	45
138	50
144	55
150	60
156	65
162	70

**Table :- GSC acceptance**



**Figure: - FP versus VAF**

The following are the observation from the table and plot:-

- Graph is linear. It also captures that nature of complexity is linear.
- If the GSC value is zero then VAF is 0.65. So the graph starts from  $UAFP * 0.65$ . GSC = 35 AFP = UAFP. So the VAF = 1.
- When GSC < 35 then AFP < UAFP. That means complexity decreases.
- When GSC > 35 then AFP > UAFP. That means complexity increases.

Readers must be wondering why 0.65? There are fourteen GSC factor from zero to five. So the maximum value of VAF =  $0.65 + (70/100) = 1.35$ . In order that VAF does not have any affect i.e. UAFP = FP VAF should be one. VAF will be one when GSC is 35 i.e. half of 70. So in order to complete value “1” value “0.65” is taken. Note value is 0.35 when GSC is 35 to complete the one factor “0.65” is required.

But following is the main problem related to GSC. GSC is applied throughout FP even when some GSC does not apply to whole function points. Here's the example to demonstrate GSC problem.

Let's take 11th GSC factor “installation ease”. The project is of 100 UAFP and there is no consideration of installation previously by client so the 11th factor is zero.

GSC with installation ease with ZERO	
GSC	Value(0-5)

Data communications	1
Distributed data processing	1
Performance	4
Heavily used configuration	0
Transaction rate	1
On-Line data entry	0
End-user efficiency	4
On-Line update	0
Complex processing	0
Reusability	3
Installation ease	0
Operational ease	4
Multiple sites	0
Facilitate change	0
<b>Total</b>	<b>18</b>

**Table : GSC with installation ease zero**

VAF =  $0.65 + (18/100) = 0.83$ . So the FP =  $100 * 0.83 = 83$  Function Points. But later the client demanded for full blown installation for the project with auto updating when new version is released. So we change out GSC table with installation ease to 5.

GSC with installation eases “5”

<b>GSC with installation ease with FIVE</b>	
<b>GSC</b>	<b>Value(0-5)</b>
Data communications	1
Distributed data processing	1
Performance	4
Heavily used configuration	0
Transaction rate	1
On-Line data entry	0
End-user efficiency	4
On-Line update	0
Complex processing	0
Reusability	3
Installation ease	5
Operational ease	4
Multiple sites	0
Facilitate change	0
<b>Total</b>	<b>23</b>

**Table :- GSC with Installation ease 5**

So VAF =  $0.65 + (23/100) = 0.88$  so the FP =  $100 * 0.88 = 88$ . The difference is of only 5 FP which from no way a proper effort estimate. To make an auto updation for a software versioning can no way be done in 5 function points , just think downloading new version, deleting the old version , updating any database structure changes etc etc. So that's the reason GSC is not accepted in software industry. Best ways is baseline you're UAFP and make your estimation on base of UAFP.

## Enhancement Function Points

Major software project fail not because of programmer's or project managers but due to moody and changing customers. In one of our huge projects we had good programmers, very enthusiastic. The project started of well but customer called ten times in a day to change something or other. Believe me programmers get pissed if the customer is changing his plans every fortnight. Well from this book point of view we have to evaluate this changes which can be addition or deletion of requirements. Function point group has come out with a methodology called as "Enhancement Function Points".

Down is the formulae

Formulae of EFP (Enhanced Function Points) = (ADD + CHGA) \* VAFA +  
(DELFP) \* VAFB

**ADD:** - This is new function points added. This value is achieved by counting all new EP (Elementary process) given in change request.

**CHGA:** - Function points which are affected due to CR. This value is achieved by counting all DET, FTR, ILF, EI, EO and EQ which are affected. Do not count elements which are not affected.

**VAFA:** - This is VAF factor which is because of CR. Example previously the application was desktop and now is changed to web so the GSC factor is affected.

**DELFP:** - When CR is for removing some functionality this value is counted. It's rare that customer removes functionalities (at least in India), but if they ever estimator has to take note of it by counting the deleted elementary process.

**VAFB:** - Again removal affects Value added factor.

Once we are through with calculating enhanced function points, it time to count total function points of the application.

Total Function points = [UFPB + ADD + CHGA] - [CHGB - DELFP]

UFPB: - Function points previously counted before enhancement.

ADD: - Newly added functionality which leads to new function points after enhancements.

CHGA: - Changed function points counted after enhancements.

CHGB: - Changed function points before enhancements.

DELFp: - Deleted function points.

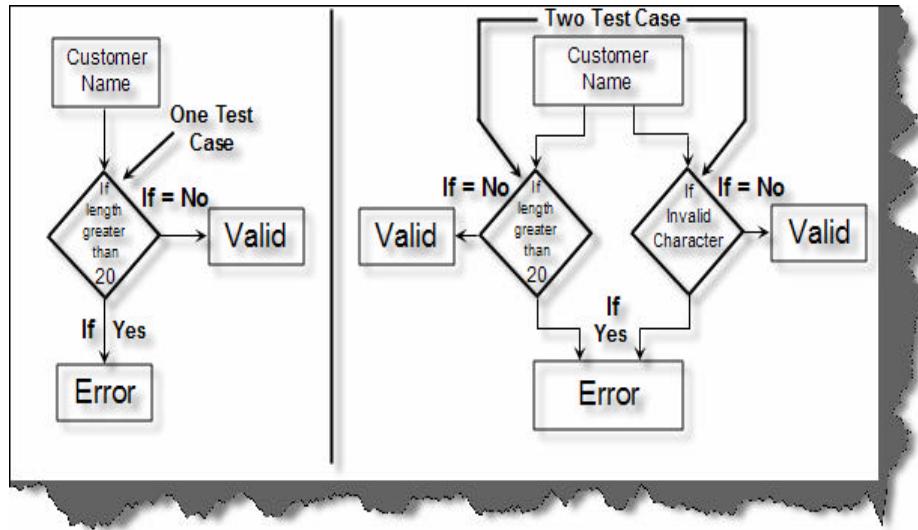
---

### **(A) Can you explain on what basis does TPA actually work?**

There are three main elements which determine estimate for black box test Size, Test strategy and Productivity. Using all these three elements we can determine the estimate for black box testing for a given project. So let's understand all these elements step by step.

**Size** : - The prime important thing in estimation is definitely the size of the project. Size of a project is mainly defined by number of function points. But a function point fails or pays least importance to the following factors:-

- Complexity: - Complexity means how many conditions exist in function points identified during project. If more conditions means more test cases that means more testing estimates. For instance below is an application which takes customer name from the end user. If the customer name is greater than 20 characters then the application should throw an error. So for this case there will be one test case. But let's say the end user also puts one more condition that if the user inputs any invalid character then the application should throw an error. Because there is one more extra condition in the project that means the complexity has increased due to the extra condition which also means that we need now two test cases to test, which means increase in test efforts. Below figure signifies the same in a pictorial manner.



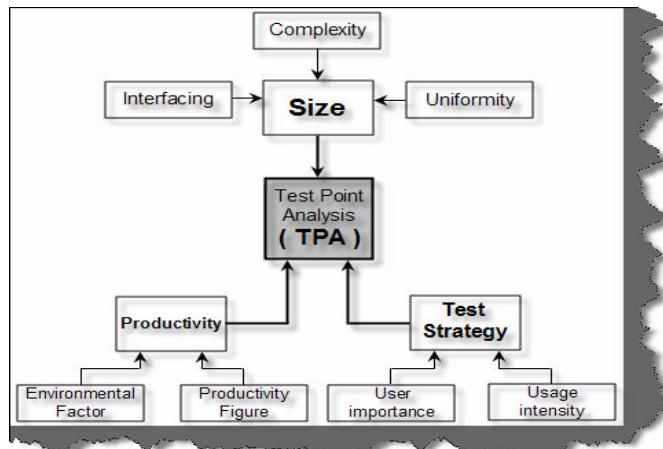
**Figure: - Complexity**

- **Interfacing** :- How much does one function affect the other part of the system?. So if this function is modified then accordingly the other systems have to be tested as this function has high impact analysis.
- **Uniformity** : - How reusable is the application?. It is important to consider how many similar structured functions exist in the system. It is important to consider the extent to which the system allows testing with slight modifications.

**Test strategy:** - Every project has certain requirements. The importance of all these requirements also affects testing estimates. Any requirement importance is from two perspectives one is the user importance and one the user usage. Depending on these two characteristics a requirement rating can be generated and a strategy can be chalked out accordingly. Which also means that estimates vary accordingly?.

**Productivity:** - This is one more important aspect to be considered while estimating black box testing. Productivity depends on lot of aspects for instance if your project has fresher's definitely your estimates shoot up, because you will need to train the fresher's in terms of project and domain knowledge. Productivity has two important aspects environment and productivity figure. Environmental factor defines how much the environment affects a project estimate. Environmental factors contains aspects like tools, test environments, availability of test ware etc. While productivity figure depends on knowledge, how many senior people are there in the team etc?

Below diagram shows the complete pictorial regarding the different elements which constitute TPA analysis as discussed in the previous section.

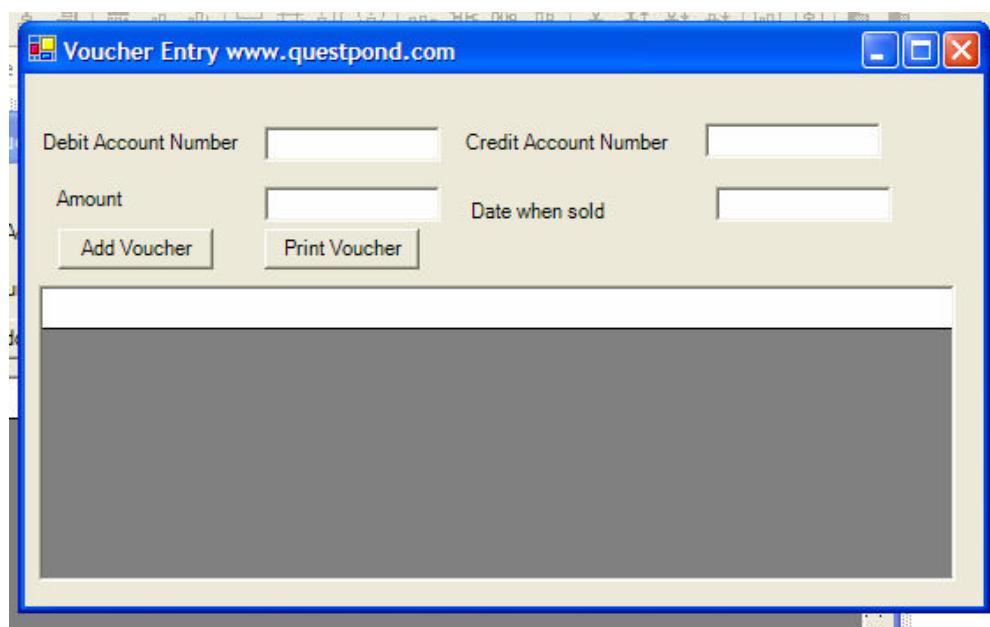


**Figure: - TPA parameters**

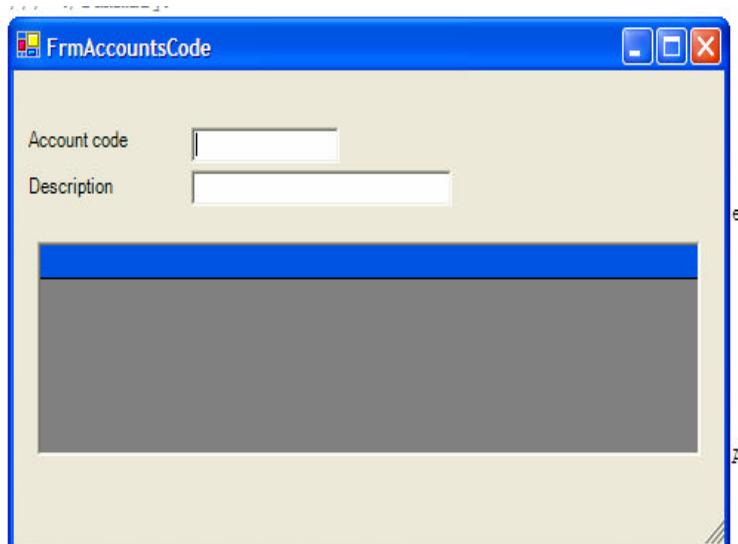
### (A) How did you do estimation for black box testing?

Note: - In CD we have provided "FunctionPoints (Accounting Application).xls" , which is used in this example to make TPA calculation easier. In the same chapter we have provided an explanation of how to use the excel sheet. The entire image snapshot which you will see in this answer is taken from "FunctionPoints (Accounting Application).xls".

In order to really answer this question let's do one complete estimation practically for a sample project. Below is a simple accounting application developed for <http://www.questpond.com> (that's my official website) website to track its sales. The first screen is a voucher entry screen. It's a normal simple voucher entry screen with an extra functionality to print the voucher. The second screen is a master screen to add accounting codes.



**Figure: - Accounting application**



**Figure: - Account code description**

Below are point wise requirements gathered from the end customer:-

- 1) The account code entered in the voucher entry screen should be a valid account code from the defined chart of accounts by the customer.
- 2) User should be able to add, delete and modify account code from the chart of account master (This is what exactly the second screen defines).
- 3) User will not be able to delete chart of account code if he has already entered transactions for the same in vouchers.

- 4) Chart of account code master will consist of account code and description of the account code.
- 5) Account code can not be greater than 10.
- 6) The voucher data entry screen consists of debit account code, credit account code, date of transaction and amount.
- 7) Once the user enters a voucher data he should be able to print the same in future any time.
- 8) The dr & cr a/c are compulsory
- 9) The Amount value should not be negative
- 10) After pressing the submit the value should be seen in the grid
- 11) Amt is compulsory and Amt should be more than zero.
- 12) The debit and credit account should be equal in value.
- 13) Only numeric and non-negative values are allowed in amount field.
- 14) Two types of entry are allowed i.e.sales and commission.
- 15) Date, amount and voucher number is compulsory.
- 16) Voucher number should be in serial wise and system should auto increment the voucher number with every voucher added.
- 17) No entry allowed one month before.
- 18) Users should be able to access data from separate geographical location. For instance if one user is working in India and the other in China , then both user should be able to access each others data through their respective location.

Now that we have all the requirements lets try to estimate how we can use TPA to do get the actual man days. Below figure shows our road map how we will achieve the same using TPA. There are in all ten steps to achieve the same.

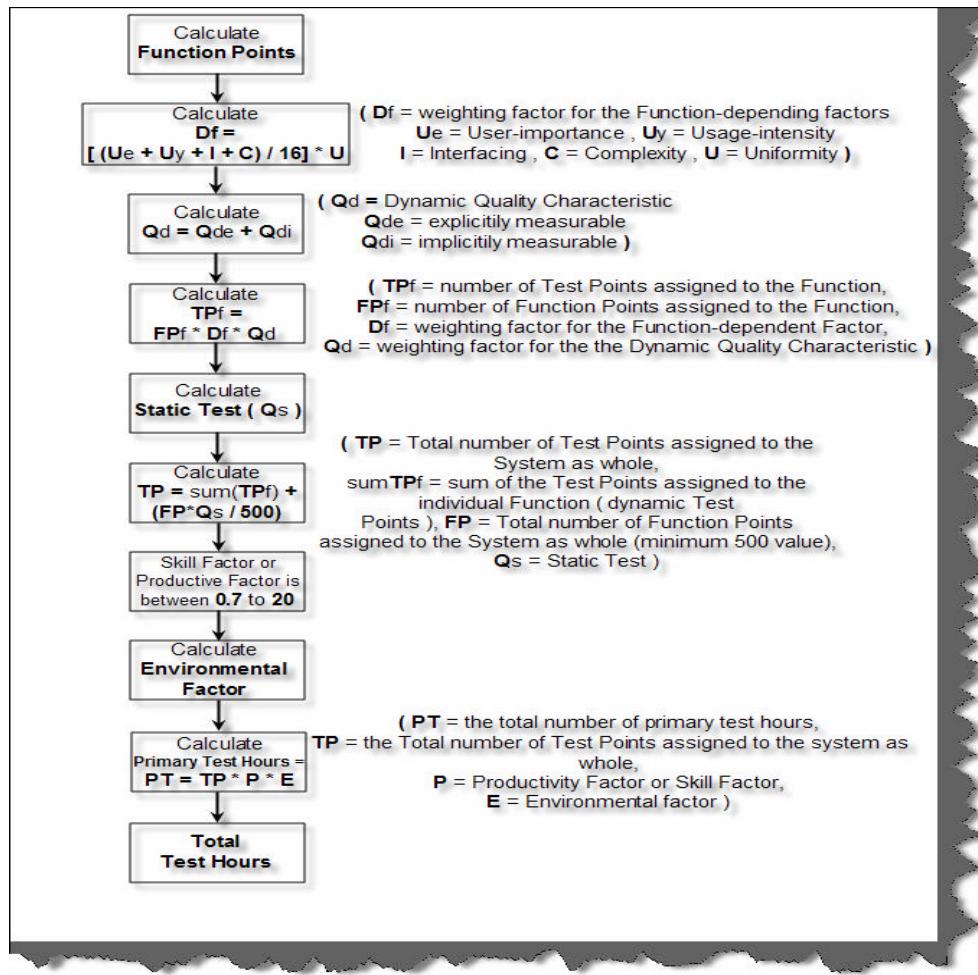


Figure: - TPA steps.

### Step 1- Calculate function points

Note: - You will not able to follow this if you have not read the function points explanation previously.

### EI calculation

Below are the EI entries for the accounting application. Currently we have two screens one is the master screen and one is the voucher transaction screen. In the description we have also described which DET's we have considered. For the add voucher screen we have 7 DET (note the buttons are also counted as DET) and for the Account code master we have 4 DET.

Functionality	DET	FTR	Value	Description
Add voucher	7	1	3	DET :- Debit account code , Credit Account code , Amount , Date , Add voucher button , Print voucher button and display grid
Add account code	4	1	3	DET:- Account code , Add button , unselect all button and Grid

**Figure: - EI for the accounting application**

### **EIF**

There are no EIF's in the system because we do not communicate with any external application.

Functionality	DET	RET	Value	Description
NA	NA	NA	NA	NA

**Figure: - EIF for the accounting application**

### **EO**

EO's are nothing but complex report. In our system we have three complex reports Trial balance, Profit and loss and Balance sheet. By default we have assumed 20 fields which makes it a complex report (When we do estimation some times assumptions are fine).

Functionality	DET	FTR	Value	Description
Report Trial Balance	20	1	5	Assumed maximum 20 fields
Profit and Loss	20	1	5	Assumed maximum 20 fields
Balance sheet	20	1	5	Assumed maximum 20 fields

**Figure: - EO for the accounting application**

### **EQ**

EQ's are nothing but simple output sent from the inside of the application to the external world. For instance simple report is typical type of EQ's. In our current accounting application we have one simple print that is the print voucher. We have assumed 20 DET's for the same so that we can move ahead with the calculation.

Functionality	DET	FTR	Value	Description
Print voucher	20	1	4	Assumed 20 DET's

**Figure: - EQ for the accounting application**

### **GSC calculation**

As said in the FPA tutorial previously GSC factor defines the other factor of the projects which the FP counting does not accommodate. For the accounting application we have

kept all the GSC factors are 1 except for two GSC factor Data communications and performance. We have kept communication as 2 because one the requirement point is that we need application data to be accessed from multiple centers which increases the data communication complexity. Other GSC factor we have considered a bit complex is the performance because one of the requirement of the end customer is that performance should be mediumly good. Below figure shows the GSC entries.

GSC Attribute	Definitions	Value
Data communications:	How many communication facilities are there to aid in the transfer or exchange of information with the application or system?	2
Distributed data processing	How are distributed data and processing functions handled?	0
Performance	Did the user require response time or throughput?	2
Heavily used configuration	How heavily used is the current hardware platform where the application will be executed?	1
Transaction rate	How frequently are transactions executed; daily, weekly, monthly, etc.?	1
On-Line data entry	What percentage of the information is entered On-Line?	1
End-user efficiency	Was the application designed for end-user efficiency?	1
On-Line update	How many ILF's are updated by On-Line transaction?	1
Complex processing	Does the application have extensive logical or mathematical processing?	1
Reusability	Was the application developed to meet one or many user's needs?	1
Installation ease	How difficult is conversion and installation?	1
Operational ease	How effective and/or automated are start-up, back up, and recovery procedures?	1
Multiple sites	Was the application specifically designed, developed, and supported to be installed at multiple sites for multiple organizations?	1
Facilitate change	Was the application specifically designed, developed, and supported to facilitate change?	1
<b>GSC</b>		<b>0.8</b>

**Figure: - GSC factors for accounting application**

### Total calculation

Now that we have filled in all the details we need to calculate the total man days. Below is the image which will explain us how the calculations are done. The first five rows i.e. ILF, EIF, EO, EQ and EI are nothing but total of the individual entries. A total unadjusted function point is the total of ILF + EIF + EO + EQ + EI. We get the total adjusted function which is nothing but Total Un-Adjusted function points multiplied by the GSC factor. Depending on organization base line we define how much FP can be completed by a programmer in one day. For instance for the below accounting application we have put 1.2 FP per day. Depending on the FP per day we get total man days. Once we have got total man days we distribute these values across the phases. One of the very important

thing what we have just got is the total execution time. So we have assigned the total man days to the execution phase. From the execution phase man days we distribute 20 percent to requirement phase, 20 percent to technical design and 5 percent to testing.

Note :- We will answer a small and sweet answer in this mid of the explanation.

### (A) How did you estimate white box testing?

The testing estimates derived from function points is actually the estimates for only white box testing. So in the below figure 1.3 man days is actually the estimate for white box testing of the project. It does not take in to account black box testing estimation.

### (A) Is there a way to estimate acceptance test cases in a system?

Total acceptance test cases = total adjusted function points multiplied by 1.2

The total estimate for this project is 37.7 man days.

Project Name	Accounting Application	
ILF		14
EIF		0
EO		15
EQ		4
EI		6
Total Unadjusted Function Points		39
Total GSC		0.8
Total Adjusted Function Points		31.2
Programmer can complete how much FP per day		1.2
<b>Total Man Days</b>		<b>26</b>
Phases	Percentage	Man Days
Requirement Gathering	20	5.2
Technical Design	20	5.2
Execution	100	26
Testing ( White box testing)	5	1.3
Total Man Days		37.7
Number of Developers		1
Total Project Schedule		37.7
Total Acceptance test case		<b>37</b>

**Figure: - Total estimation of the accounting application**

Now that we have completed the function point analysis for this project lets move to the second step to calculate black box testing using TPA.

### Step 2:- Calculate Df (Function dependant factors)

Df is defined for each function point. So all the function point description as well as value is taken and Df is calculated for each of them. You can see from the figure below how every function point factor is take and Df calculated for the same.

function\factors	TPf	FPf	Ue	Uy	I	C	U	$Df = (( Ue + Uy + I + C ) / 16) * U$
								Df
Voucher data	14.84	7	12	12	2	3	1	1.81
chart of accounts data	5.12	7	3	2	2	3	1	0.63
Report trial balance	4.75	5	3	2	2	6	1	0.81
Report profit and loss	4.75	5	3	2	2	6	1	0.81
Report balance sheet	4.75	5	3	2	2	6	1	0.81
Print voucher	9.36	4	12	12	2	6	1	2.00
add Voucher	8.34	3	12	12	2	12	1	2.38
Add account code	3.29	3	6	2	4	3	1	0.94

Figure: - Df calculated

But we have still not seen how Df will be calculated. Df is calculated using four inputs User importance, Usage intensity, Interfacing and Complexity. Below figure show the different inputs in a pictorial manner. All the four factors are rated with Low, Normal and High and assigned to each function factors derived from function points. So let's understand these factors step by step.

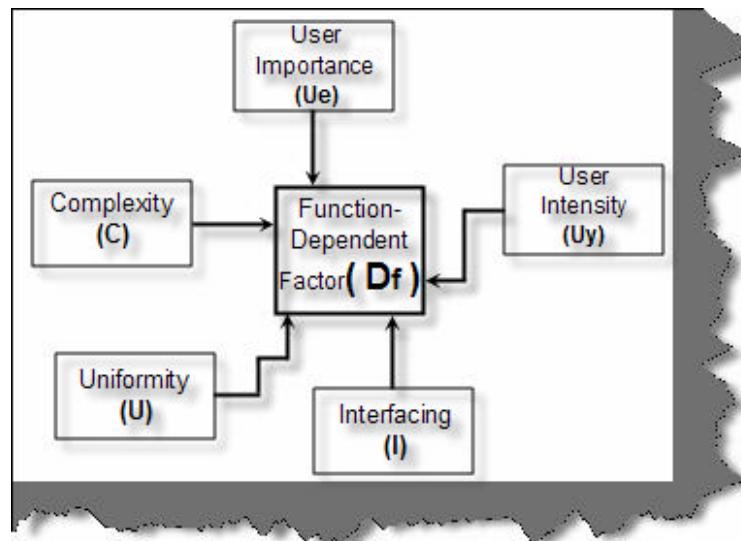


Figure: - Factors on which Df depends

**User importance (Ue):** - How important is this function factor to the user and compared to other function factors. Below figure shows how they are rated. Voucher data, Print voucher and Add voucher is rated with high user importance. With out these the user can not work at all. Reports have been rated low because they do not really stop the user from working, definitely they are of high importance but not as high as the add voucher and

print voucher. Chart of accounts master is rated low because the master data is something which is added one time and can also be added from the back end.

User importance (Ue)									
Rating		Description							
3	Low	The importance of the function relative to the other function is low.							
6	Normal	The importance of the function relative to the other function is normal.							
12	High	The importance of the function relative to the other function is high.							

function\factors	TPf	FPf	Ue	Uy	I	C	U	Df
Voucher data	14.84	7	12	12	2	3	1	1.81
chart of accounts data	5.12	7	3	2	2	3	1	0.63
Report trial balance	4.75	5	3	2	2	6	1	0.81
Report profit and loss	4.75	5	3	2	2	6	1	0.81
Report balance sheet	4.75	5	3	2	2	6	1	0.81
Print voucher	9.36	4	12	12	2	6	1	2.00
add Voucher	8.34	3	12	12	2	12	1	2.38
Add account code	3.29	3	6	2	4	3	1	0.94

Figure: - User importance

**Usage intensity (Uy):** - This factor tells how many users use it and how often. Below figure shows how we have assigned the values to each function factors. Add voucher, print voucher and voucher data is the most used function factors, hence they are rated high. Other all function factors are rated as low.

Usage intensity (Uy)									
Rating		Description							
2	Low	The function is only used a few times per day or per week.							
4	Normal	The function is being used a great many times per day.							
12	High	The function is used continuously throughout the day.							

function\factors	TPf	FPf	Ue	Uy	I	C	U	Df
Voucher data	14.84	7	12	12	2	3	1	1.81
chart of accounts data	5.12	7	3	2	2	3	1	0.63
Report trial balance	4.75	5	3	2	2	6	1	0.81
Report profit and loss	4.75	5	3	2	2	6	1	0.81
Report balance sheet	4.75	5	3	2	2	6	1	0.81
Print voucher	9.36	4	12	12	2	6	1	2.00
add Voucher	8.34	3	12	12	2	12	1	2.38
Add account code	3.29	3	6	2	4	3	1	0.94

Figure: - Usage intensity

**Interfacing (I):** - This factor defines how much impact does this function factor affect the other parts of the system. But how do we now find the impact?. In TPA concept of LDS affected is used to determine the interfacing rating. LDS means logical data source. In our project we have two logical data source one is Voucher data and the other is the

Account code data (i.e. Chart of accounts data). Following are the important points to be noted which determine the interfacing:

- We need to consider only functions which modify LDS. If a function is not modifying LDS then its rating is LOW by default.
- To define LDS we need to define how many LDS is affected by the function and how many other functions access the LDS. Other functions only need to access the function, even if they do not modify its still considered.

Below is the table which defines complexity level according to number of LDS and Functions impacting on the LDS.

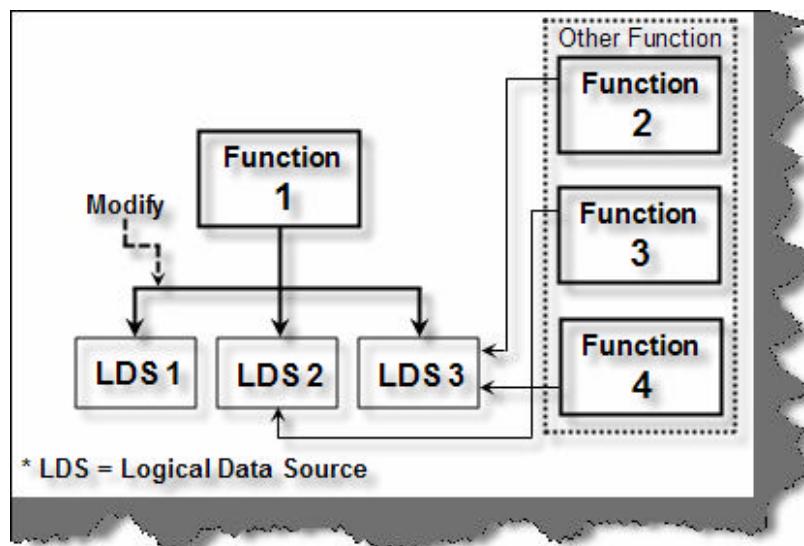


Figure: - LDS and the function concept

LDS ↓	Functions →		
	1	2 to 5	greater than 5
1	L	L	A
2 to 5	L	A	H
greater than 5	A	H	H

( \* L = Low, A = Average, H = High )

Figure: - LDS ratings

So now depending on the two points defined above lets try to find out the interfacing value for our accounting project. As said previously we have two functions which modify LDS in our project one is the Add Voucher which affects the Voucher data and Add account code which affects the Chart of Accounts code (i.e. the Accounts code master).

So first let's see Add voucher function, below is the diagram which explains in detail which LDS and functions are involved in the same. Add voucher primarily affects Voucher data LDS. But other functions like reports and print also use the LDS. So in total there are five numbers of functions and one LDS. Now looking at the number of LDS and number of function table the impact complexity factor is LOW.

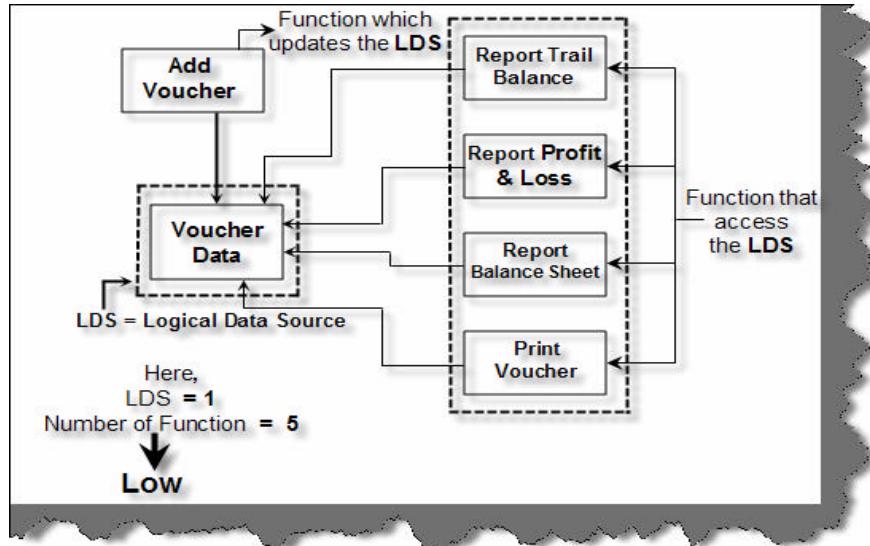
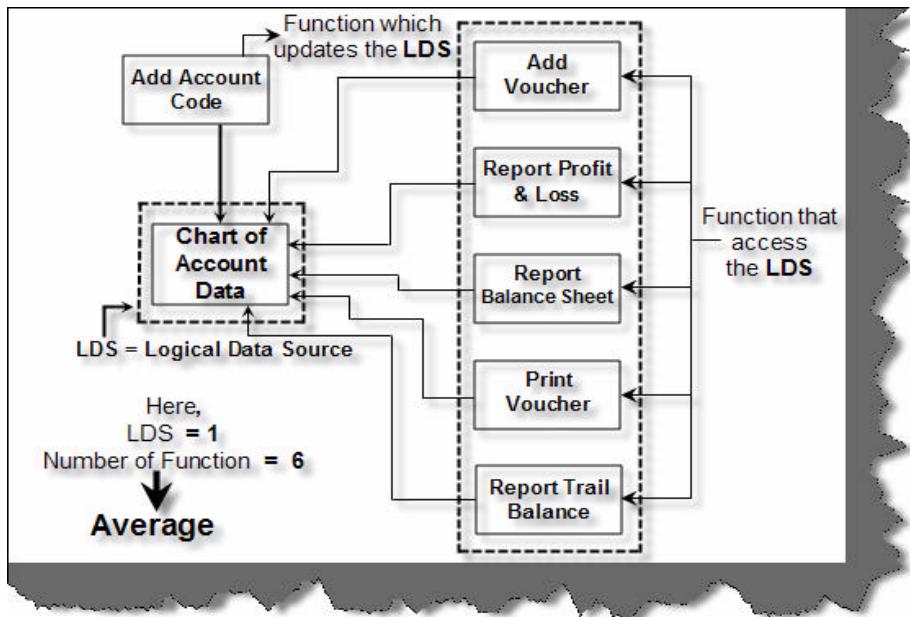


Figure: - Add voucher data

The other function which does modification is the Add account code. The LDS affected is the chart of account code and the function which affects it is the Add account code function. There are other functions who indirectly affect this function for instance report which needs to access account code , print voucher which uses the account code to print account description and also the Add voucher function uses the chart of accounts code LDS to validate if the account code is proper or not. So again we see the look up table and the impact complexity factor is AVERAGE.



**Figure : - Add account code LDS and functions**

The other function factors do not modify any data so we give them a LOW rating. Below is the interfacing complexity factor assigned below.

Interfacing (I)			TPf	FPf	Ue	Uy	I	C	U	Df
Rating		Description								
2		Low	The degree of interfacing associated with the function is low.							
4		Normal	The degree of interfacing associated with the function is normal.							
8		High	The degree of interfacing associated with the function is high.							
<hr/>										
function\factors			TPf	FPf	Ue	Uy	I	C	U	Df
Voucher data			14.84	7	12	12	2	3	1	1.81
chart of accounts data			5.12	7	3	2	2	3	1	0.63
Report trail balance			4.75	5	3	2	2	6	1	0.81
Report profit and loss			4.75	5	3	2	2	6	1	0.81
Report balance sheet			4.75	5	3	2	2	6	1	0.81
Print voucher			9.36	4	12	12	2	6	1	2.00
add Voucher			8.34	3	12	12	2	12	1	2.38
Add account code			3.29	3	6	2	4	3	1	0.94

**Figure: - Interfacing**

**Complexity (C):-** This factor defines how complex is the algorithm for the particular function factor. Add voucher is the most complex functionality in the project and it can have more than eleven conditions so we have rated the Complexity factor as the highest.

Reports are mediumly complex and can be rated as averagely complex. So as discussed we have assigned values accordingly as shown in the figure below.

Complexity (C)										
Rating	Description									
3	Low	The function contains no more than five conditions.								
6	Normal	The function contains between six and eleven conditions.								
12	High	The function contains more than eleven conditions.								
function factors		TPf	FPf	Ue	Uy	I	C	U	DF	
Voucher data		14.84	7	12	12	2	3	1	1.81	
chart of accounts data		5.12	7	3	2	2	3	1	0.63	
Report trial balance		4.75	5	3	2	2	6	1	0.81	
Report profit and loss		4.75	5	3	2	2	6	1	0.81	
Report balance sheet		4.75	5	3	2	2	6	1	0.81	
Print voucher		9.36	4	12	12	2	6	1	2.00	
add Voucher		8.34	3	12	12	2	12	1	2.38	
Add account code		3.29	3	6	2	4	3	1	0.94	

## **Figure: - Complexity**

**Uniformity (U):** This factor defines how reusable is the system. For instance if a test case written for one function can be again applied then it affects the testing estimates accordingly. Currently for this project we have taken a uniformity factor of 1. So for example if the customer had a requirement to also update accounts code. Then we could have had two functions i.e. Add voucher and update voucher, but the test case for both of them are same only with minimal change.

Uniformity (U)									
Rating	Description								
<b>0.6</b>	In the case of a second occurrence of a virtually unique function : in such cases, the test specifications can be largely reused								
<b>0.6</b>	In the case of a clone function: the test specifications can be reused for clone functions.								
<b>0.6</b>	In the case of a dummy function (provided that reusable test specifications have already been drawn up for the dummy).								
<b>1</b>	Otherwise Uniformity factor is 1								
function\factors		TPf	FPf	Ue	Uy	I	C	U	Df
Voucher data		14.84	7	12	12	2	3	1	1.81
chart of accounts data		5.12	7	3	2	2	3	1	0.63
Report trial balance		4.75	5	3	2	2	6	1	0.81
Report profit and loss		4.75	5	3	2	2	6	1	0.81
Report balance sheet		4.75	5	3	2	2	6	1	0.81
Print voucher		9.36	4	12	12	2	6	1	2.00
add Voucher		8.34	3	12	12	2	12	1	2.38
Add account code		3.29	3	6	2	4	3	1	0.94

### **Figure: - Uniformity**

Once we have all the five factors we apply the below formulae to calculate Df for all the function factors.

$$Df = [(U_e + U_Y + I + C)/16] * U$$

### Step 3:- Calculate Qd:-

The third step is to calculate Qd. Qd i.e dynamic quality characteristics has two parts one is the explicit characteristic (Qde) and other is implicit (Qdi). Qde has five important characteristics Functionality, Security, Suitability, Performance and Portability. Below diagram shows how we rate those ratings. Qdi define the implicit characteristic part of the Qd. These are not standard and vary from project to project. For instance we have identified for this accounting application four characteristics user friendly, efficiency, performance and maintainability. From these four characteristics which ever are important we assign 0.02 value for the same. We can see from the below figure for user friendliness we have assigned 0.02 value other are left. In Qde part we have given functionality normal importance and performance as relatively unimportant but we do need to account the same. Once we have Qde and Qdi then  $Qd = Qde + Qdi$ . For this sample you can see that the total value of Qd is 1.17 (which is obtained from  $1.15 + 0.02$ ).

Qd is calculated using the rating multiplied by the value. The below table shows the rating and the next after it shows the actual value. So the 1.15 has come from the below formulae

$$((5 * 0.75) + (3 * 0.05) + (4 * 0.10) + (3 * 0.10) + (3 * .10)) / 4$$

Characteristics\Rating	0	3	4	5	6
<b>functionality</b>	( Weighting 0.75 )				
<b>security</b>	( Weighting 0.05 )				
<b>Usability</b>	( Weighting 0.10 )				
<b>Efficiency</b>	( Weighting 0.10 )				

Figure: - Qd ratings

1) Dynamic quality characteristics (Qd)		
((0,3,4,5,6)*we Dynamic quality characteristics (Qd))		
	Rating	Description
functionality	5	Quality requirement are not important and are therefore disregarded for test purposes.
security	3	Quality requirement are relatively unimportant but do need to be taken into consideration for test purposes.
suitability	4	Quality requirement are of normal importance. (This rating is generally appropriate where the information system relates to a support process.)
performance	3	Quality requirements are very important. (This rating is generally appropriate where the information system relates to a primary process.)
portability	3	
Q de	1.15	
userfriendliness	0.02	
efficiency	0	
performance	0	
maintainability	0	
Q di	0.02	
Q dynamic	1.17	(Qd=Qde +Qdi)

**Figure: - Calculation of Qd (Dynamic characteristic)**

#### **Step 4 Calculate TPf for each function:-**

In this step we calculate TPf (number of test points assigned to each function). This is done by using three data values (FPf, Df and Qd) calculated till now, below is the formulae for the same.

$$TPf = FPf * DF * Qd$$

Because we are using the excel sheet these calculations happen automatically. Below figure which shows how the TPf calculations are done.

functionality	5	(weight factor 0,75)						
security	3	(weight factor 0,05)						
suitability	4	(weight factor 0,10)						
performance	3	(weight factor 0,05)						
portability	3	(weight factor 0,05)						
<b>Q de</b>	<b>1.15</b>							explicitly measurable
userfriendliness	0.02	(weight factor 0,02)						
efficiency	0	(weight factor 0,02)						
performance	0	(weight factor 0,02)						
maintainability	0	(weight factor 0,02)						
<b>Q di</b>	<b>0.02</b>							implicitly measurable
<b>Q dynamic</b>	<b>1.17</b>	(Qd=Qde + Qdi)						

2) Function dependent variables (Df) and test points (TPf)

$$Df = ((Ue + Uy + I + C) / 16) * U$$

$$TPf = FPf * Df * Qd$$

function\factors	TPf	FPf	Ue	Uy	I	C	U	Df
Voucher data	14.84	7	12	12	2	3	1	1.81
chart of accounts data	5.12	7	3	2	2	3	1	0.63
Report trail balance	4.75	5	3	2	2	6	1	0.81
Report profit and loss	4.75	5	3	2	2	6	1	0.81
Report balance sheet	4.75	5	3	2	2	6	1	0.81
Print voucher	9.36	4	12	12	2	6	1	2.00
add Voucher	8.34	3	12	12	2	12	1	2.38
Add account code	3.29	3	6	2	4	3	1	0.94

Figure: - Calculation of TPf

### Step 5 Calculate static test points Qs:-

In this step we take in to account the static quality characteristic of the project. This is done by defining a check list and then if the test team needs to consider them we assign a value of 16 to those properties. For this project we have only considered easy to use as a criteria and hence assigned 16 to it.

<b>3) Statically measurable quality characteristics (Qs) =</b>		
flexibility	0	(Y/N = 0/16)
testability	0	(Y/N = 0/16)
security	0	(Y/N = 0/16)
continuity	0	(Y/N = 0/16)
Easy to use	16	
<b>4) Total number of test points TP (TP=</b>		
TP =	43.25	+ <b>C.P.I.: 0,16</b>

If Quality characteristic is tested by means of checklist (static test) then value is 16 or else it will be 0

Figure: - Qs calculation

### Step 6 calculate total number of test points :-

Now that we have TPf's for all function factors, FP and Qs (static test point data), its time to calculate Tp (Total number of test points).

$$Tp = \text{sum}(TPf) + (FP * Qs / 500)$$

For the accounting system total  $Tp = 71.21$  (use a calculator to check it out yourself, just makes the concept better to understand). Below is the figure which shows how the total  $Tp$  is derived.

4) Total number of test points TP (TP= sum(TPf) + (FP*Qs)/500)				
TP =	55.21	+	( 500 * 16 ) / 500	
TOTAL NUMBER OF TEST POINTS			71.21	

Figure: - Total number of test points

#### Step 7 calculate Productivity / Skill factor:-

Productivity / Skill factor shows the number of test hours needed per test points. It's a measure of experience, knowledge, and expertise and teams ability to perform.

Productivity factor vary from project to project and also organization to organization. For instance if we have project team with many seniors then the productivity increases. But if we have fresher's who are just learning then definitely the productivity decreases. Higher the productivity factor higher is the number of test hours required.

For this project we have considered we have good resources and with great ability. So we have entered a value of 1.50 which means we have considered the highest productivity.

6) Primary test hours (PT=TP*Skill*E)					Skill Factor or Productivity factor is considered between 0.7 o 2.0
Skill factor	1.50	*			
PT=	68.14	*	1.50	*	0.95
TOTAL PRIMARY HOURS			97.34		

Figure: - Productivity factor / Skill factor

#### Step 8 Calculate environmental Factor (E):-

Number of test hours for each test point is influenced not only by skills but also the environment in which those resources work. Below figure shows the different environmental factors. You can also see the table ratings for every environmental factor.

5) Environmental factor E =		Testware	
		Rating	Description
test tools	2	1	A usable general initial data set (tables, etc) and specified test cases are available for the test.
Development testing	8	2	A usable general initial data set (tables, etc) is available for the test.
test basis	3	3	
development environm	2	4	No usable testware is available.
test environment	1		
testware	4		

Figure :- Testware

5) Environmental factor E =		Test tools	
		Rating	Description
test tools	2	1	Testing involves the use of a query language such as SQL: a record and playback tool is also being used.
Development testing	8	2	Testing involves the use of a query language such as SQL, but no record and playback tool is being used.
test basis	3	3	
development environm	2	4	No test tools are available.
test environment	1		
testware	4		

Figure: - Test tools

5) Environmental factor E =		Test environment	
		Rating	Description
test tools	2	1	The environment has been used for testing several times in the past.
Development testing	8	2	The test is to be conducted in a newly equipped environment similar to other well-used environment within the organization.
test basis	3	3	
development environm	2	4	The test is to be conducted in a newly equipped environment which may be considered experimental within the organization.
test environment	1		
testware	4		

Figure: - Test environment

5) Environmental factor E =		Test basis	
		Rating	Description
test tools	2	3	During the system development documentation standards are being used and a template, in addition the inspections are organized.
Development testing	8	6	During the system development documentation standards are being used and a template.
test basis	3	12	The system documentation was not developed using a specific standards and a template.
development environm	2		
test environment	1		
testware	4		

Figure :- Test basis

5) Environmental factor E =		Development testing	
		Rating	Description
test tools	2	2	A development testing plan is available and the test team is familiar with the actual test cases and test results.
Development testing	8	4	A development testing plan is available.
test basis	3	8	No development testing plan is available.
development environm	2		
test environment	1		
testware	4		

Figure: - Development testing

5) Environmental factor E =		Development environment	
		Rating	Description
test tools	2	2	The system was developed using a 4 GL programming language with an integrated DBMS containing numerous constraints.
Development testing	8	4	The system was developed using a 4 GL programming language, possibly in combination with a 3GL programming language.
test basis	3	8	The system was developed using only a 3 GL programming language such as COBOL, PASCAL OR PRG.
development environm	2		
test environment	1		
testware	4		

Figure: - Development environment

#### Step 9 Calculate primary test hours (PT):-

Primary test hours are the product of Test points, Skill factor and Environmental factors.  
Below formulae shows the concept in more detail:-

$$\text{Primary test hours} = \text{TP} * \text{Skill factor} * \text{E}$$

For the accounting application total primary test hours are 101.73 as shown in the figure below.

6) Primary test hours (PT=TP*Skill*E)					
Skill factor	1.50				
PT=	71.21	*	1.50	*	0.95
TOTAL PRIMARY HOURS					101.73

Figure :- Primary test hours

### Step 10 Calculate total hours :-

Every process involves planning and management activities also. We also need to take into account these activities. Planning and management is affected by two important concepts Team size and Management tools. So below are the rating sheet for Team size and Management tools. These but values are summed and the percentage of this value is then multiplied with the primary test hours.

7) Total number of test hours		Team size	
Team size	Rating	Rating	Description
Planning and control tools	3	3	The team consists of no more than four people.
	8	6	The team consists of between five and ten people.
TOTAL HOURS	11 %	12	The team consists of more than ten people.

Figure: - Number of test hours

7) Total number of test hours		Planning and control tools	
Team size	Rating	Rating	Description
Planning and control tools	3	2	Both an automated time registration system and an automated defect tracking system (including CM) are available.
	8	4	Either an automated time registration system or an automated defect tracking system (including CM) arte available.
TOTAL HOURS	11 %	8	No automated (management) systems are available.

Figure: - Planning and control tools

Finally we distribute the same across the phases. So the total black box testing for this project in man is 101.73 man hours which 13 man day approximately.

8) Distribution over phases		Incl man.overhead	Excl man.overhead
preparation	10 %	11.29 hour	10.17 hour
specification	40 %	45.17 hour	40.69 hour
execution	45 %	50.81 hour	45.78 hour
completion	5 %	5.65 hour	5.09 hour

## **Figure: - Distribution over phases**

### **Question left for second edition**

**Note:** - It's not possible to cover all scenarios in this book. Below are the things which are left out and we will definitely try to cover the same in the second edition. Till then if you can send some really good and precise answers to me at shiv\_koirala@yahoo.com we will definitely highlight your name in this book beside the answer.

- Can you explain top and bottom integration testing?
- Can you explain cyclomatic complexity?
- Can you explain smoke testing?
- What are the main attributes of test automation?
- How will you choose and evaluate a tool for test automation?
- What are the main benefits and what can go wrong in automation testing?
- Describe common problems and challenges in automation testing?
- What types of documents would you need for QA, QC, and Software Testing?
- Did you create test plans independently?
- When does testing start and when does it end in a project life cycle?
- What is the difference between SQA and a tester?
- What is IEEE 829?
- In a project you have found 100 defects what do you say about such project?
- When we say that there is 100 % test coverage what does it signify?
- What are the important metrics you think in testing?
- Define quality?
- In a project there are lot of defects which ones will you resolve first?
- Describe the previous project scenarios and the test case written for the same?
- Can you explain defect leakage?
- What's the main role of a test leader?
- What's the difference between re-testing and regression testing?
- What's the difference between functional and system testing?
- Can you explain test bed?
- When do we say testing is complete?
- Can you explain non-compliance testing?
- What's the difference between V and U shape?
- Can you explain FUZZ testing?
- What's the difference between system testing and end-to-end testing?
- What's the difference between use case and test case?
- What's the difference between volume and load testing?
- Your customer does not know how to write UAT document how will you handle this situation?
- One of the projects is over tested what is the main disadvantage?
- When do you stop testing?
- How to test memory leakages in a project?

Is V model better than waterfall model?  
What is the difference between SDLC and STLC?  
Can you explain ACID testing?  
Can you explain risk analysis?  
What is the use of data flow diagram?  
How do we perform database testing?  
What is meant by Show stopper?  
What are the deliverables in software testing?  
How can you reduce duplicate test cases in a project?  
What is a minimum requirement to start testing?  
What do you mean by testing policy?  
How can we map test cases with requirement and what is it called?  
What are the entry criteria for automated testing?  
What are the drawbacks of adhoc testing?  
Can you explain orthogonal array in detail ?

### **Some winrunner questions**

What is Winrunner ?  
WinRunner is suitable for which type of applications?  
What are all the different types of recordings available in WinRunner?  
What's the difference between Context Sensitive and Analog recordings?  
What are the limitationand advantages of winrunner?  
Can you explain the concept of Synchronization in Winrunner?  
What is the concept of check points in WinRunner?  
Explain the difference between Winrunner and testdirector?  
Explain project tree in test director?  
How does Winrunner identify GUI objects?  
Can you explain data parameterization in WinRunner ?  
Can you do database testing using Winrunner ?  
How is exception handling done using Winrunner ?  
What is the concept of data caching in automated testing?

## **Interview questions**

This section is not to be included in this book. But we have done it specifically to just have a fair idea about what's asked in other technologies also. If you want to buy those book you can get it from any BPB book shop mentioned in this books first page or else you can mail the same to [bpb@bol.net.in](mailto:bpb@bol.net.in) or [bpb@vsnl.com](mailto:bpb@vsnl.com)

### **.NET Interview Questions Book**

Basic .NET Framework questions  
What is IL? (Twist :- What is MSIL or CIL , What is JIT?)

What is the CLR?  
What is the CTS?  
What is CLS(Common Language Specification)?  
What is Managed Code?  
What is Assembly ?  
What are different types of Assembly?  
What is NameSpace?  
What is Difference between NameSpace and Assembly?  
If you want to view a Assembly how to you go about it (Twist : What is ILDASM ? )?  
What is Manifest?  
Where is version information stored of a assembly ?  
Is versioning applicable to private assemblies?  
What is GAC (Twist :- What are situations when you register .NET assembly in GAC ?)  
What is concept of strong names (Twist :- How do we generate strong names or what is the process of generating string names , What is use of SN.EXE , How do we apply strong names to assembly ? , How do you sign an assembly ?)?  
How to add and remove a assembly from GAC?  
What is Delay signing ?  
What is garbage collection?  
Can we force garbage collector to run ?  
What is reflection?  
What are different type of JIT ?  
What are Value types and Reference types ?  
What is concept of Boxing and Unboxing ?  
What's difference between VB.NET and C# ?  
What's difference between System exceptions and Application exceptions?  
What is CODE Access security?

## NET Interoperability

How can we use COM Components in .NET (Twist : What is RCW ?)?  
Once i have developed the COM wrapper do i have to still register the COM in registry?  
How can we use .NET components in COM (Twist :- What is CCW (COM callable wrapper) ?, What caution needs to be taken in order that .NET components is compatible with COM ?)  
How can we make Windows API calls in .NET?  
When we use windows API in .NET is it managed or unmanaged code ?  
What is COM ?  
What is Reference counting in COM ?  
Can you describe IUNKNOWN interface in short ?

Can you explain what is DCOM ?  
How do we create DCOM object in VB6?  
How to implement DTC in .NET ?  
How many types of Transactions are there in COM + .NET ?  
How do you do object pooling in .NET ?  
What are types of compatibility in VB6?

Threading  
What is Multi-tasking ?  
What is Multi-threading ?  
What is a Thread ?  
Did VB6 support multi-threading ?  
Can we have multiple threads in one App domain ?  
Which namespace has threading ?  
Can you explain in brief how can we implement threading ?  
How can we change priority and what the levels of priority are provided by .NET ?  
What does Addressof operator do in background ?  
How can you reference current thread of the method ?  
What's Thread.Sleep() in threading ?  
How can we make a thread sleep for infinite period ?  
What is Suspend and Resume in Threading ?  
What the way to stop a long running thread ?  
How do i debug thread ?  
What's Thread.Join() in threading ?  
What are Daemon thread's and how can a thread be created as Daemon ?  
When working with shared data in threading how do you implement synchronization ?  
Can we use events with threading ?  
How can we know a state of a thread ?  
what is a monitor object ?  
what are wait handles ?(Twist :- What is a mutex object ?)  
what is ManualResetEvent and AutoResetEvent ?  
What is ReaderWriter Locks ?  
How can you avoid deadlock in threading ?  
What's difference between thread and process ?

Remoting and Webservices  
What is an application domain ?  
What is .NET Remoting ?  
Which class does the remote object has to inherit ?  
What are two different types of remote object creation mode in .NET ?  
Describe in detail Basic of SAO architecture of Remoting ?

What is the situation you will use singleton architecture in remoting ?  
What is fundamental of published or precreated objects in Remoting ?  
What are the ways client can create object on server in CAO model ?  
Are CAO stateful in nature ?  
In CAO model when we want client objects to be created by “NEW” keyword is there any precautions to be taken ?  
Is it a good design practice to distribute the implementation to Remoting Client ?  
What is LeaseTime,SponsorshipTime ,RenewonCallTime and LeaseManagerPollTime?  
Which config file has all the supported channels/protocol ?  
How can you specify remoting parameters using Config files ?  
Can Non-Default constructors be used with Single Call SAO?(Twist :- What are the limitation of constructors for Single call SAO ?)  
How can we call methods in remoting Asynchronously ?  
What is Asynchronous One-Way Calls ?  
What is marshalling and what are different kinds of marshalling ?  
What is ObjRef object in remoting ?  
What is a WebService ?  
What is UDDI ?  
What is DISCO ?  
What is WSDL?  
What are the different phase of acquiring a proxy object in Webservice ?  
What is file extension of Webservices ?  
Which attribute is used in order that the method can be used as WebService ?  
What are the steps to create a webservice and consume it ?  
Do webservice have state ?

Caching Concepts  
What is application object ?  
What's the difference between Cache object and application object ?  
How can get access to cache object ?  
What are dependencies in cache and types of dependencies ?  
Can you show a simple code showing file dependency in cache ?  
What is Cache Callback in Cache ?  
What is scavenging ?  
What are different types of caching using cache object of ASP.NET?  
How can you cache different version of same page using ASP.NET cache object ?  
How will implement Page Fragment Caching ?  
What are ASP.NET session and compare ASP.NET session with classic ASP session variables?  
Which various modes of storing ASP.NET session ?  
Is Session\_End event supported in all session modes ?  
What are the precautions you will take in order that StateServer Mode work properly ?

What are the precautions you will take in order that SQLSERVER Mode work properly ?  
Where do you specify session state mode in ASP.NET ?  
What are the other ways you can maintain state ?  
What are benefits and Limitation of using Hidden fields ?  
What is ViewState ?  
Do performance vary for viewstate according to User controls ?  
What are benefits and Limitation of using Viewstate for state management?  
How can you use Hidden frames to cache client data ?  
What are benefits and Limitation of using Hidden frames?  
What are benefits and Limitation of using Cookies?  
What is Query String and What are benefits and Limitation of using Query Strings?

## OOPS

What is Object Oriented Programming ?  
What's a Class ?  
What's a Object ?  
What's the relation between Classes and Objects ?  
What are different properties provided by Object-oriented systems ?(Twist :- Can you explain different properties of Object Oriented Systems?)(Twist :- What's difference between Association , Aggregation and Inheritance relationships?)  
How can we achieve inheritance in VB.NET ?  
What are abstract classes ?  
What's a Interface ?  
What is difference between abstract classes and interfaces?  
What is a delegate ?  
What are event's ?  
Do events have return type ?  
Can event's have access modifiers ?  
Can we have shared events ?  
What is shadowing ?  
What's difference between Shadowing and Overriding ?  
What's difference between delegate and events?  
If we inherit a class do the private variables also get inherited ?  
What are different accessibility levels defined in .NET ?  
Can you prevent a class from overriding ?  
What's the use of "MustInherit" keyword in VB.NET ?  
Why can not you specify accessibility modifier in Interface ?  
What are similarities between Class and structure ?  
What's a difference between Class and structure's ?  
What does virtual keyword mean ?  
What are shared (VB.NET)/Static(C#) variables?  
What is Dispose method in .NET ?  
What's the use of "OverRides" and "Overridable" keywords ?

Where are all .NET Collection classes located ?  
What is ArrayList ?  
What's a HashTable ?(Twist :- What's difference between HashTable and ArrayList ?)  
What are queues and stacks ?  
What is ENUM ?  
What is nested Classes ?  
What's Operator Overloading in .NET?  
In below sample code if we create a object of class2 which constructor will fire first ?  
What's the significance of Finalize method in .NET?  
Why is it preferred to not use finalize for clean up?  
How can we suppress a finalize method?  
What's the use of DISPOSE method?  
How do I force the Dispose method to be called automatically, as clients can forget to call Dispose method?  
In what instances you will declare a constructor to be private?

## ASP.NET

What's the sequence in which ASP.NET events are processed ?  
In which event are the controls fully loaded ?  
How can we identify that the Page is PostBack ?  
How does ASP.NET maintain state in between subsequent request ?  
What is event bubbling ?  
How do we assign page specific attributes ?  
Administrator wants to make a security check that no one has tampered with ViewState , how can we ensure this ?  
What's the use of @ Register directives ?  
What's the use of SmartNavigation property ?  
What is AppSetting Section in “Web.Config” file ?  
Where is ViewState information stored ?  
What's the use of @ OutputCache directive in ASP.NET ?  
How can we create custom controls in ASP.NET ?  
How many types of validation controls are provided by ASP.NET ?  
Can you explain what is “AutoPostBack” feature in ASP.NET ?  
How can you enable automatic paging in DataGrid ?  
What's the use of “GLOBAL.ASAX” file ?  
What's the difference between “Web.config” and “Machine.Config” ?  
What's a SESSION and APPLICATION object ?  
What's difference between Server.Transfer and response.Redirect ?  
What's difference between Authentication and authorization ?  
What is impersonation in ASP.NET ?  
Can you explain in brief how the ASP.NET authentication process works ?  
What are the various ways of authentication techniques in ASP.NET ?  
How does authorization work in ASP.NET ?

What's difference between Datagrid , Datalist and repeater ?  
From performance point of view how do they rate ?  
What's the method to customize columns in DataGrid?  
How can we format data inside DataGrid?  
How will decide the design consideration to take a Datagrid , datalist or repeater ?  
Difference between ASP and ASP.NET?  
What are major events in GLOBAL.ASAX file ?  
What order they are triggered ?  
Do session use cookies ?  
How can we force all the validation control to run ?  
How can we check if all the validation control are valid and proper ?  
If you have client side validation is enabled in your Web page , Does that mean server side code is not run?  
Which JavaScript file is referenced for validating the validators at the client side ?  
How to disable client side script in validators?  
I want to show the entire validation error message in a message box on the client side?  
You find that one of your validation is very complicated and does not fit in any of the validators , so what will you do ?  
What is Tracing in ASP.NET ?  
How do we enable tracing ?  
What exactly happens when ASPX page is requested from Browser?  
How can we kill a user session ?  
How do you upload a file in ASP.NET ?  
How do I send email message from ASP.NET ?  
What are different IIS isolation levels?

.NET Architecture  
What are design patterns ?  
What's difference between Factory and Abstract Factory Pattern's?  
What's MVC pattern? (Twist: - How can you implement MVC pattern in ASP.NET?)  
How can we implement singleton pattern in .NET?  
How do you implement prototype pattern in .NET?(Twist: - How to implement cloning in .NET ? , What is shallow copy and deep copy ?)  
What are the situations you will use a Web Service and Remoting in projects?  
Can you give a practical implementation of FAÇADE patterns?  
How can we implement observer pattern in .NET?  
What is three tier architecture?  
Have you ever worked with Microsoft Application Blocks, if yes then which?  
What is Service Oriented architecture?

## **ADO.NET**

What is the namespace in which .NET has the data functionality classes ?  
Can you give a overview of ADO.NET architecture ?  
What are the two fundamental objects in ADO.NET ?  
What is difference between dataset and datareader ?  
What are major difference between classic ADO and ADO.NET ?  
What is the use of connection object ?  
What is the use of command objects and what are the methods provided by the command object ?  
What is the use of dataadapter ?  
What are basic methods of Dataadapter ?  
What is Dataset object?  
What are the various objects in Dataset ?  
How can we connect to Microsoft Access , Foxpro , Oracle etc ?  
How do we connect to SQL SERVER , which namespace do we use ?  
How do we use stored procedure in ADO.NET and how do we provide parameters to the stored procedures?  
How can we force the connection object to close after my datareader is closed ?  
I want to force the datareader to return only schema of the datastore rather than data ?  
How can we fine tune the command object when we are expecting a single row or a single value ?  
Which is the best place to store connectionstring in .NET projects ?  
What are steps involved to fill a dataset ?(Twist :- How can we use dataadapter to fill a dataset ?)  
What are the various methods provided by the dataset object to generate XML?  
How can we save all data from dataset ?  
How can we check that some changes have been made to dataset since it was loaded ?(Twist :- How can cancel all changes done in dataset ? ,How do we get changed value dataset ? )  
How add/remove row's in "DataTable" object of "DataSet" ?  
What's basic use of "DataView" ?  
What's difference between "DataSet" and "DataReader" ?  
How can we load multiple tables in a DataSet ?  
How can we add relation's between table in a DataSet ?  
What's the use of CommandBuilder ?  
What's difference between "Optimistic" and "Pessimistic" locking ?  
How many way's are there to implement locking in ADO.NET ?  
How can we perform transactions in .NET?  
What's difference between Dataset. clone and Dataset. copy ?

## **SQL SERVER**

What is normalization? What are different type of normalization?  
What is denormalization ?  
What is a candidate key ?

What are different types of joins and what's the difference between them ?  
What are indexes and What is the difference between clustered and nonclustered indexes?  
How can you increase SQL performance ?  
What is the use of OLAP ?  
What's a measure in OLAP ?  
What are dimensions in OLAP ?  
What are levels in dimensions ?  
What are fact tables and dimension tables in OLAP ? (Twist :- can you explain the star schema for OLAP ? )  
What is DTS?  
What is fillfactor ? (Twist :- When does page split occurs ?)  
What is RAID and how does it work ?  
What's the difference between DELETE TABLE and TRUNCATE TABLE commands?  
What are the problems that can occur if you do not implement locking properly in SQL SERVER ?  
What are different transaction levels in SQL SERVER ?(Twist :- what are different types of locks in SQL SERVER ?)  
What are different locks in SQL SERVER ?  
Can we suggest locking hints to SQL SERVER ?  
What is LOCK escalation?  
What are the different ways of moving data/databases between servers and databases in SQL Server?  
What are advantages of SQL 2000 over SQL 7.0 ?  
What is the difference between a HAVING CLAUSE and a WHERE CLAUSE?  
What is difference between UNION and UNION ALL SQL syntax ?  
How can you raise custom errors from stored procedure ?  
What is ACID fundamental and what are transactions in SQL SERVER ?  
What is DBCC?  
What is purpose of Replication ?  
What are different type of replication supported by SQL SERVER ?  
What is BCP utility in SQL SERVER ?  
What are different types of triggers in SQL SERVER 2000 ?  
If we have multiple AFTER Triggers on table how can we define the sequence of the triggers ?  
What is SQL injection ?

## UML

What is UML?  
How many types of diagrams are there in UML ?(Twist :- Explain in short all types of diagrams in UML ?)  
What are advantages of using UML?(Twist: - What is Modeling and why UML ?)

What's the sequence of UML diagrams in project?(Twist: - How did you implement UML in your project?)  
Just a small Twist: - Do I need all UML diagrams in a project?  
Give a small brief explanation of all Elements in activity diagrams?  
Explain Different elements of a collaboration diagram ?  
Explain Component diagrams ?  
Explain all parts of a deployment diagram?  
Describe various components in sequence diagrams?  
What are the element in State Chart diagrams ?  
Describe different elements in Static Chart diagrams ?  
Explain different elements of a Use Case ?(Twist: - What's difference between Activity and sequence diagrams?(I leave this to the readers))

## Project Management

What is project management?  
Is spending in IT project's constant through out the project?  
Who is a stakeholder ?  
Can you explain project life cycle ?(Twist :- How many phases are there in software project ?)  
Are risk constant through out the project ?  
Can you explain different software development life cycles ?  
What is triple constraint triangle in project management ?  
What is a project baselines ?  
What is effort variance?  
How is normally a project management plan document organized ?  
How do you estimate a project?  
What is CAR (Causal Analysis and Resolution)?  
How do you handle change request?  
What is internal change request?  
What is difference between SITP and UTP in testing ?  
What are the software you have used for project management?  
What are the metrics followed in project management?(Twist: - What metrics will you look at in order to see the project is moving successfully?)  
You have people in your team who do not meet their deadlines or do not perform what are the actions you will take ? (Twist :- Two of your resources have conflicts between them how would you sort it out ?)  
How do you start a project?  
How did you do resource allocations?  
How do you do code reviews ?

## SQL Server Interview Questions Book

## **Database Concepts**

What is a database or database management systems (DBMS)?  
What's difference between DBMS and RDBMS ?  
What are CODD rules?  
Is access database a RDBMS?  
What's the main difference between ACCESS and SQL SERVER?  
What's the difference between MSDE and SQL SERVER 2000?  
What is SQL SERVER Express 2005 Edition?  
What is SQL Server 2000 Workload Governor?  
What's the difference between SQL SERVER 2000 and 2005?  
What are E-R diagrams?  
How many types of relationship exist in database designing?  
Can you explain Fourth Normal Form?  
Can you explain Fifth Normal Form?  
What's the difference between Fourth and Fifth normal form?  
Have you heard about sixth normal form?  
What is Extent and Page?  
What are the different sections in Page?  
What are page splits?  
In which files does actually SQL Server store data?  
What is Collation in SQL Server?  
Can we have a different collation for database and table?

## **SQL**

Revisiting basic syntax of SQL?  
What are “GRANT” and “REVOKE’ statements?  
What is Cascade and Restrict in DROP table SQL?  
What is a DDL, DML and DCL concept in RDBMS world?  
What are different types of joins in SQL?  
What is “CROSS JOIN”?  
You want to select the first record in a given set of rows?  
How do you sort in SQL?  
How do you select unique rows using SQL?  
Can you name some aggregate function is SQL Server?  
What is the default “SORT” order for a SQL?  
What is a self-join?  
What's the difference between DELETE and TRUNCATE ?  
Select addresses which are between ‘1/1/2004’ and ‘1/4/2004’?  
What are Wildcard operators in SQL Server?  
What's the difference between “UNION” and “UNION ALL” ?  
What are cursors and what are the situations you will use them?  
What are the steps to create a cursor?  
What are the different Cursor Types?  
What are “Global” and “Local” cursors?

What is “Group by” clause?  
What is ROLLUP?  
What is CUBE?  
What is the difference between “HAVING” and “WHERE” clause?  
What is “COMPUTE” clause in SQL?  
What is “WITH TIES” clause in SQL?  
What does “SET ROWCOUNT” syntax achieves?  
What is a Sub-Query?  
What is “Correlated Subqueries”?  
What is “ALL” and “ANY” operator?  
What is a “CASE” statement in SQL?  
What does COLLATE Keyword in SQL signify?

## .NET Integration

What are steps to load a .NET code in SQL SERVER 2005?  
How can we drop a assembly from SQL SERVER?  
Are changes made to assembly updated automatically in database?  
Why do we need to drop assembly for updating changes?  
How to see assemblies loaded in SQL Server?  
I want to see which files are linked with which assemblies?  
Does .NET CLR and SQL SERVER run in different process?  
Does .NET controls SQL SERVER or is it vice-versa?  
Is SQLCLR configured by default?  
How to configure CLR for SQL SERVER?  
Is .NET feature loaded by default in SQL Server?  
How does SQL Server control .NET run-time?  
What's a “SAND BOX” in SQL Server 2005?  
What is a application domain?  
How are .NET Appdomain allocated in SQL SERVER 2005?  
What is Syntax for creating a new assembly in SQL Server 2005?  
Do Assemblies loaded in database need actual .NET DLL?  
Does SQL Server handle unmanaged resources?  
What is Multi-tasking ?  
What is Multi-threading ?  
What is a Thread ?  
Can we have multiple threads in one App domain ?  
What is Non-preemptive threading?  
What is pre-emptive threading?  
Can you explain threading model in SQL Server?  
How does .NET and SQL Server thread work?  
How are exception in SQLCLR code handled?

Are all .NET libraries allowed in SQL Server?  
What is “Hostprotectionattribute” in SQL Server 2005?  
How many types of permission level are there for an assembly?  
Can you name system tables for .NET assemblies?  
Are two version of same assembly allowed in SQL Server?  
How are changes made in assembly replicated?  
Is it a good practice to drop a assembly for changes?  
In one of the projects following steps where done, will it work?  
What does Alter assembly with unchecked data signify?  
How do I drop an assembly?  
Can we creat SQLCLR using .NET framework 1.0?  
While creating .NET UDF what checks should be done?  
How do you define a function from the .NET assembly?  
Can compare between T-SQL and SQLCLR ?  
With respect to .NET is SQL SERVER case sensitive?  
Does case sensitive rule apply for VB.NET?  
Can nested classes be accessed in T-SQL?  
Can we have SQLCLR procedure input as array?  
Can object datatype be used in SQLCLR?  
How's precision handled for decimal datatypes in .NET?  
How do we define INPUT and OUTPUT parameters in SQLCLR?  
Is it good to use .NET datatypes in SQLCLR?  
How to move values from SQL to .NET datatypes?  
What is System.Data.SqlClient?  
What is SQLContext?  
Can you explain essential steps to deploy SQLCLR?  
How do create function in SQL Server using .NET?  
How do we create trigger using .NET?  
How to create User Define Functions using .NET?  
How to create User Defined Create aggregates using .NET?  
What is Asynchronous support in ADO.NET?  
What is MARS support in ADO.NET?  
What is SQLbulkcopy object in ADO.NET ?  
How to select range of rows using ADO.NET?

## ADO.NET

Which are namespaces for ADO.NET?  
Can you give a overview of ADO.NET architecture ?  
What are the two fundamental objects in ADO.NET ?  
What is difference between dataset and datareader ?  
What are major difference between classic ADO and ADO.NET ?

What is the use of connection object ?  
What are the methods provided by the command object ?  
What is the use of dataadapter ?  
What are basic methods of Dataadapter ?  
What is Dataset object?  
What are the various objects in Dataset ?  
How can we connect to Microsoft Access , Foxpro , Oracle etc ?  
What's the namespace to connect to SQL Server?  
How do we use stored procedure in ADO.NET?  
How can we force the connection object to close?  
I want to force the datareader to return only schema?  
Can we optimize command object when there is only one row?  
Which is the best place to store connectionstring ?  
What are steps involved to fill a dataset ?  
What are the methods provided by the dataset for XML?  
How can we save all data from dataset ?  
How can we check for changes made to dataset?  
How can we add/remove row's in "DataTable" object of "DataSet" ?  
What's basic use of "DataView" ?  
What's difference between "DataSet" and "DataReader" ?  
How can we load multiple tables in a DataSet ?  
How can we add relation's between table in a DataSet ?  
What's the use of CommandBuilder ?  
What's difference between "Optimistic" and "Pessimistic" locking ?  
How many way's are there to implement locking in ADO.NET ?  
How can we perform transactions in .NET?  
What's difference between Dataset. clone and Dataset. copy ?  
Whats the difference between Dataset and ADO Recordset?

## Notification Services

What are notification services?  
What are basic components of Notification services?  
Can you explain architecture of Notification Services?  
Which are the two XML files needed for notification services?  
What is Nscontrols command?  
What are the situations you will use "Notification" Services?

## Service Broker

What do we need Queues?  
What is "Asynchronous" communication?  
What is SQL Server Service broker?  
What are the essential components of SQL Server Service broker?  
What is the main purpose of having Conversation Group?

How to implement Service Broker?  
How do we encrypt data between Dialogs?

## XML Integration

What is XML?  
What is the version information in XML?  
What is ROOT element in XML?  
If XML does not have closing tag will it work?  
Is XML case sensitive?  
What's the difference between XML and HTML?  
Is XML meant to replace HTML?  
Can you explain why your project needed XML?  
What is DTD (Document Type definition)?  
What is well formed XML?  
What is a valid XML?  
What is CDATA section in XML?  
What is CSS?  
What is XSL?  
What is Element and attributes in XML?  
Can we define a column as XML?  
How do we specify the XML data type as typed or untyped?  
How can we create the XSD schema?  
How do I insert in to a table which has XSD schema attached to it?  
What is maximum size for XML datatype?  
What is Xquery?  
What are XML indexes?  
What are secondary XML indexes?  
What is FOR XML in SQL Server?  
Can I use FOR XML to generate SCHEMA of a table and how?  
What is the OPENXML statement in SQL Server?  
I have huge XML file which we want to load in database?  
How to call stored procedure using HTTP SOAP?  
What is XMLA ?

## Data Warehousing/Data Mining

What is “Data Warehousing”?

What are Data Marts?

What are Fact tables and Dimension Tables?

What is Snow Flake Schema design in database?

What is ETL process in Data warehousing?

How can we do ETL process in SQL Server?

What is “Data mining”?

Compare “Data mining” and “Data Warehousing”?

What is BCP?

How can we import and export using BCP utility?

What is Bulk Insert?

What is DTS ?

Can you brief about the Data warehouse project you worked on?

What is an OLTP (Online Transaction Processing) System?

What is an OLAP (On-line Analytical processing) system?

What is Conceptual, Logical and Physical model?

What is Data purging?

What is Analysis Services?

What are CUBES?

What are the primary ways to store data in OLAP?

What is META DATA information in Data warehousing projects?

What is multi-dimensional analysis?

What is MDX?

How did you plan your Data ware house project?

What are different deliverables according to phases?

Can you explain how analysis service works?

What are the different problems that “Data mining” can solve?

What are different stages of “Data mining”?

What is Discrete and Continuous data in Data mining world?

What is MODEL is Data mining world?

How are models actually derived?

What is a Decision Tree Algorithm?

Can decision tree be implemented using SQL?

What is Naïve Bayes Algorithm?

Explain clustering algorithm?

Explain in detail Neural Networks?

What is Back propagation in Neural Networks?

What is Time Series algorithm in data mining?

Explain Association algorithm in Data mining?

What is Sequence clustering algorithm?

What are algorithms provided by Microsoft in SQL Server?

How does data mining and data warehousing work together?

What is XMLA ?

What is Discover and Execute in XMLA?

## Integration Services/DTS

What is Integration Services import / export wizard?  
What are prime components in Integration Services?  
How can we develop a DTS project in Integration Services?

## Replication

Whats the best way to update data between SQL Servers?  
What are the scenarios you will need multiple databases with schema?  
How will you plan your replication?  
What is a publisher, distributor and subscriber in “Replication”?  
What is “Push” and “Pull” subscription?  
Can a publication support push and pull at one time?  
What are different models / types of replication?  
What is Snapshot replication?  
What are the advantages and disadvantages of using Snapshot replication?  
What type of data will qualify for “Snapshot replication”?  
What’s the actual location where the distributor runs?  
Can you explain in detail how exactly “Snapshot Replication” works?  
What is merge replication?  
How does merge replication works?  
What are advantages and disadvantages of Merge replication?  
What is conflict resolution in Merge replication?  
What is a transactional replication?  
Can you explain in detail how transactional replication works?  
What are data type concerns during replications?

## Reporting Services

Can you explain how can we make a simple report in reporting services?  
How do I specify stored procedures in Reporting Services?  
What is the architecture for “Reporting Services “?

## Database Optimization

What are indexes?

What are B-Trees?

I have a table which has lot of inserts, is it a good database design to create indexes on that table?

What are “Table Scan’s” and “Index Scan’s”?

What are the two types of indexes and explain them in detail?

What is “FillFactor” concept in indexes?

What is the best value for “FillFactor”?

What are “Index statistics”?

How can we see statistics of an index?

How do you reorganize your index, once you find the problem?

What is Fragmentation?

How can we measure Fragmentation?

How can we remove the Fragmented spaces?

What are the criteria you will look in to while selecting an index?

What is “Index Tuning Wizard”?

What is an Execution plan?

How do you see the SQL plan in textual format?

What is nested join, hash join and merge join in SQL Query plan?

What joins are good in what situations? 298

## Transaction and Locks

What is a “Database Transactions “?

What is ACID?

What is “Begin Trans”, “Commit Tran”, “Rollback Tran” and “Save Tran”?

What are “Checkpoint’s” in SQL Server?

What are “Implicit Transactions”?

Is it good to use “Implicit Transactions”?

What is Concurrency?

What kind of problems occurs if we do not implement proper locking strategy?

What are “Dirty reads”?

What are “Unrepeatable reads”?

What are “Phantom rows”?

What are “Lost Updates”?

What are different levels of granularity of locking resources?

What are different types of Locks in SQL Server?

What are different Isolation levels in SQL Server?

If you are using COM+ what “Isolation” level is set by default?

What are “Lock” hints?

What is a “Deadlock” ?

What are the steps you can take to avoid “Deadlocks” ?

How can I know what locks are running on which resource?

## **JAVA Interview Questions Book**

### **OOPS and CORE JAVA**

What is JVM (Java Virtual Machine)?

What is JIT (Just-in-Time) Compilation?

What is Object Oriented Programming?

What's a Class?

What's an Object?

What's the relation between Classes and Objects?

What are different properties provided by Object-oriented systems?

How do you implement inheritance in Java?

How can we implement polymorphism in Java?

What's an interface and how will you go about implementing an interface?

What is an Abstract class?

What are Abstract methods?

What's the difference between “Abstract” classes and “Interfaces”?

What's difference between Static and Non-Static fields of a class?

What are inner classes and what's the practical implementation of inner classes?

What are packages?

What is a constructor in class?

Can constructors be parameterized?

Can you explain transient and volatile modifiers?

What is the use of “instanceof ” keyword?

What are Native methods in Java?

Explain in depth Garbage collector?

How does the garbage collector determine that the object has to be marked for deletion?

Can you explain “finalize()” method?  
How can we force the garbage collector to run?  
What’s the main difference between “Switch” and “If ” comparison?  
What’s the use of JAVAP tool?  
What are applets?  
In which package is the applet class located?  
What are native interfaces in Java?  
what are Class loader’s?  
what is Bootstrap, Extension and System Class loader?  
Can you explain the flow between bootstrap, extension and system class loader?  
Can you explain how can you practically do dynamic loading?  
How can you copy one array in to a different array?  
Can you explain the core collection interfaces?  
Can you explain in brief the collection classes which implement the collection interfaces?  
What’s the difference between standard JAVA array and ArrayList class?  
What’s the use of “ensureCapacity” in ArrayList class?  
How can we obtain an array from an ArrayList class?  
What is “LinkedList” class for?  
Can you explain HashSet class in collections?  
what is LinkedHashSet class?  
what is a TreeSet class?  
what’s the use of Comparator Interface?  
How can we access elements of a collection?  
What is Map and SortedMap Interface?  
Have you used any collection algorithm?  
Why do we use collections when we had traditional ways for collection?  
Can you name the legacy classes and interface for collections?  
What is Enumeration Interface?  
what’s the main difference between ArrayList / HashMap and Vector / Hashtable?  
Are String object Immutable, Can you explain the concept?  
what is a StringBuffer class and how does it differs from String class?  
what is the difference between StringBuilder and StringBuffer class?  
What is Pass by Value and Pass by reference? How does JAVA handle the same?  
What are access modifiers?  
what is Assertion?  
Can you explain the fundamentals of deep and shallow Cloning?  
How do we implement Shallow cloning?  
How do we implement deep cloning?  
What’s the impact of private constructor?  
What are the situations you will need a constructor to be private?  
Can you explain final modifier?  
What are static Initializers?  
If we have multiple static initializer blocks how is the sequence handled?  
Define casting? What are the different types of Casting?  
Can you explain Widening conversion and Narrowing conversion?

Can we assign parent object to child objects?  
Define exceptions?  
Can you explain in short how JAVA exception handling works?  
Can you explain different exception types?  
Can you explain checked and unchecked exceptions?  
Can we create our own exception class?  
What are chained exceptions?  
What is serialization?  
How do we implement serialization actually?  
What's the use of Externalizable Interface?

## Threading

What's difference between thread and process?  
What is thread safety and synchronization?  
What is semaphore?  
What are monitors?  
What's the importance of synchronized blocks?  
How do we create threads?  
what's the difference in using runnable and extends in threads?  
Can you explain Thread.sleep?  
How to stop a thread?  
What is wait() and notify() ?  
Can you explain how Scheduling and Priority works in threads?  
Can you explain Yielding in threading?  
what are daemon threads?

## JDBC

How does JAVA interact with databases?  
Can we interact with non-relational sources using JDBC?  
Can you explain in depth the different sections in JDBC?  
Can you explain in short how you go about using JDBC API in code?  
How do you handle SQL exceptions?  
If there is more than one exception in SQLException” class how to go about displaying it?  
Explain Type1, Type2, Type3 and Type4 drivers in JDBC?

What are the advantages and disadvantages of using JDBC-ODBC bridge driver?  
What are the advantages and disadvantages of using Native-API/ Partially Java Driver?  
What are the advantages and disadvantages of using Net-Protocol/ All-Java driver?  
What are the advantages and disadvantages of using Native-protocol/ All-Java driver?  
Define meta-data?  
What is DatabaseMetaData?  
Can you explain "ConnectionFactory" class?  
I want to display tables of a database how do I do it?  
Define "ResultSetMetaData"?  
What is the difference between "ResultSet" and "RowSet"?  
Can "ResultSet" objects be serialized?  
Can you explain "ResultSet", "RowSet", "CachedRowset", "JdbcRowset" and "WebRowSet" relation ship?  
what are the different types of resultset?  
Explain the concept of "PreparedStatement" "statement interface"?  
What's the difference between "Statement" and "PreparedStatement"?  
How can we call stored procedure using JDBC?  
Can you explain "CallableStatement" interface in detail?  
How do you get a resultset object from stored procedure?  
How can we do batch updates using "CallableStatement" Interface?  
Define transactions?  
what is ACID in transaction?  
what are the four essential properties of a transaction?  
Explain concurrency and locking?  
What are different types of locks?  
What are the different types of levels of resource on which locks can be placed?  
Define lock escalation?  
What is Table level and Row level locking?  
What are the problems that can occur if you do not implement locking properly?  
What are different transaction levels?  
Twist: - what are different types of locks?  
What is difference between optimistic and pessimistic locking?  
What are deadlocks?  
How can we set transaction level through JDBC API?  
Can you explain transaction control in JDBC?  
What are Savepoints in a transaction?

## Servlets and JSP

What are Servlets?  
What are advantages of servlets over CGI?  
Can you explain Servlet life cycle?

What are the two important API's in for Servlets?  
Can you explain in detail "javax.servlet" package?  
What's the use of ServletContext?  
How do we define an application level scope for servlet?  
What's the difference between GenericServlet and HttpServlet?  
Can you explain in detail javax.servlet.http package?  
What's the architecture of a Servlet package?  
Why is HTTP protocol called as a stateless protocol?  
What are the different ways we can maintain state between requests?  
What is URL rewriting?  
What are cookies?  
What are sessions in Servlets?  
What's the difference between getSession(true) and getSession(false) ?  
What's the difference between "doPost" and "doGet" methods?  
Which are the different ways you can communicate between servlets?  
What is functionality of "RequestDispatcher" object?  
How do we share data using "getServletContext ()"?  
Explain the concept of SSI?  
What are filters in JAVA?  
Can you explain in short how do you go about implementing filters using Apache Tomcat?  
Twist: - Explain step by step of how to implement filters?  
what's the difference between Authentication and authorization?  
Explain in brief the directory structure of a web application?  
Can you explain JSP page life cycle?  
What is EL?  
how does EL search for an attribute?  
What are the implicit EL objects in JSP?  
How can we disable EL?  
what is JSTL?  
Can you explain in short what the different types of JSTL tags are?  
How can we use beans in JSP?  
What is <jsp:forward> tag for ?  
What are JSP directives?  
what are Page directives?  
what are include directives?  
Can you explain taglib directives?  
How does JSP engines instantiate tag handler classes instances?  
what's the difference between JavaBeans and taglib directives?  
what are the different scopes an object can have in a JSP page?  
what are different implicit objects of JSP?  
what are different Authentication Options available in servlets?  
Can you explain how do we practically implement security on a resource?  
How do we practically implement form based authentication?  
How do we authenticate using JDBC?  
Can you explain JDBCRealm?

Can you explain how do you configure JNDIRealm?  
How did you implement caching in JSP?

## EJB

What is EJB?  
what are the different kind of EJB's?  
you are designing architecture for a project how do you decide whether you should use  
session, entity or message driven bean?  
Can you explain "EJBHome" and "EJBObject" in EJB?  
Can client directly create object of session or entity beans?  
Can you explain the concept of local interfaces?  
What are the limitations of using Local object?  
Which application server have you used for EJB ?  
Can you explain step by step practically developing and deploying EJB component?  
what is Passivation and Activation in EJB?  
Can beans who are involved in transaction have "Passivation" process?  
How does the server decide which beans to passivate and activate?  
In what format is the conversational data written to the disk?  
Can you explain in brief Life cycle for Stateless and Stateful beans?

## Struts

What's MVC pattern?  
Define struts?  
Can you explain the directory structure for a struts folder in brief ?  
Can you give an overview of how a struts application flows?  
Twist: - What are action and action form classes in Struts?

## XML and Web Services

What is XML?

What is the version information in XML?  
What is ROOT element in XML?  
If XML does not have closing tag will it work?  
Is XML case sensitive?  
What is the difference between XML and HTML?  
Is XML meant to replace HTML?  
Can you explain why your project needed XML?  
What is DTD (Document Type definition)?  
What is well formed XML?  
What is a valid XML?  
What is CDATA section in XML?  
What is CSS?  
What is XSL?  
What is element and attributes in XML?  
What are the standard ways of parsing XML document?  
In What scenarios will you use a DOM parser and SAX parser?  
What is XSLT?  
Define XPATH?  
What is the concept of XPOINTER?  
What is a Web Service ?  
What is DISCO ?  
What is SOAP ?  
What is WSDL ?  
Can you explain UDDI ?  
Can you explain JAXP ?  
What is a XML registry?  
What is JAXR?  
What is JAXM?  
Can you explain how JAXM messaging model works?  
Can you explain JAX-RPC?  
Internationalization  
Can you explain i18n and l10n?  
Can you explain internationalization and localization?  
What is Locale?  
How do we display numbers, currency and Dates according to proper Locale format?  
what are resource bundles?  
How do we load a resource bundle file?  
How can we do inheritance in resource bundles?

JNI

What is Native Interface in JAVA?

Can you say in brief steps required to implement Native interfaces in Java?

Can JNI be used for VB6, C# or VB.NET directly?

What are JNI functions and pointers?

How does the garbage collector know JNI objects are no more used?

Twist: - What are the different types of references JNI supports?

Twist: - How to do you delete global objects?

how does the native language C or C++ understand data types in JAVA?

Can you explain exception handling in JNI?

What are limitations for “JNIEnv” pointer in multi-threading scenarios?

What are the advantages and disadvantages of using “JNI”?

Architecture

What are design patterns ?

What is the difference between Factory and Abstract Factory Patterns?

What is MVC pattern?

Twist: - How can you implement MVC pattern in Servlets and JSP?

How can we implement singleton pattern in JAVA?

How do you implement prototype pattern in JAVA?

Twist: - How to implement cloning in JAVA? What is shallow copy and deep copy ?

Can you give a practical implementation of FAÇADE patterns?

How can we implement observer pattern in JAVA?

What is three tier architecture?

What is Service Oriented architecture?

What is aspect oriented programming?

## Project Management

What is project management?

Is spending in IT projects constant through out the project?

Who is a stakeholder ?

Can you explain project life cycle ?

Twist :- How many phases are there in software project ?

Are risk constant through out the project ?

Can you explain different software development life cycles ?

What is triple constraint triangle in project management ?

What is a project baselines ?

What is effort variance?

How is normally a project management plan document organized ?

How do you estimate a project?

What is CAR (Causal Analysis and Resolution)?

What is DAR (Decision Analysis and Resolution) ?

What is a fish bone diagram ?

Twist:- What is Ishikawa diagram ?

What is pareto principle ?

Twist :- What is 80/20 principle ?

How do you handle change request?  
What is internal change request?  
What is difference between SITP and UTP in testing ?  
What is the software you have used for project management?  
What are the metrics followed in project management?  
Twist: - What metrics will you look at in order to see the project is moving successfully?  
You have people in your team who do not meet there deadlines or do not perform what  
are the actions you will take ?  
Twist :- Two of your resources have conflicts between them how would you sort it out ?  
What is black box testing and White box testing?  
What's the difference between Unit testing, Assembly testing and Regression testing?  
What is V model in testing?  
How do you start a project?  
How did you do resource allocations?  
How will you do code reviews ?  
What is CMMI?  
What are the five levels in CMMI?  
What is continuous and staged representation?  
Can you explain the process areas?  
What is SIX sigma?  
What is DMAIC and DMADV ?  
What are the various roles in Six Sigma implementation?  
What are function points?  
Twist: - Define Elementary process in FPA?  
What are the different types of elementary process in FPA?  
What are the different elements in Functions points?  
Can you explain in GSC and VAF in function points?  
What are unadjusted function points and how is it calculated?  
Can you explain steps in function points?  
What is the FP per day in your current company?  
Twist :- What is your company's productivity factor ?  
Do you know Use Case points?  
What is COCOMO I, COCOMOII and COCOMOIII?  
What is SMC approach of estimation?  
How do you estimate maintenance project and change requests?

## UML

What is UML?  
How many types of diagrams are there in UML ?  
Twist :- Explain in short all types of diagrams in UML ?

What are advantages of using UML?

Twist: - What is Modeling and why UML ?

What is the sequence of UML diagrams in project?

Twist: - How did you implement UML in your project?

Just a small Twist: - Do I need all UML diagrams in a project?

Give a small brief explanation of all Elements in activity diagrams?

Explain Different elements of a collaboration diagram ?

Explain Component diagrams ?

Explain all parts of a deployment diagram?

Describe the various components in sequence diagrams?

What are the element in State Chart diagrams ?

Describe different elements in Static Chart diagrams ?

Explain the different elements of a Use Case ?

Twist: - What is the difference between Activity and sequence diagrams?(I leave this to the readers)