Chapter 05: System Testing and Implementation

Topics Covered through the Chapter

5.1 Introduction

System implementation and testing report is mainly concentrating on how the system is going to implemented and tested. This will check how the system is going to develop physically. In here, the importance of selecting the right technology for the development such as appropriate language selections is discussed.

The testing methodologies and their objectives which is used with the development will be discussed in detail. Testing the system ensures that the implemented system will run with minimum errors and bugs.

And also this report will provide information about the implementation facts, which is needed to run the system in the real environment. The implementation facts conveys about the system implementation procedures in depth in order to provide comprehensive knowledge to the reader regarding data runs, installation methods and system handover procedures.

5.2 Technology Considerations

Technology that suits for the system development should be decided by considering the domain and the requirements for the system. The quality of the product is neither depends upon the advanced and complex tools or the low quality tools used in the development but depend on selecting the appropriate tools and technology.

Existence of more technological considerations can be seen, since the proposed system of ASRS is a web based system. Time for the production, Efficiency and the performance of the system, Usability and Flexibility of the system and functionality of the system should be considered in developing the system. It is convenient to identify most appropriate technological methodologies in order to satisfy the functional requirements and the non-functional requirements of the system in the system development procedure.

5.2.1 Selecting the Language

Programming language is a necessary technical factor that should focus in implementing the system. When selecting the programming language, it is utmost necessary to select the language so that it merges with the development tools where the system is going to implement with. Basically the compatibility of the language with the tools used is a must in the development.

Identification of several programming languages was observable during the development. Selection of the most appropriate language was a challenge that was emerged at the

development. It is much harder to select the most appropriate language without an initial knowledge about several development languages which is available for the development. Following few languages were at the research level of the development.

- C#
- Visual Basic
- Java Script
- PHP
- HTML

At the beginning ASP.net was used as the technology in the development. C#, Visual Basic, JavaScript, html was the programming languages. With the researches that have been done about the languages throughout the initial system development process resulted PHP as the final decided programming language for the entire development with together with the following supporting languages.

- HTML
- CSS
- Java Script

Following are identified as the basic factors in selection of a programming language.

- **Networking tools and resources for the development are available.**

  PHP is far more compatible with the web based development. The proposed system is an online student recruitment system for KDU. PHP is editor independent. PHP developers have access to an extensive number of editors such as Notepad++, Sublime text 2 and advanced technologies such as VI and VIM.
  ASP.net relies on an available number of developers at Microsoft for making improvements and updates. There are less support contributors available to solve ASP.net challenges.

- **Time to Development/coding time and to Deploy**

  It takes a larger amount (more lines) of code to accomplish complex features and functionality with ASP.net compared to PHP, adding more time to the development process.

Additionally, PHP is interpreted at the server, so when changing a functionality, no additional steps are required to see the changes. On the other hand, ASP.net needs to be compiled each time the code is modified. Again, the development process is more time-consuming when using ASP.net as opposed to PHP.

- **Platform Dependency**

PHP is platform independent and can run on any platform — Linux, UNIX, Mac OS X, Windows.

ASP.net is built to run only on Windows platform

- **Re-usability, flexibility and familiarity**

VI and VIM are very advanced and independent editors, and the programmers who learn and use those editors to the fullest capabilities can perform very complex programming, in a fast, efficient and independent way. Those programmers have more control and flexibility, and when it comes to the need of using and integrating other essential platforms, such as JavaScript, Ajax, JQuery, etc., the PHP developers have a better advantage because of their familiarity with the open source environment and hand coding using VI or VIM editors.

- **Availability of literature**

Literature availability becomes compatible, considering the PHP usage with the tutorials, blogs and other resources for the development since it is Open source language.

5.2.2 Selection of Tools

Implementation of the proposed system of ASRS needs to have experience on set of tools. Tools were helpful in creating the models of the system during system development making the development much more convenient and easy for the developer. Selection of tools for the development has to be done in way that the selected tools are compatible with the development. Following are some tools used in the development process.

- **Visual Editors**

User interfaces relevant for the development is created using set of online visual editors. Usage of visual editors helpful in creating the user interfaces without hardcoding and also it helpful in the easiness testing purposes and it reduces the time on development. These visual editors were mostly used for the modeling of the

application sets used in the ASRS. Following are the used visual editors in the development of ASRS.

- PForm Builder
- Wufoo from Builder

- **Server Support**

ASRS is a web based system where applications are submitted by the candidates and will be processed by the administrative staff of the KDU registrar office. Getting the support of the server is important in the system development in order to check the data transformation between the modules of the system. Having a server like XAMPP or IIS is imperative in the system development. IIS server was the most compatible server, since the KDU server is an IIS server

- **Code Editors**

Code Editors such as Notepad++, Sublime text 2 were used in the development to handle and manage the code easier in the development process.

- **PDF Report Generation Tool**

Administrators of the system are provided with reports relevant to the applications which are being submitted. TCPDF report generating tool is used for the report generation purpose.

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5.2.3 System Development Strategy

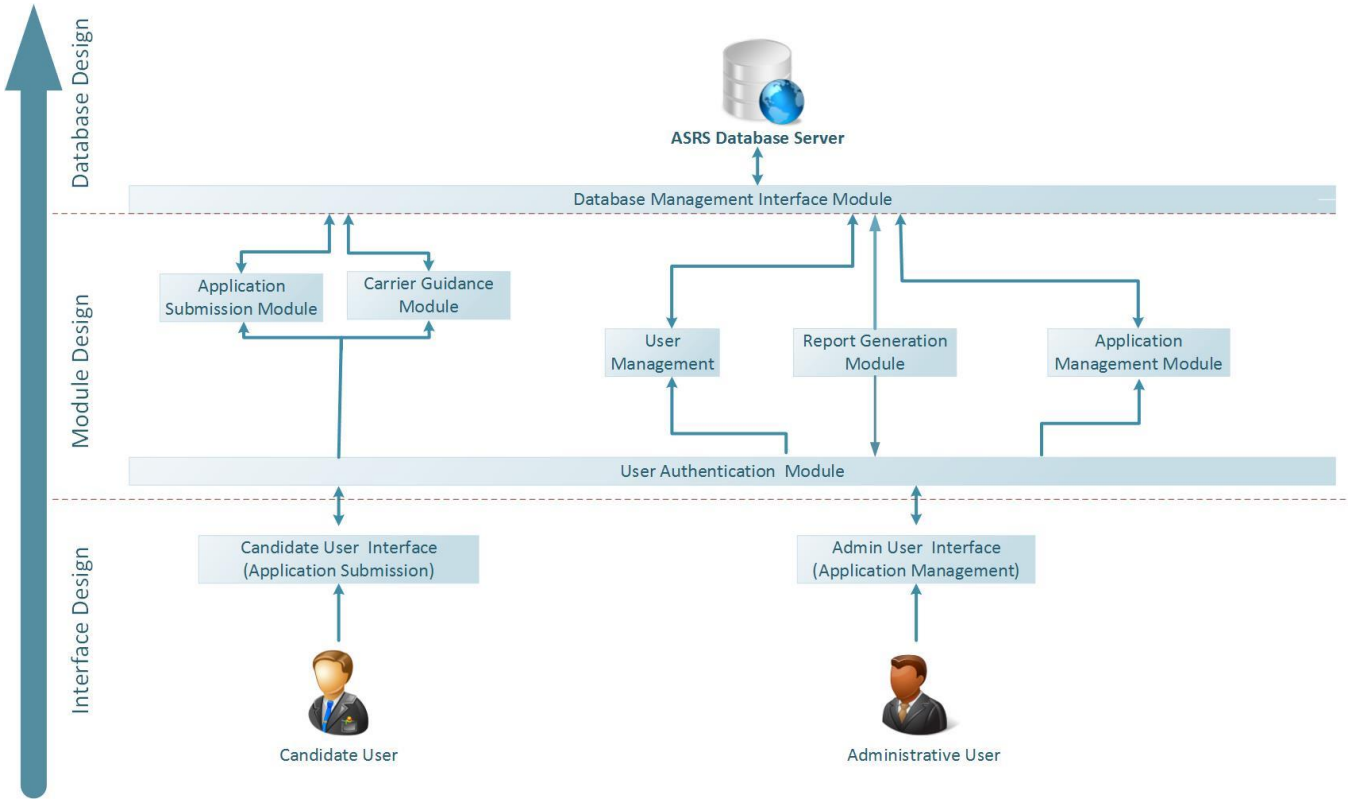

Figure 56 : System Development Order
Source: Author

Figure 56 depicts the system development strategy in regards to the development of the proposed ASRS. Building the prototypes was easier in initiating the system development methodology through the identified interfaces. Interface design using prototypes let the client to understand and verify the flow of the system. Interface prototypes acts as a usability prototype rather than concentrating about the functionality of the system. Through the interface designing, the proposed system module flow is accepted by the administrative staff of the registrar office, KDU.

And later, development proceed with the module design and the database design in order to make the system complete in a modular basis rather than implementing the whole system as a single module.

This strategy is identified as the top down approach and was chosen as the development strategy, in the easiness in proceeding with the system development. In here, next steps

decide the functionality of the system proceeding with the module designing and the database designing.

5.3 Testing

Testing of ASRS is a major the task to perform successful project. Software testing is a methodology that can be implemented at any time in the system development process.

Excellent performance on a test case depicts an error free, well performing system with the tested modules, functionalities. The objectives made on system testing depict the testing level to be used to accomplish the task.

5.3.1 Objectives of Testing a System

The main aim of the system development is to create the proposed ASRS which is usable, intuitive, simple, and functional. Following can be accepted as the objectives of the system testing. Achieving these objectives allows the system to be proceeds with a successful development.

- **To explore the Functionality of the system**

  Most of the system tests are being conducted to see whether system is functioning with the implemented functions. Exploring the functionality through test cases emphasize the fact that all the functional requirements are fulfilled according to client's requirements. Functional prototypes are used in most of test cases in order to explore the functional achievements of the system.

- **To Identify any misinterpreted, misunderstood and missed Requirements**

  At the initial requirement gathering phase, initial requirements are gathered and analyzed. Testing the system is helpful identifying, "what the actual requirement is?" Therefore testing is useful in developing the system accurately by acquiring the feedback from the user regarding the requirement fulfillment.

- **To Identify any issues with Connectivity with the database**

  The developed system must be definitely checked against for the connectivity issues. Critical issues will be generated if the ASRS is not properly connected to the database, since connectivity to the database is comparatively important to test the functionality of the system.

- **To Identify errors in the Development**

  It is imperative to have test runs in order to detect errors in the system development. Error checking of the system can be tested can be started from the initial stage of the system development. These identified errors may occur due to coding errors, errors in connecting to the database (as mention in the above point), and system compatibility issues with the platforms and with the server.

- **To Identify the fulfillment of the non-functional requirements of the system**

  Achieving the nonfunctional requirements such as Usability, performance, efficiency and security can be checked through the testing process.

- **To rectify the flow of the system**

  System testing ensures the correct flow of the system by the conducting integration test on connecting the system modules. Satisfying this objective resulted in removing if there are any incompatibilities between the modules developed.

5.3.2 Testing Strategy

The test levels to be performed in testing and the description of testing activities within the test levels are known as test strategy. There are primarily three levels of testing as unit testing, integration testing and system testing.

- **Unit Testing**

Unit testing is the testing of an individual unit or group of related units. It is often done by the programmer to test that the unit he/she has implemented is producing expected output against given input. It reduces the level of bugs in system and discovers usability issues in earlier.

The proposed system of ASRS is a component based development. The most convenient way of finding the bugs at the modular level is the unit testing. And also unit testing is a fast testing level which will out put the result in less than a half a minute. Therefore usage of unit testing level is prominent throughout the development process of proposed ASRS.

Following Table 08 depicts component and the objective of testing the particular component.

Component	Description
Carrier Guidance Module	Carrier guidance module is designed to provide particular details about the most appropriate course details for the particular candidate after entering the Advanced Level Examination result details. Any of the system users can type their advanced level stream and the university entrance level to see for the relevant courses.
Database Management Module	Creation of the database, tables and writing queries were main tasks in the database management module. Successfulness of table, database creation and reliability of the queries were checked.
User Authentication Module	User authentication module let the registered users to successfully login to the system with the validation of the user. And the user without an account is given the opportunity to create the account. Valid username and password are checked. Writing invalid usernames and passwords checks the validations implemented in the module. User Registration is done by submitting the username, password and e-mail. (Database Management Module is a default module in Unit testing)
Application Submission Module	Application submission module is designed to submit the application data to the relevant tables. Application is filled and check for the correct entries of data for the relevant tables. As the full application is segmented, data

	entered in each segment which belong to one record should be gone to one record in the database. Invalid format of data also being used to check the validations in the application. (Database Management Module is a default module in Unit testing)
User Management Module	User Management module manage users of the system. Super Administrator is the responsible person of managing the users of the system. Updating the user level by typing the relevant username is checked. Deleting the users from the database is checked by writing the username of the particular user. Invalid usernames are also checked to have the validation error message to be displayed. (Database Management Module is a default module in Unit testing)
Application Management Module	Application Management Module allows administrator type users to view the submitted applications, search for the submitted application and shortlisting the applications. Functionality of the module is checked by searching the information particular to the course type. And also writing the application number on the space given will give all the application details in table.
Report Generation Module	Generating reports on the selected information is the functionality of the report generation module. Reports are generated in the format of PDF. Function of creating the PDF is being checked.

Table 8 : Test Case- Unit Testing
Source: Author

- **Integration Testing**

Integration testing is testing in which a group of components are combined to produce output. Also, the interaction between software and hardware is tested in integration testing if software and hardware components have any relation.

The way that integration testing works is by getting the individual modules that have been identified through the unit testing phase and integration of set of modules into a group. The integration testing phase will make sure when the modules are being integrated together that the problems, for example errors or bugs caused due to the integration of the modules are eliminated.

Component	Description
User Authentication Module	Integration of the two modules is checked. Users are only allowed to access the application submission module only after login with their account with valid username and password.
Application Submission Module	
User Authentication Module	Users are checked against the super admin username and the password. If only the user is identified as super admin of the system, the pages are directed to the user management module.
User Management Module	
Application Management Module	Application management module allows the admin users to select the particular set of applications. Taking the details of those selected application details in PDF format is checked.
Report Generation Module	

Table 9 : Test Plan – Integration testing
Source: Author

- **System Testing**

Testing the behavior of the whole software/system as defined in software requirements specification (SRS) is known as system testing. System testing is accomplished with full system implementation and environment. System testing is done after integration testing is completed. The main focus of this testing is to evaluate Functional and Non-Functional requirements of the system. Furthermore system testing emphasizes how the system will react in the real environment of the system implementation and the issues that will arise; bugs and also the developer will be able to come across new requirements of the client in order to make the system a more successful product.

Component	Description
Carrier Guidance Module	Event flow of the whole system is checked by testing all the modules in the system. Relevant page redirection by clicking on the particular link or the button. Typing the valid admin username and password, Identifying admin username and password and proceed with admin functionalities. And checking the candidate username and password and allow them to proceed with their functionalities.
User Authentication Module	
Application Submission Module	
User Management Module	
Application Management Module	
Report Generation Module	

Table 10 : Test Plan – System Testing
Source: Author

(Refer Appendix D for Test Logs)

5.3.3 Test deliverables

Test Deliverables are the artifacts that are given to the stakeholders of system project. There are different test deliverables at every phase of the system development such as reports, charts and other documents which is provided on a regular basis. Some test deliverables are provided before testing phase, some are provided during the testing phase and some after the testing cycles is over.

5.3.4 Errors and Bugs

- **Run time errors**

  This error was found in various situations. Many reasons are found which led this this error, such as invalid code generation and technical errors running the system. This error is fixed by increasing the system memory and fixing the invalid algorithms.
  Figure 58 shows an error occurred due to invalid coding.

Figure 57 : Errors on invalid Coding
Source: Author

- **Errors on connecting SQL database**

Figure 58 : Errors on connecting SQL Database
Source: Author

Issues in the database connections may occur due to server incompatibility problems and if the invalid connection string is written. (See Appendix D for more details)

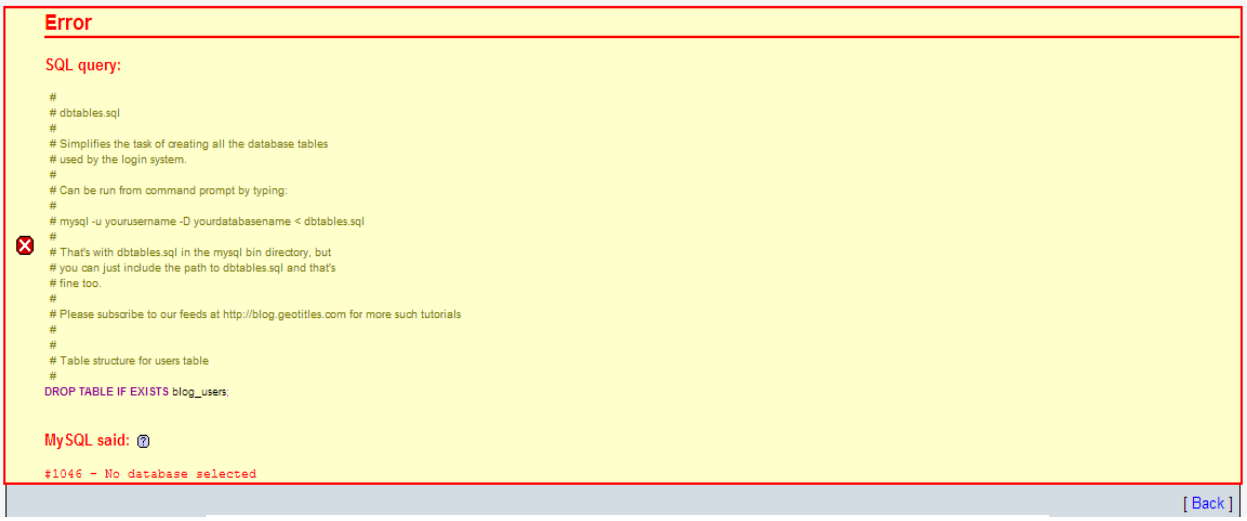

Figure 59 : Errors on importing the database
Source: Author

XAMPP server does not create a database when importing databases. But WAMPP and IIS server supports in importing the databases without creating a database initially. Previously mention error occurs due to the usage of XAMPP server in local hosting. Creation of a database must be done in importing in order to eliminate this error.

- **Segmentation faults**

Issues will be identified due to inappropriate flow of the system. Then the faults may occur in the system testing and in system integration testing.

- **Error connecting to server**

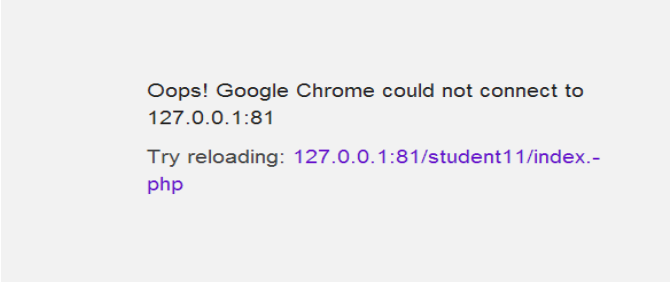

Figure 60 : Errors on connecting Server
Source: Author

Warning: mail() [function.mail]: Failed to connect to mailserver at "localhost" port 25, verify your "SMTP" and "smtp_port" setting in php.ini or use ini_set() in **C:\xampp\htdocs\student11\include\mailer.php** on line **38**

Warning: Cannot modify header information - headers already sent by (output started at C:\xampp\htdocs\student11\include\mailer.php:38) in **C:\xampp\htdocs\student11\process.php** on line **104**

Figure 61 : Errors on requesting the service from SMTP server
Source: Author

Figure 62 shows the error generated in using the e-mail address for the user registration. This error occurs due to the following reason.

Windows does not by default have an SMTP server installed. XAMPP won't install one either. If there IS one installed, then it's not running, because "connection refuse" on port 25 means nothing's there listening for email. This error can be eliminated by using the IIS server.

5.4 Implementation Plan

Implementation of the proposed system is decided and planned in the implementation stage. An outcome of the implementation plan is to identify how the developed system will be deployed and transitioned into an operational system. Plan will provide an overview of the system, major tasks which will be involved during the implementation and other requirements which supports to the implementation process.

5.4.1 System Overview

Functionalities of the proposed ASRS are an automated sub component of the prevailing manual application processing at KDU. There are two main users identified in the system as candidate and the admin user. Candidate main functionality is to submit the application through the online ASRS. Managing the submitted applications through the online ASRS is the admin functionalities with regards to the system.

Proposed system is discovered as the sub system of the prevailing manual system is because that all the application categories which is processed through the manual system is not being taken into consideration in the development. Candidates who are willing to apply to the University only for Certificate Courses; Diploma Courses; Undergraduate Courses or Postgraduate Courses can engage with the online application submission through proposed ASRS.

5.4.2 Installation of the System

Installation of the system should be conducted with the co-ordination of management of the client side which the system should be deployed in-order minimize the risks and contingencies discussed in above section. Installation of the proposed ASRS is being done by hosting the application in the server that belongs to KDU server. And the relevant database is also imported to the server database in the installation process. The installation process of the ASRS is completed afterwards hosting the system.

(Installation Guide is provided in Appendix D)

5.4.3 System Changeover

System changeover determines how the developed system should be installed and implemented in the real environment. Among the installation methods, parallel run of the implemented system is convenient.

In pilot running, both the new and the old systems are fully operational for a period of time, allowing comparison of the two. This allows for the new system to be tested with a real-world set of data, which can be compared to the old system. Also, if the new system fails, the old can continue with a minimum loss of data, as both systems are kept up-to-date.

The usage of pilot running is also selected as a suitable path in implementing the system. But the disadvantage will occur in confusing, if the system undergoing pilot run does fail, the data in the new system is lost. It can also lead to some confusion as to which system is being used for what.

According to clarifications and identifications, parallel run is selected as the appropriate system changeover methodology in implementing the system of ASRS for KDU as per the system objectives, functionalities and scope of the ASRS.

5.4.4 User Training

Importance of a user training process is identified in the system implementation. The need for the user training emerged as the prevailing system is operated manually. In order to reduce the gap between the manual usage and the automated usage and also to make them familiar with the available system functionalities, the users of the system should be given a user training to make them familiar with the available system functionalities.

5.5 Summary

The entire chapter is about the system implementation and testing of the proposed system of ASRS. The implementation phase depicts how the system is being developed and implemented. This phase also concentrates on detailed description about how the system is developed with appropriate selection of languages, tools and etc.., how the system is going to implement and whether the system needs user training or not.

System Testing is the other major phase which is discussed in the chapter. Software testing can commenced at any time in the software development process. The system testing process is used to verify the development against the requirements, to check the system for errors, to check the flow of the system etc… The errors discovered in testing the system are being discussed in a more detail approach in the testing phase.