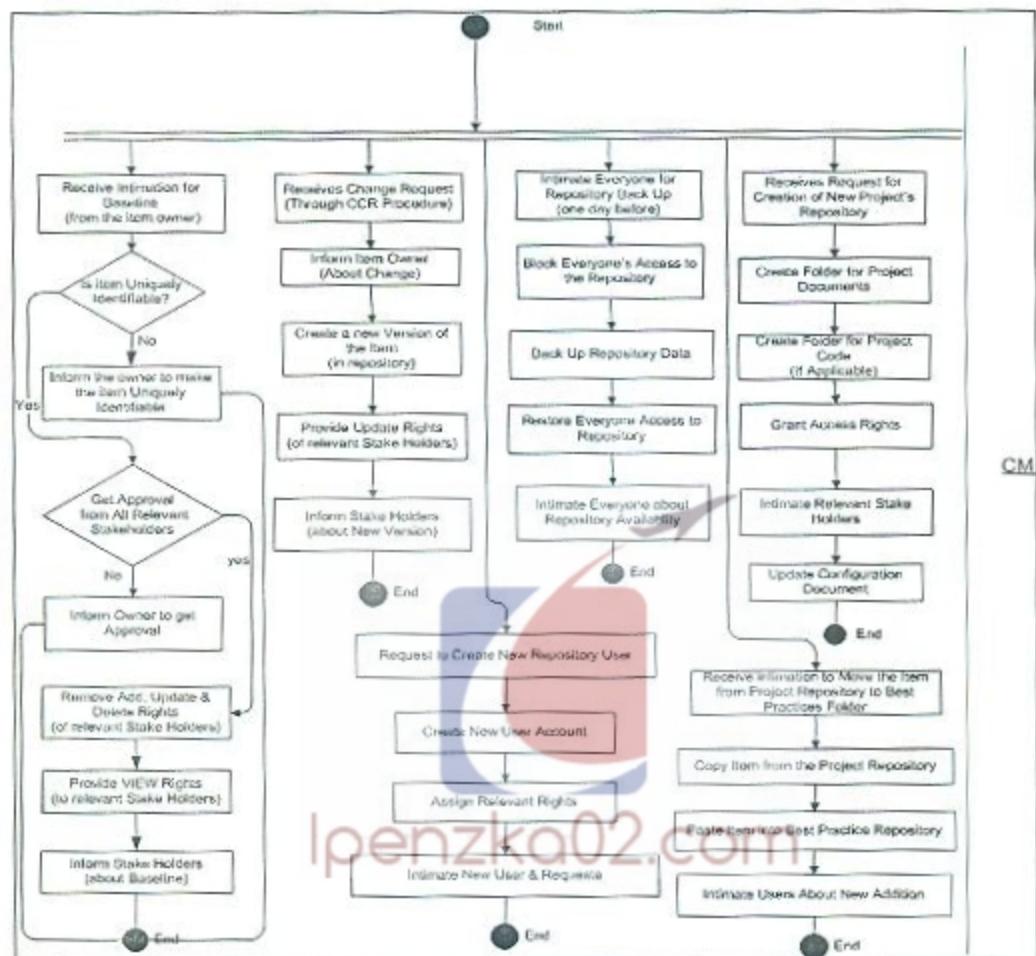


Example 4-9, Implementation and Monitoring of Software Configuration management Process area

While working in kalsoft, I was responsible for executing following process of Software Configuration Management throughout the organization.

Following is the process flow of Configuration management activities I implemented and executed while working in the organization.



Example 4-10, Configuration Management SCAMPI Class A, B, CMMI version 1.1 levels 2 and 3 Appraisals (Back in 2005-2006)

During my employment, I actively provided CMMI appraisal for Configuration Management Process Area of CMMI Level-II and successfully completed final assessment and contributed my effort to take organization to higher level of maturity.

My SCAMPI class A, B (V1.1) appraisal was conducted during 6th to 10th Sept, 2005 and 20th to 25th Feb, 2006 with Raghu R. Kamath and PM Shareef (Lead Appraiser SCAMPI-Appraisal Service Provider Trimentus Technologies-SEI Partner) in Kalsoft (Pvt) Ltd, Karachi, Pakistan.

I have also studied following course during Masters Program that have added further value to my knowledge about Capability Maturity Model Integration and the best practices it support.

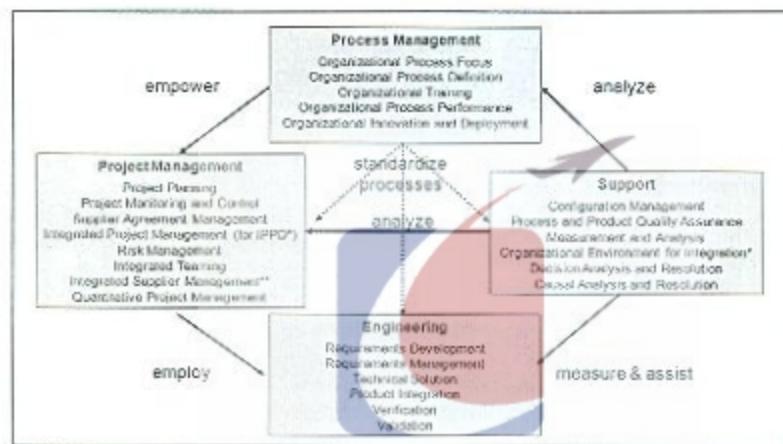
## Capability Maturity Model Integration

In this specialized course I studied about topics like CMMI Introduction, other available models and their comparisons with CMMI, how it integrates with system and software process areas and make a framework, How CMMI established, CMMI contribution in Enterprise wide improvement, CMMI bodies of Knowledge that contained system engineering, software engineering, IPPD-Integrated Product and process improvement, supplier sourcing, CMMI source models, Understanding CMMI representation, (Staged and Continuous), CMMI Maturity Levels (Performed, Managed, Defined, Quantitatively managed, Optimizing), Relating Process Area Capability and Organization Maturity, comparisons between staged and continuous representations and their advantages, CMMI Product Suite, Other CMMI models (SE/SW Staged, SE/SW Continuous, SE/SW/IPPD Staged, SE/SW/IPPD Continuous, SE/SW/IPPD/SS Staged, SE/SW/IPPD/SS Continuous, SW Staged, SW Continuous), Model Selection, Model Components (Process Area that comprises of Specific Goals and Generic Goals), Practices in each Process area, Specific practice and Generic practices, CMMI Model structure, Process Area by Maturity Level in Staged Representation, Process Area by Maturity Level in Continuous representation, Organization of Process Areas in Continuous representation (Project Management, Support, Engineering, Process Management), Process Area Capability Profile, Comparison between SW-CMM V1.1 vs. CMMI V1.1, IPPD-Introduction, scope, process areas organized by category,

MS (Computing)  
Transcript

Course: SE5122

Following is the Example of Process Areas Organized by Category



Software quality assurance and Verification and Validations,

In Software quality assurance, it is ensured that software developed meets and complies with defined or standardized quality specifications. Software Quality Assurance is an ongoing process within the software development life cycle (SDLC) that routinely checks the developed software to ensure that it meets desired quality measures and in order to ensure it, software Verification and Validation activities are performed.

In Verification and validation, quality control in the work products is ensured by confirming that customer requirements are fulfilled and the specified criteria are met at every stage of the product life cycle.

In software development life cycle, the Build (Converted Source code file into software artefact) is released to Software Testing Team after Unit testing done by developer. As soon as Software Testing Team also got CRS (Customer Requirement Specification) or FSD (Functional Specification document), use case, activity diagram etc from the development with Project Document, they start taking thorough understanding about the requirement and start to identify test specifications.

Using CRS/FSD and other documents Software testers starts planning for both test documents preparation and testing and produce following artefacts based on above documents. Base on following artefacts, verification and validations are performed to ensure that software quality is produced as intended. I have worked for product quality assurance and have been extensively involved in

- Test Plan
- Test Cases
- Requirement Traceability Matrix
- Bugs Reports
- Test Checklists For Example (Checklist for Test Plan, FSD Review, Design Review)
- Test Case Execution Log
- Integration Testing Plan

#### Example 4-10, Implementation of QA Process in Bank Al habib Quality Assurance Department.

When I initially joined Bank Al habib IT QA department, I found that quality assurance process was not implemented. QA team members were following ad hoc practices of software testing. They were not involved in reviewing the requirement in order to subsequently identify appropriate test specifications and test cases. At that time, I was given an assignment to document the process and provide training to team with QA process and area of improvements and Quality Assurance activities that were required in order to implement the process. After analysis, I documented the complete QA process and provided training to team. I was also responsible to ensure that all stakeholders are following process onward. Attached: ITQA Procedure

AHBS- ITQA Procedure

#### **Customer Support:**

I have been involved in providing support to operations and customer response team in various organizations.

For example in Mobile Complete, providing support to Customer Response team (CRT) was part of my job responsibility in order to rectify the issues occurring at client site with immediate response.

For example in Wavetec (Pvt), I used to provide training to IT Operations team for their product knowledge and support to resolve client site technical issues.

Refer to Experience Letters from companies

Mobile Complete

Wavetec (Pvt) Ltd

#### **IT Infrastructure Library:**

In this course I gained knowledge and understanding about standardize IT language to save time and resources when dealing with queries. In this course, I gained understanding about how to deal with various challenges faced by IT department in different domains like Change Management, Disaster Recovery, Help Desk Management, Service delivery and various levels of service. ITIL adds value by fixing expectations at different levels of support and provide IT support according to business requirements. This course has benefit to my over all understanding and knowledge about the software product support levels within and outside organization, it has broaden my knowledge in terms of support providing industry.

MS (Computing) Transcript

Course:SE5241

In this course I have studied topics like Introduction to ITIL (IT Infrastructure Library), IT Service Management Concepts (The benefits and importance of Service Management, Service Management disciplines, Service improvement programme), Service Desk Support (Service Desk options and procedures), Incident Management (Incident logging and management, Incident classification and prioritization), Problem Management (Incident, Problem and Known Error Control, Trend identification, Problem reduction), Change Management (Centralized change control, Change Management processes, Roles and Responsibilities), Configuration Management (Basic principles of asset and configuration management, The Configuration Management Database (CMDB), Data capture and audit).

SLA Management (The Service Level Management process, Typical contents of Service Level Agreements, Monitoring, reporting and reviewing, IT service Financial Management (Budgeting, IT Accounting, Charging for IT Services), Capacity Management (Capacity forecasting, The capacity plan, Elements of Capacity Management), IT Service Continuity Management (Risk Management, Business Impact Analysis, Contingency options and the IT Service Continuity Plan), IT Security Management.



#### Documentation and Audit:

##### Example 4-11, Conducting Internal Audit

While working in Kalsoft (Pvt) Ltd, I was also responsible to prepare Internal Quality Audit Plans, Conducting Internal Quality Audits, Coordinating and following-up with sections heads on non-compliances and report to higher management regarding audit activities, status accounting and reviews.

Corrective Action Request form 1 and 2

#### Information System Audit and Security:

This course has added further value to my overall knowledge related to Information system audit activities.

MS (Computing) Transcript

Course: SE5117

I studied about the importance of Control in an Information System. It mean how system should be accessed, resources should be utilized and how data should be control from unauthorized access. I studied about the need of assessment of information system design, its placement and its quality of controls. In this course I also studied about the basic theory of computer security policy, its general model and problems it faces. This subject provide an opportunity to learn different models of information security and how to deal with related risks. It also provide knowledge about the basic issues in auditing computer security policies and mechanisms.

In this course I studied about purpose and value of IS audit and IT governance, Organizational responsibility (Executive Management, Auditors, IT and Information Security, General users), Information Security (Confidentiality, Integrity and Availability), Ethics and Legal Issues, Major Guidance of Audit and Assessment, Risk, Information Security Programs, Information Security Management, Policy - Process and Procedure, Basic Job Responsibility of various functions in Organization, Software and System development life cycle, Application Development, Networking, Controls, Audit Planning, Audit vs Assessment, Facilitate Security and environment controls.

**Documentation:**

Documentation is always been an important part of Software Engineering process, without it, it is almost impossible to maintain any software project. The documents may be Requirement document, architecture document, Technical document, End User Document etc.

I have been involved in documenting System User Manuals, System and Procedure manuals, Technical Documentations like test specification documents, training manuals etc.

Refer to  
Experience Letters.

Statutory Declaration.

Wavetec (Pvt) Ltd



## Element Five

Knowledge that supports engineering design.

### Context

The design process – the root of engineering – is the process of devising a system, component or process to meet desired needs. Engineering design is a systematic process that involves problem definition and scoping, research, analysis, option development and selection, modelling to predict future performance, detailed design and testing. Importantly, it also involves communication of the outcome in a way that enables the design solution to be realised.

Washington Accord graduates are expected to be able to apply this knowledge of the design process to solve complex engineering problems.

### Performance Indicators

- Ability to undertake research and analysis to support the design process
- Ability to investigate a situation or the behaviour of a system and identify relevant causes and effects
- Ability to develop from first principles and construct mathematical, physical and conceptual models of situations, systems and devices, with a clear understanding of the assumptions made in development of such models
- Application of technical knowledge, design methods and appropriate tools and resources to design components, systems or processes to meet specified criteria
- Ability to analyse the pros and cons of alternative design options to support the development of an optimised design alternative
- Ability to analyse the constructability or manufacturing feasibility of a project or product
- Experience of personally conducting a significant design exercise, providing evidence of the consideration of various realistic constraints, such as safety, reliability, ethics, economic factors, aesthetics and social impact.
- Ability to apply appropriate design methods in solving complex engineering problems

lpenzka02.com

<p>Summarise your knowledge that supports engineering design relevant to your discipline and how it has been developed and applied through formal study, on-job learning and/or continuing professional development.</p> <p>Note, please cross-reference to your academic transcript(s) and continuing professional development records, as appropriate.</p> <p>I have been involved in various Test Automation Framework work design processes research and analysis. For which I have studied various research papers and articles from internet. Following are some of the examples</p> <ul style="list-style-type: none"> <li>• Amarical, S., &amp; Constantinescu, R. (2014). Designing a Software Test Automation Framework. <i>Informatica Economica</i>, 18(1), 152.</li> <li>• Laukkonen, P. (2006). <i>Data-driven and keyword-driven test automation frameworks</i> (Doctoral dissertation, HELSINKI UNIVERSITY OF TECHNOLOGY).</li> <li>• Kelly, M. (2003). Choosing a test automation framework. <i>IBM DeveloperWorks</i>, 18.</li> <li>• Kim, E. H., Na, J. C., &amp; Ryoo, S. M. (2009, July). Implementing an effective test automation framework. In <i>2009 33rd Annual IEEE International Computer Software and Applications Conference</i> (Vol. 2, pp. 534-538). IEEE.</li> </ul> <p>Test Automation Framework provides an overall environment in which the tests are automated and executed. It is a set of assumptions, concepts and best practices that provide support for automated software testing.</p> <p>It is a major block on which success of the automation project enormously depends. Selecting right architectural framework for automation development means that the automation code can be used for longer periods.</p> <p>The framework provides the user with various benefits that helps to develop, execute and report the automation test scripts efficiently. It is more like a system that has created specifically to automate system tests.</p> <p>Test Automation framework provide significant savings over the course of longer projects, and the ability to execute more thorough test on application by allowing to build and maintain scripts with less employee overhead.</p> <p>I have research and analyzed various test automation framework methodologies. These methodologies differ from each other based on their support to different key factors to do automation like reusability, ease of maintenance etc. Based on those factors they are adapted for subsequent Framework Design.</p> <pre> graph TD     TA[Test Automation Frameworks] --&gt; MBF[Module Based Testing Framework]     TA --&gt; LATF[Library Architecture Testing Framework]     TA --&gt; DDTF[Data Driven Testing Framework]     TA --&gt; KDTF[Keyword Driven Testing Framework]     TA --&gt; HTF[Hybrid Testing Framework]     </pre> <p style="text-align: center;">Test Automation Frameworks</p>	<p>Provide annotations to your supplementary evidence (document and page number)</p>
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------

Based on studying various research papers about the test automation framework I found following framework methodologies.

- Module Based Testing Framework
- Library Architecture Testing Framework
- Data-Driven Testing Framework
- Keyword Driven Testing Framework
- Hybrid Testing Framework
- BDD Framework

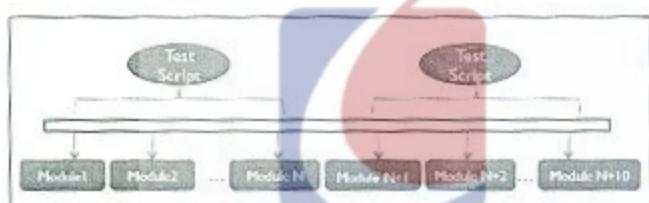
### 1) Module Based Testing Framework:

It is considered as basic test automation framework and it is built on the concept of abstraction. It involves creation of the independent scripts that represent the modules of application under test. These modules in turn are used in a hierarchical fashion to build large test cases.

In this approach, an abstraction layer is build for a component to hide it from the rest of the application, that layer insulates the application from modifications in the component and provides modularity in the application design. When the changes made to other part of the application, the changes do not affect that component.

The use of this framework yields a higher degree of modularization and adds to the overall maintainability of the test scripts.

Example of Module Based Architecture,



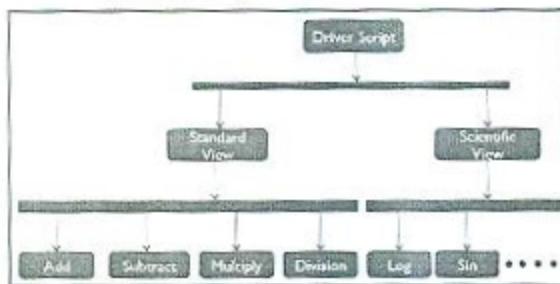
For example, consider the calculator program for demonstration in which the basic functions of a calculator are addition, subtraction, multiplication, division that are part of standard view.

A Sample scripts for these functions as follows,

```
Add
Sub Main
    Window Set Context, "Caption=Calculator", ""
    PushButton Click, "ObjectIndex=10"           'Press 5
    PushButton Click, "ObjectIndex=20"           'Press +
    PushButton Click, "ObjectIndex=14"           'Press 6
    PushButton Click, "ObjectIndex=21"           'Press =
    Result = LabelUP (CompareProperties, "Text=11.", "UP=Object Properties")
                                                'Compare Expected to Actual Results
End Sub
```

In this way, addition, subtraction, multiplication and division scripts are created. At next level of hierarchy, two scripts are created as standard view and scientific view; in which standard view contain calls to scripts created above for each function.

### Example of High Level Module Based Architecture,



The Driver Script is the top most level of hierarchy, which contains the scripts of standard and scientific view.

#### A Sample Example of Driver Script,

```
Sub Main  
    'Test the Standard View  
    CallScript "Test Script Mod Framework - Standard"  
    'Test the Scientific View  
    CallScript "Test Script Mod Framework - Scientific"  
End Sub
```

This framework represents a high level of modularization such that when there is a change in the functionality, we can change the bottom level script (the script that actually test that control) without affecting all the other test cases.

Following table explain advantages and disadvantages of Module Based Approach.

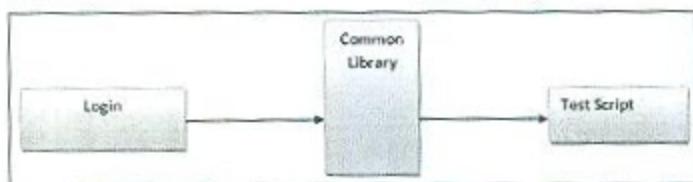
S.No	Advantages	Disadvantages
1	This framework support high level of modularization with easier and cost efficient maintenance.	While implementing test scripts for each module separately, test data is embed in test scripts. Therefore, same scripts cannot be used with different set of test data, as it requires manipulation in the test scripts.
2	In this, creating new driver script for different tests is easy and fast as the functionality is available to use in test library.	
3	If the changes are implemented in one part of the application, Only the relevant test script representing that part of the application needs to be fixed leaving all the other parts untouched.	
4	The framework is scalable	

### 2) Library Architecture Testing Framework:

This framework is very similar to the test script modularity framework, in other words it is fundamentally built on Module Based Testing Frame work with some additional advantages. It divides the application under test into procedures and functions instead of scripts. This framework requires the creation of common library constituting common functions for the application under test. These library files directly called from the test case script. The fundamental behind the framework is to determine the common steps,

group them into functions under a library, and call those functions in the test scripts whenever required. It also yields high degree of modularization and adds to the overall maintainability of the test scripts.

Diagrammatic representation of Library Architecture Framework



Following table explain some of the main advantages and disadvantages of Library Architecture approach

S.No	Advantages	Disadvantages
1	This framework also introduces high level of modularization like Module Based Framework with easier and cost efficient maintenance.	Like in Module Based Automation Framework The test data is part of test scripts, therefore any change in the test data require changes in the test script as well.
2	This framework allows great degree of re-usability because various test scripts can efficiently use common functions across the Framework.	In this framework complication increases due to maintenance of common function library.

### 3) Data Driven Testing Framework:

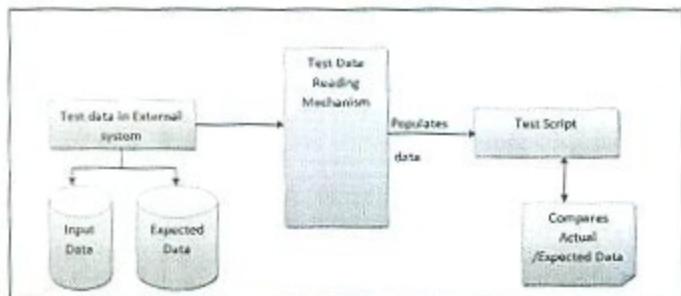
In Data-driven testing framework, the test data is stored in external files or database (data pools, ODBC sources, CVS files, Excel files, DAO objects, ADO objects etc.). In which values are loaded into corresponding variables in manually captured scripts. The navigation flow of application under test is coded in test script.

Data Driven Testing Framework allows large number of tests to be executed quickly using the automation scripts made for similar scenario. Instead of creating large number of scripts for testing individual test conditions with similar scenario. Therefore such type of architecture used when it is required to test the same functionality multiple times with the different set of input data. In this case, test data is not embedded in the test script but it is retained in some external database outside the test scripts.

This framework helps the user segregate the test script logic and the test data from each other. In this framework, new scripts developed for new scenarios.

This framework is also suitable for applications that are under development.

Diagrammatic representation of Data Driven Framework



Following table, explain some of the main advantages and disadvantages of Data Driven approach.

S.No	Advantages	Disadvantages
1	It reduces the number of overall test scripts and overall less amount of code is needed to implement all the test cases	A test case is belongs to same scenario with different type of data input. For new kind of scenario, new script needs to create.
2	It is flexible when maintenance of scripts is required. It mean when application functionality changed, only the specific business function script needs to be maintain. In addition, any change in the test data matrix would not hamper the test script code. Hence, the framework allows greater flexibility and maintainability.	Tools that support Data Driven scripting required proficiency in scripting language it support, because it all depends on tool how much it is proficient to execute it.
3	Test Data can be created before test script creation	Separate Data Files are required for each test case. Therefore, each data file managed separately. It usually requires data files kept in separate directories due to distinct Test Cases.
4	Test Script can be developed while application development is still in progress	Tester has to re-enter specific data in required data file whenever change in Test Plan occur due to test data. Therefore process is complex and requires an extra effort to come up with the test data sources and reading mechanisms.
5	A modular design can be use with Data Driven Approach by combining each scenario incorporating navigation control. This way duplication of effort reduced in creating automated test scripts.	It required careful attention while working with the format of Text Editors. For example, Note pad, when test data need to incorporate in such files, test script may produce errors while processing the script due to file format or incorrect content.

#### 4) Keyword Driven Testing Framework,

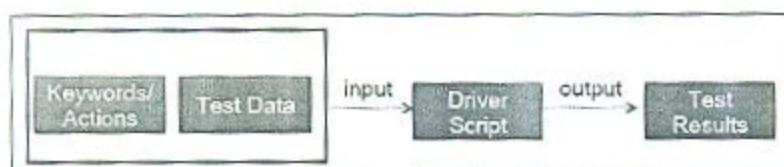
Keyword driven testing is an application independent framework that utilizes data tables and self-explanatory keywords to explain the actions, how to perform on the application under test.

This framework extends the idea used by Data Driven framework. In this framework, the directives, also called Key Words (Actions) that tell what to do on the application elements, are also stored in external data file along with actual test data. In this test, script code drives the Application Under Test and the Test Data (Actions and Data).

Keyword Driven framework implementation requires programming skills and a high level of abstraction. This approach makes it easier for the test engineers to create test cases without ever touching the framework code.

This type of framework fits to broader range of applications, but limited by the technology used to implement it.

### Diagrammatic representation of Keyword Driven Framework



For Example,

Consider actions performed by the mouse while interacting with calculator to execute basic functions and create sample table that maps the actions performed with the mouse on the window of the calculator interface.

Window	Control	Action	Arguments
Calculator	Pushbutton	Click	2
Calculator	Pushbutton	Click	+
Calculator	Pushbutton	Click	3
Calculator	Pushbutton	Click	=
Calculator		Verify Result	5
Calculator		Clear	
Calculator	Pushbutton	Click	5
Calculator	Pushbutton	Click	-
Calculator	Pushbutton	Click	3
Calculator	Pushbutton	Click	=
Calculator		Verify Result	2

In above table,

- The windows column represents the application for which mouse action is to be perform.
- The control column represents the control that user is clicking with the mouse.
- The action column represents the action performed by the mouse.
- The argument column contains the specific control value, which is test data.

After creating the table, we create a set of scripts to read the table in order to execute each step based on the keyword contained in the action field and log any relevant information.

Below is the pseudo code that represent such script

```
Main Script / Program  
    Establish Connection with Data tables.  
    Read in Row and parse out values.  
    Pass values to appropriate functions.  
    Close connection to data tables.  
  
Return  
  
Menu Module Set focus to window.  
    Select the menu pad option.  
Return.  
  
Pushbutton Module Set focus to window.  
    Push the button based on argument.  
Return.  
  
Verify Result Module Set focus to window.  
    Get contents from label.  
Return  
Compare contents with argument value.  
    Log results.  
Return.
```

Following table, explain some of the main advantages and disadvantages of KeyWord Driven approach.

S.No	Advantages	Disadvantages
1	It provide all the advantages that Data Driven approach provides like reduced number of overall test cases, Maintenance of Scripts, Proactive creation of Test Data before test script creation etc	The user need to be well experienced with the Keyword creation mechanism in order to work efficiently and take out full benefit provided by this methodology
3	A single keyword can be used across multiple test scripts. Similarly all the Keywords are reused across multiple test cases.	Keyword Driven Framework is more complex then Data Driven Framework. Because when number of Keyword grown, the framework get expand and gradually it become complicated to maintain and manage.
4	The detail Test Plan can be written in spreadsheet format containing all input and test data for verification.	In this careful attention is required while working with format of Text Editor like notepad, incase when test data needed to incorporate in such data files. Because, due to complexity of file format or due to incorrect content, the script may failed while execution and produce errors.

5	If any utility scripts is created by script developer using tool's scripting language prior to making any detailed test plan being written, then the tester can use the automated testing tool immediately using "spreadsheet-input" method, without learning the tool scripting language. In this case, automation expertise is not required for tester to maintain or create a new set of test cases.	Incase when application requires more customized utilities, then tester will have to learn a number of 'key words' and special formats. In this case, it will be time consuming for tester and it will affect initial Test Plan development.	

#### 4) Hybrid Testing Framework,

Hybrid Test Automation framework is a combination of all of the above techniques; it utilizes the strength of all above frameworks and try to mitigate their weaknesses. It accommodates both Keyword-Driven testing and Data-Driven scripts.

In Hybrid Testing Framework, Data Driven Scripts take advantage of the powerful libraries and utilities that accompany a keyword driven architecture.

The framework is defined by the following three main components

- a) Core Data Driven Engine
- b) Component Functions
- c) Support Libraries

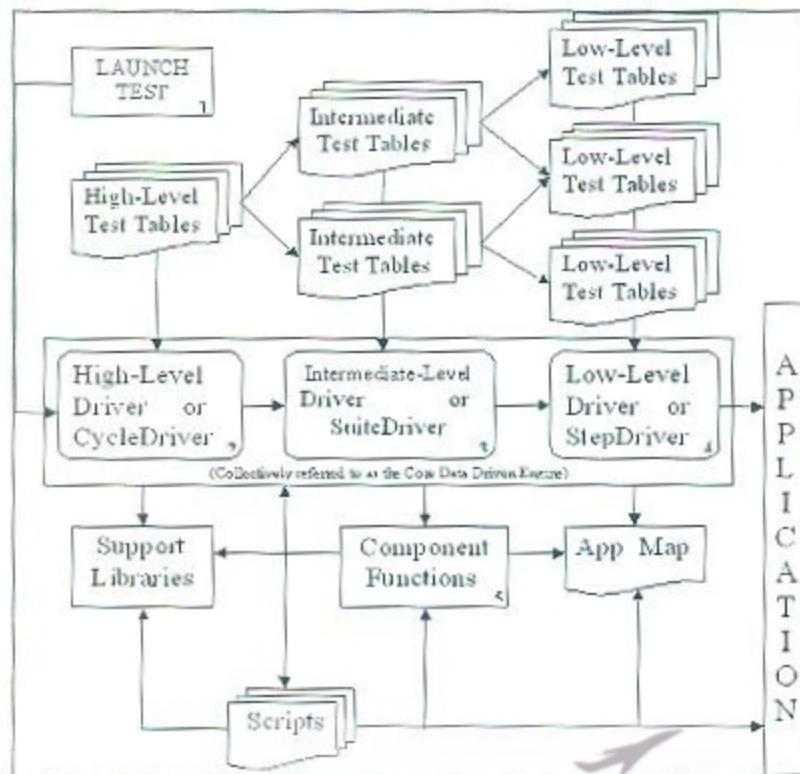
Support Libraries provide generic routines. The core engine and component functions are highly dependent on the existence of all three elements.

#### Framework Working:

In this framework, the test execution starts with the 'Launch Test Script' that involves Core Data Driven Engine by providing one or more High-Level test tables to CycleDriver. CycleDriver processes these test tables invoking the SuiteDriver for each Intermediate Level test table it encounters. SuiteDriver processes these intermediate level tables invoking StepDriver for each Low Level test table it encounters. As StepDriver processes these Low Level tables, it attempts to keep the application in sync with the test. When StepDriver encounters a Low Level command for a specific component, it determines what type of component is involved and invokes the corresponding Component Function module to handle the task.

All of each elements of the framework mentioned above rely on the information provided in the App Map to interface or bridge the automation framework with the application being tested. App Map is the only means by which the framework can identify the objects in the application under test.

Diagrammatic representation of Hybrid Testing Framework



Following table, explain some of the main advantages and disadvantages of Hybrid Test Automation framework.

S.No	Advantages	Disadvantages
1	Framework can accommodate various types of applications and clients requests easily	Strong technical expertise is required to design and maintain the Hybrid framework.
2	It requires less generalization, compared to the keyword driven framework but allows more flexibility than purely Data Driven Approach	
3	Framework allow fast and less costly way to develop Test Scripts due to higher code re-usability	

#### Example, Automation Framework Design Exercise

Period (2013, Oct – 2014, Jan)

After evaluation of automated functional testing tool (Refer to Episode-2), I carried out Test Automation Framework design exercise to automate testing of Core Banking System existing functionalities and new functionalities.

The Core banking system is currently in production (Live environment) and working in entire branch network across Pakistan. This system is continuously being enhanced with new features that require testing of existing feature thoroughly in each major release.

**Constructability/Feasibility of the Project:**

I did feasibility analysis of the Test Automation Framework design. Following are some of the key points

**1. Tool Compatibility:**

The tool evaluated i.e. QFT was compatible with the Core Banking System as it was able to successfully recognized all the java swing components (GUI Objects) of the core banking application and there was not any additional plug-in was required to develop Automated test scripts. Please refer to Episode-2 for more detail about the tool evaluation exercise.

**2. Need of Additional Technology:**

The UI controls provided by the tools were also rich in functionalities and easy to use. Almost all the scripts could be developed using UI controls provided by the tool. The tool was also supported Perl language and that language could be used for more advance test scripts development.

**3. Need of Test Data Storage:**

The test data generated by script execution was required to store in database. Because many test scripts were required to access those data generated by system using script to execute other dependent test scripts. The tool used was compatible with IBMDB2 database used in core banking system and could be able to communicate with database with appropriate driver and able to generate test data in database.

**4. Test Automation Framework Selection:**

Data Driven framework was choose to develop Test Automation framework because of following reasons:

- 4.1. Test data was stored in external files or database. While executing scripts, values were loaded into corresponding variables in manually captured scripts. The navigation flow of application under test was handled in test script with recorded steps. The tool was highly supported to Data Driven methodology. In core banking system, almost all the test scripts were required to execute with various combinations of input test data, specially the financial test scripts, were it was required to store test data in external data source for which excel sheet were used. In order to use system generated data as external data source, SQL queries were used to interact with database with appropriate DB2 driver.
- 4.2. The Data Driven methodology allows large number of tests to be executed quickly using the automation scripts made for similar scenario, instead of creating large number of scripts for testing individual test conditions in similar scenario. In core banking system, same functionalities were required to test multiple times with different set of input data. In this case, data driven framework and tool was highly acceptable to use.
- 4.3. In Data Driven approach, test data is not embedded in test scripts but retained in external data source. The tool is rich in UI controls and highly supportive to Data Driven Mechanism, because the test scripts did not required to hardcode the values in it, making script segregated between test script logic and test data.

4.4. It was also convenient to develop separate script for different scenario using tool and it was required for maximum test coverage.

4.5. The framework was designed in such a way that a tester was able to execute

- a) A single script in framework with multiple data input provided by an external data source
- b) A complete module comprises of multiple scripts with separate data source for each script.
- c) An entire framework covering all the cases exist in Framework in one go.

**Evidences of Design Exercise:**

I implemented Data Driven Framework to automate the required testing as follows.

1. System was comprised of Financial and Non Financial Functionalities. For these activities, most of the system functionalities were required to test with various combination and different set of data input to ensure maximum test coverage.

**Example:**

In Fund transfer activity (Single Scenario), different set of input data can be

- Transaction to be occurred from different types of Accounts (Account Nature)
- Different Modes of Transactions (Payment Mode)
- Different Values of Amount (Above Posting Limit and Below Posting Limit)
- Different Currencies

2. The single script was able to verify the non-financial conditions and input data values from external data source. Therefore, separate script for each data input was not required to develop, hence it helped to minimize the number of scripts to create and maximize the test coverage in single script.

3. Data was not required to embed in script beside business logic validations; that I was able to handle in script. There for test data was maintained in some external database outside the test scripts. In this frame work I used three different sources of external data source according to test scenario

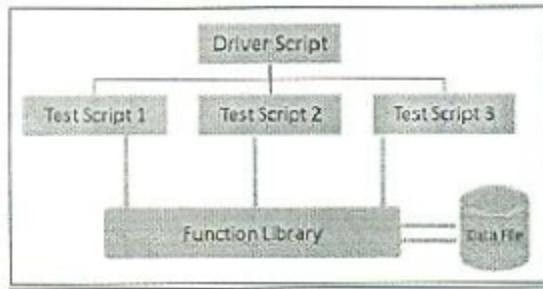
- a) Excel Sheets that contained test data with different combination of input values to be used with scripts
- b) SQL queries using db2 driver to directly retrieve data (generated by system) from database
- c) Data tables (QFT feature) to call combination of data defined in tables and attached with test scripts.

4. The navigation to system functionalities handled by recorded procedures maintained in a separate library.

5. Test Set is able to call the data Input from external Data Source having same field names as input variables defined in the script (i.e. Excel Sheet, DB2 Database, User define data table in script) and execute the Test Case by calling producers and applying the data to script. It helped segregate the test script logic and the test data from each other.

6. Framework allowed incorporating new script for newly developed functionality (new test scenario). In this case, I create separate navigation scripts and separate test script containing business logic that also call test data input variables and keep both scripts in separate library.

Following is the diagrammatic representation of Test Automation Framework Design Excercise.



In below snap shot, a major Test Set is created that contain all the main scenarios of Fund Transfer Business Cases. Inside it, each Test Set is the separate main scenario of Fund Transfer activity for which separate script is created.

```

Test-suite
  Test-set: Launch&Initialize_App
  Test-set: Module:Teller
    Test-set: Teller----Business-Case 1: Pay_Cash
    Test-set: Teller----Business-Case 2: Receive_Deposit
    Test-set: Teller----Business-Case 3: Fund_Transfer
      Test-set: Teller----SubCase 3-1: Transfer_Funds
        Test-set: Teller----Sub Case-3-1-1: Fund_Transfer_from_Cust_To_GL
        Test-set: Teller----Sub Case-3-1-2: Fund_Transfer_from_Cust_To_GL
        Test-set: Teller----Sub Case-3-1-3: Fund_Transfer_from_Cust_To_GL
        Test-set: Teller----Sub Case-3-1-4: Fund_Transfer_from_GL_To_GL
        Test-set: Teller----Sub Case-3-1-5: Fund_Transfer_from_GL_To_ND
        Test-set: Teller----Sub Case-3-1-6: Fund_Transfer_from_GL_To_ND
        Test-set: Teller----Sub Case-3-1-7: Fund_Transfer_from_MN_to_Cust
        Test-set: Teller----Sub Case-3-1-8: Fund_Transfer_from_MN_to_GL
        Test-set: Teller----SubCase 3-2: Forex Remittance
        Test-set: Teller----SubCase 3-3: Exchange Voucher
        Test-set: Teller----SubCase 3-4: Fund_Transfer_InterBranch
        Test-set: Teller----Business-Case 4: Outward_Clearing
        Test-set: Teller----Business-Case 5: OBC
        Test-set: Teller----Business-Case 6: Bank_Charges
      Test-case: Return_To_MainMenu
    Test-set: Module:Term_Deposit
    Test-set: Module:Remittances
    Test-set: Module:Setup
    Test-set: Module:CRM
    Test-set: Module:UPM
  
```

In below snap shot, Test set used Data Driver to call data source and Test Case (Business Scenario) of a Fund Transfer Activity that will execute Fund Transfer Script to transfer fund From Customer Account to General Ledger Account.

```

Test-suite
  Test-set: Launch&Initialize_App
  Test-set: Module:Teller
    Test-set: Teller----Business-Case 1: Pay_Cash
    Test-set: Teller----Business-Case 2: Receive_Deposit
    Test-set: Teller----Business-Case 3: Fund_Transfer
      Test-set: Teller----SubCase 3-1: Transfer_Funds
        Test-set: Teller----Sub Case-3-1-1: Fund_Transfer_from_Cust_To_GL
        Test-set: Teller----Sub Case-3-1-2: Fund_Transfer_from_Cust_To_GL
        Data driver: DataSource_Fund_Transfer_Cust_To_GL
          Exec file: Fund_Transfer_Cust_To_GL
            Test-case: Execute_Fund_Transfer
              Call procedure: Module: Teller.Teller_Select_B_Retun_Options.Select_FundTransfer()
              Call procedure: Module: Teller.Teller_Execute_Transaction.Fund_Transfer.Execute_Fund_Transfer_Cust_to_GL()
        Test-set: Teller----Sub Case-3-1-3: Fund_Transfer_from_Cust_to_GL
        Test-set: Teller----Sub Case-3-1-4: Fund_Transfer_from_GL_to_Cust
        Test-set: Teller----Sub Case-3-1-5: Fund_Transfer_from_GL_to_GL
        Test-set: Teller----Sub Case-3-1-6: Fund_Transfer_from_GL_to_ND
        Test-set: Teller----Sub Case-3-1-7: Fund_Transfer_from_MN_to_Cust
        Test-set: Teller----Sub Case-3-1-8: Fund_Transfer_from_MN_to_GL
      Test-set: Teller----SubCase 3-2: Forex Remittance
      Test-set: Teller----SubCase 3-3: Exchange Voucher
      Test-set: Teller----SubCase 3-4: Fund_Transfer_InterBranch
      Test-set: Teller----Business-Case 4: Outward_Clearing
      Test-set: Teller----Business-Case 5: OBC
      Test-case: Return_To_MainMenu
  
```

In below snapshot Test Set calling Data Source defined in Excel file that is separately maintained and contained different sets of data input.

The screenshot shows a test set structure with various test cases and sub-cases. A callout box highlights a 'Data Drive Calling Testcase Data Source' node, which is described as 'Data source for this case or different sets of data input'. Another callout box highlights a 'Test Case Name' section containing 'ID\_Fund\_Transfer\_Release\_1.xlsx' and 'Worksheet name Fund\_Transfer\_Cust\_To\_GL'. The interface also includes sections for 'Comments', 'Variables in rows', 'Off-Item ID', and 'Delay before (ms)'.

In below snapshot Excel file (called above) shows different sets of Data input.

The Excel spreadsheet contains a table with columns: 'Customer', 'Cust\_no', 'Dr\_Cust\_Accno', 'Dr\_Code', 'Dr\_Amount', 'Cr\_Cust', 'Cr\_Code', 'Cr\_Amount', and 'Description'. The data includes various fund transfer transactions such as 'PAKISTANIRUPEX-500', 'PAKISTANIRUPEX-500', 'PAKISTANIRUPEX-500', etc., with descriptions like 'Check for Fund Transfer Transaction with Invalid Credit Code' and 'Execute Fund Transfer Transaction from Cust to GL - PKR Amount'.

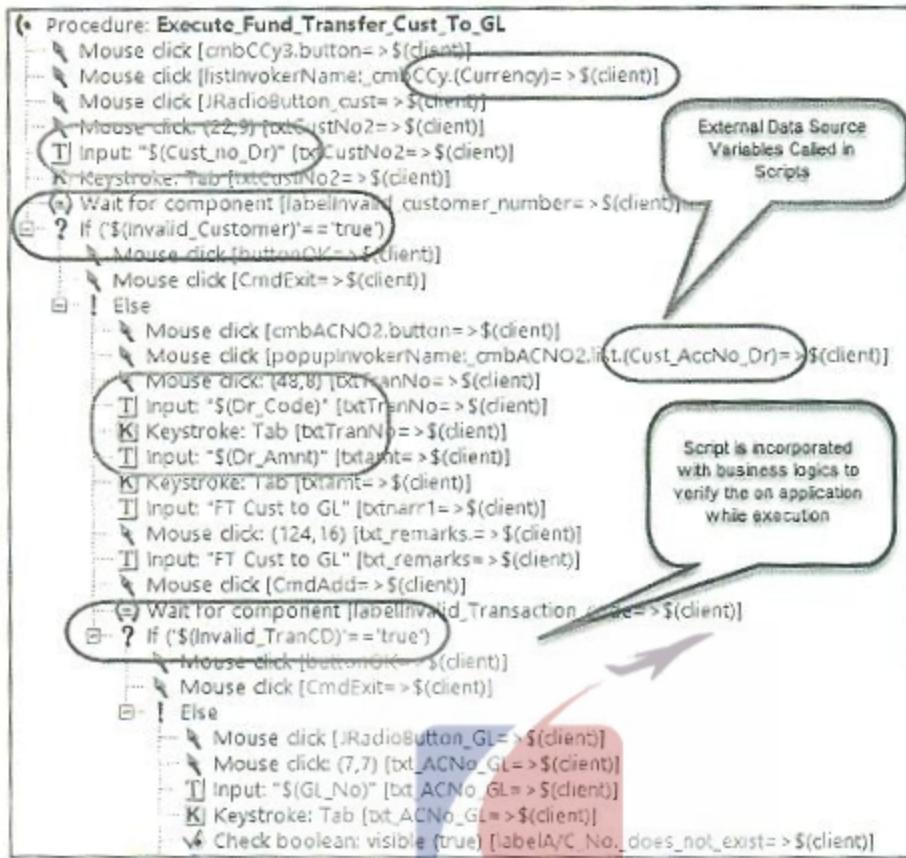
In below snapshot Test Case calling Navigation Procedure to Go to Fund Transfer Activity and then Calling Fund Transfer Scenario of Customer AC to GL Account.

The screenshot shows a test case structure with various test steps. A callout box highlights a 'Test Case call Navigation Script (Procedure) and then Test Execution Script (Procedure) that contains business Logics of Customer to General ledger (GL) Amount' node. Another callout box highlights a 'Testcase: Execute\_Fund\_Transfer' node, which is described as 'Call procedure: Module: Teller.Teller\_Select\_R\_Return\_Options.Select\_FundTransfer()' and 'Call procedure: Module: Teller.Teller\_Execute\_Transaction.Fund\_Transfer.Execute\_Fund\_Transfer\_Cust\_To\_GL()'.

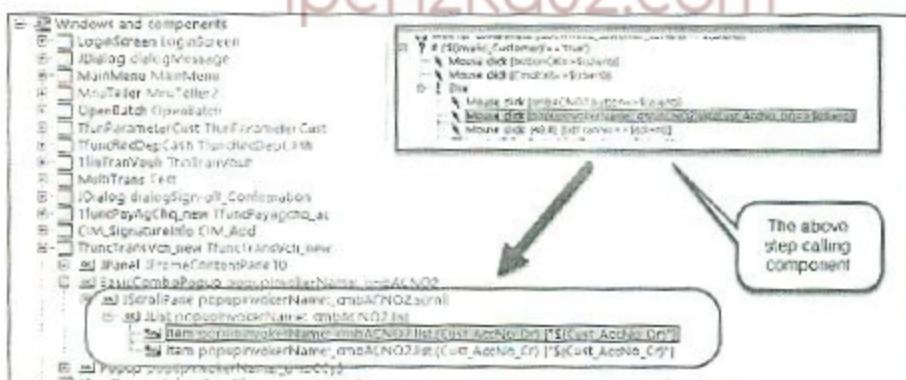
In below snap shot Test Library Contain Navigation Scripts recorded as procedure to Navigate to Fund Transfer Activity. The Procedures Node is the test library in which all the test scripts in the form of procedures are managed in different packages according to different modules. The procedures are managed in such a way that if any change is required in any procedure, they can easily be located allowing easy maintenance when framework size gets larger.

The screenshot shows a test library structure with a 'Procedures' node expanded. Under 'Package: Teller.Execute\_Transaction', there are several procedures listed: 'Procedure: Select\_FundTransfer', 'Procedure: Select\_Exchange\_Vouch\_Outward\_Ledgerment', 'Procedure: Exit\_& Return\_To\_Teller\_S', 'Procedure: Select\_Exchange\_Vouch\_Inward\_Ledgerment', and 'Procedure: Select\_Batch\_Remittance\_OPRC\_Ledgerment'. A callout box highlights the 'Procedure: Select\_FundTransfer' node, which is described as 'Navigation Script to Navigate to Fund Transfer Activity'.

Test Library Contain Fund Transfer script recorded as Procedure to Execute Actual Fund Transfer Scenario. In this script Data Input variables of External data source (Excel file as above) are called, so that when script execute , all different sets of data input apply to script one by one and execute the script for each data set.



Component Library is managed by QFT tool itself. This component library shows the Java Swing Components recorded in each step while interacting with application. This library grows automatically when scripts are recorded.



After Execution of Script, Following is the result of execution in report form

## Test Automation Implementation Strategy:

After acquisition of automated testing tool, I had created an implementation strategy document and implemented the tool. I also provided detailed training to software testing team. The document contained test automation framework purpose, test library management and configuration management strategy, Test Automation Framework environment setup and configuration, Test Automation approach, Test Automation process and roles and responsibility matrix and test automation design strategy.

- 1) Test Automation Implementation strategy document is Attached
  - 2) Email Communication Attached



## **Element Six**

### **Knowledge of engineering practice in the engineering discipline**

#### **Context**

Engineers require knowledge of a broad range of tools and techniques relating to technical (measurement, modelling, drawing, design), business (financial management, project management) and interpersonal (communications, teamwork) aspects of modern engineering practice.

Washington Accord graduates are expected to be able to,

Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations.

Apply knowledge of management principles and economic decision making as part of the management of engineering projects

Function effectively as an individual and as a member or leader in diverse teams

Communicate effectively with both technical and non-technical audiences

#### **Performance Indicators**

##### **Tools and technologies,**

Awareness of critical issues affecting current technical and professional practice

Awareness of current tools of analysis, simulation, visualisation, synthesis and design, particularly computer-based models and packages, and competence in the use of a representative selection of these

Appreciation of the accuracy and limitations of such tools and the assumptions inherent in their use

Knowledge of materials and resources relevant to the discipline and their main properties and ability to select appropriate materials and techniques for particular objectives

Knowledge of a wide range of laboratory procedures relevant to the discipline and a clear understanding of the principles and practices of laboratory safety

knowledge of current types of systems, equipment, information technology, and specifications that accomplish specific design objectives

##### **Communication,**

write correspondence that clearly and concisely communicates facts and circumstances related to a project, product or process

plan, prepare and deliver an oral presentation, with appropriate visual aids and other supporting materials

communicate effectively with both technical and non-technical individuals and audience

##### **Engineering management principles and economic decision making,**

apply appropriate tools and techniques to monitor project schedules and costs

##### **Team work,**

- Operate as an effective team member or leader of a multidisciplinary team

<p>Summarise your knowledge in each of these core areas underpinning engineering practice and how it was developed through formal study, on-job learning and/or continuing professional development.</p> <p>Note, please cross-reference to your academic transcript(s) and continuing professional development records, as appropriate.</p> <p><b>Critical Issues Affecting Current Professional Practices:</b></p> <p>Software development organizations are adapting agile development methodology and leaving Waterfall behind and this shift has affected software-testing practices as well. I came across various critical issues while practicing software testing over the period during my professional experience in last ten years. Some of them are describe below.</p> <p><b>Inadequate Test Coverage:</b>  In Agile methodology there is continuous integration, changing requirements occurs, and it is very easy to miss critical test cases for any requirement. I have mitigated such issues by linking test cases with user stories that have always provided me good control over the test coverage.</p> <p>Another cause of test coverage missing is the code change and the impacted area not tested. In this case, I have recommended code coverage analysis tools that can be used to identify the code areas that required proper testing.</p> <p><b>Early Defect Detection:</b>  Defects identified late in development life cycle are always costly to fix. It mean that defects identified during requirement definition are much less costly and have low impact on future coding, than those found late in testing or in production.</p> <p>I have come across with this situation, when critical issues are identified later in software development life cycle. It become hectic for QA as well as for developer to resolve those issues when code is freeze; but require code changes that may affect other stable areas of code.</p> <p>To resolve such type of situation, I have been involved in recommending software engineers to keep reviewing their code until software testing is completed. This practice has always helped to identify risky code during development and helped to identify critical bugs early during development life cycle.</p> <p>Such issues can also be controlled, if code coverage analysis tools are used to identify any missing error routines, data type mismatch issues etc in code.</p> <p><b>Performance Bottlenecks:</b>  When software gets more mature then complexity of the code increases because more lines of codes are added. The increase in code size introduces performance related issues and normally such issues occur when it is not addressed during development. For this, developer must know the areas of code that are affecting performance of application and causing performance issues. In this case testing tools can help to identify the slow areas and track the performance of the application.</p> <p><b>Tools and Technologies:</b>  I started to gain knowledge and understanding about tools and technologies since my bachelors in computer engineering programme. During program, I worked in various programming tools. For Example Microsoft Visual Basic 6.0 to develop a library management system as part of my course work project. I also worked in AutoCAD tool while studying Computer Aided Engineering Drawing during bachelors programme as part of my course work assignments.</p>	<p>Provide annotations to your supplementary evidence (document and page number)</p>
---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------

When I started to work professionally, I gradually realized that tools and technologies are continuously upgrading and advancing rapidly, therefore in order to keep myself updated with technological advancement, I would need to upgrade my knowledge and awareness about tools and technologies accordingly. Therefore, I started to explore various tools and technologies related to my field of work taken in depth understanding of their practical usage.

When I started my career as Software Configuration Engineer, I extensively work in Software Configuration Management tools like Microsoft Visual Source Safe 2005 to maintain the repository of the organizational and project artefacts. Later on, I also explored other tools of configuration management like WinCVS.

In order to gain knowledge about Project management, I also explored Microsoft Project Professional and Microsoft Project servers that provide web interface to manage multiple projects via Project Web App Component.

Traditionally projects were managed in different ways, now have been changed and relevant tools and technologies have been upgraded to support new way of project management. Similarly, the software development methodologies have changed. If we see a decade ago, waterfall methodology was extensively used in software development for large-scale software project. It is due to newly emerged concepts of time to market that means product should be delivered and available to use when it is conceived by the user. This phenomenon has made the software development a challenging field of work and this is the reason how software development tools and technologies are upgrading rapidly.

For example Microsoft team foundation server (TFS) 2012 that I use for sprint and capacity planning in Bank Al Habib IT Innovation. It provides complete solution for Software Development Life Cycle. For Example using this tool sprint and capacity for team is planned. It provides complete view of sprint progress and monitoring control during sprint in the form of burn chart. It is also integrated with other tools like Microsoft Test Manager for Managing, Executing and Monitoring of Test Case Execution. It has built-in mechanism to report software bugs. It is also integrated with Visual Studio for software development and source code merging. It also provides its own configuration management mechanism and maintains complete history of change occurred in any artefacts maintained in its repository.

I am working in the field of software quality assurance since last ten years. I have been involved in almost all the phases of software development life cycle with the role of software quality assurance professional for example

- Prepare user acceptance tests when user requirements captured and analyzed. It is very essential to identify those test cases at this stage as it explained what user actually want from system to be developed. These test cases are the essential, based on their successful execution user actually accept the system.
- Preparing system test plans when software requirements are specified. It is very essential to develop complete understanding about the environment in which the new system will operate. Similar environment is required to setup and configure to perform entire testing.
- During Architectural design, I have been involved in planning integration testing by understanding the complete system architecture. To identify integration test cases is highly complex task, in which complete end to end test cases are identified that are executed after all major modules of the entire system are developed and integrated in an environment and worked as complete system.
- I have extensively worked in manual functional testing and relevant automated functional testing. Here requirement traceability is very critical while creating test cases, such that each test case must be traceable to actual requirement of the user.

- I have also worked for software performance testing that is considered as non-functional requirement of the system. It is very essential to perform this testing in order to measure the performance aspect of the system execution.

During each phase, I have gained understanding and knowledge about the tools and technology usage.

For example, requirement traceability is very crucial when test cases are developed from software requirement document. For Quality Assurance professional it is very critical to ensure that each test case identified is traceable to actual requirement. If the project is large scale, then it becomes difficult to manage test cases in excel sheets and documents. Here requirement management software like HP Mercury Quality Centre (previously called test director) plays important role to manage the test case and complete traceability of requirement. I have working knowledge of Mercury Quality Centre and well aware about how the software requirement are managed and maintained in it, test cases are created in it and how they are managed with complete traceability to actual requirement specifications.

While performing software testing, Software test professionals required software-testing tools in order to execute automated functional testing. It depends on the technology in which the product is actually developed. For functional testing of Java swing applications, I have thorough working knowledge of tools like QFT. For Dot net applications, I have used Coded UI, Rational functional testers, QTP etc. It is very important to understand that not all cases are automated, therefore it is very important to balance between automated and manual test case execution. Normally the new features of the software product are tested manually or they may be executed automatically, if they require repeated effort. Automated testing is applied to those cases that are already working in system or required repeated test execution. Just to verify any repeat impact, Automated tests are executed to find the results quickly.

While performing testing, I have working knowledge of test data generation tools like SQL Data Generator, IBM DB2 test data generator to generate test data.

For Performance testing of software systems, there are various performance testing tools like Rational Performance Tester and Load Runner tools that are highly competitive and accurate in results. I have working knowledge of both these tools.

For desktop-based applications, I normally use performance profiler to identify memory consumption. There are various other commercially available and open source software's like Yourkit profiler, Java Profilers for which I have working knowledge.

Since the software development industry is going from client server based architecture to service oriented architecture (SOA), therefore the development of web services is highly popular. In order to test the web services there are various tools, from which I have working knowledge of SOAP UI to test web services.

There are various open source software's available that support all phases of software development life cycle. The open source software's are the computer software with source code made available with a license in which the copyright holder provides the rights to study, change, and distribute the software to anyone and for any purpose. They are developed in a collaborative public manner from multiple independent sources but they have various advantages and disadvantages of use.

#### Communications:

I have worked with different leading roles in various organizations, where I have to interact with external stakeholders like Business Users and Clients, as well as I