**2.1 Introduction**

This chapter is intended to outline the concepts of a management information system and subsequent technologies; detailing their current architecture, development patterns/components including existing standards. This chapter will also compare and discuss current system frameworks summarising key features and drawing conclusions in selecting a robust development environment. The final segment of this chapter will illustrate the fundamental concept of this project, analysing potential means of creating a management information system; evaluating their effectiveness and compatibility; concluding from this for the final design approach.

**2.2 Literature Review: Information System**

An information system (IS) is any combination of [information technology](http://en.wikipedia.org/wiki/Information_technology) and people's activities using that technology to support operations, management. In a very broad sense, the term *information system* is frequently used to refer to the interaction between people, [algorithmic](http://en.wikipedia.org/wiki/Algorithmic) processes, data and technology. In this sense, the term is used to refer not only to the [information and communication technology](http://en.wikipedia.org/wiki/Information_and_communication_technology) (ICT) an organization uses, but also to the way in which people interact with this technology in support of business processes.

ISs can be categorized in four parts:

1. Management Information System (MIS)
2. Decision Support System (DSS)
3. Executive Information System (EIS)
4. Transaction Processing System (TPS)

**2.2.1 MIS**

A management information system (MIS) is a [system](http://en.wikipedia.org/wiki/System) that provides information needed to manage organizations effectively. Management information systems involve three primary resources: technology, information, and people. It's important to recognize that while all three resources are key components when studying management information systems, the most important resource is people. Management information systems are regarded as a subset of the overall [internal controls](http://en.wikipedia.org/wiki/Internal_control) procedures in a business, which cover the application of people, documents, technologies, and procedures used by [management](http://en.wikipedia.org/wiki/Management_accountant) personnel to solve business problems such as costing a product, service or a business-wide strategy. Management information systems are distinct from regular information systems in that they are used to analyze other [information systems](http://en.wikipedia.org/wiki/Information_system) applied in operational activities in the organization. Academically, the term is commonly used to refer to the group of information management methods tied to the automation or support of human decision making, e.g. [Decision Support Systems](http://en.wikipedia.org/wiki/Decision_Support_System), [Expert systems](http://en.wikipedia.org/wiki/Expert_system), and [Executive information systems](http://en.wikipedia.org/wiki/Executive_information_system).

*Advantages*

1. The company is able to highlight their strength and weaknesses due to the presence of revenue reports, employee performance records etc. The identification of these aspects can help the company to improve their business processes and operations.
2. The availability of the customer data and feedback can help the company to align their business processes according to the needs of the customers. The effective management of customer data can help the company to perform direct marketing and promotion activities.
3. Information is considered to be an important asset for any company in the modern competitive world. The consumer buying trends and behaviors can be predicted by the analysis of sales and revenue reports from each operating region of the company.

**2.2.2 DSS**

A **decision** support system (DSS) is a computer-based [information system](http://en.wikipedia.org/wiki/Information_system) that supports business or organizational [decision-making](http://en.wikipedia.org/wiki/Decision-making) activities. DSSs serve the management, operations, and planning levels of an organization and help to make decisions, which may be rapidly changing and not easily specified in advance.

DSSs include [knowledge-based systems](http://en.wikipedia.org/wiki/Expert_system). A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from a combination of raw data, documents, personal knowledge, or business models to identify and solve problems and make decisions.

Typical information that a decision support application might gather and present are:

1. Inventories of information assets (including legacy and relational data sources, cubes, [data warehouses](http://en.wikipedia.org/wiki/Data_warehouse), and [data marts](http://en.wikipedia.org/wiki/Data_mart)),
2. Comparative sales figures between one period and the next,

Projected revenue figures based on product sales assumption

**2.3 Methodology Review**

The use of selected process techniques to improve the quality of a software development effort cannot be overemphasised. Using a Software Development method usually results in fewer defects and, therefore, ultimately provides shorter delivery times and better value. The policies, processes and procedures used are classed as a software development methodology (SDM) or system development life cycle (SDLC) (Chapman, 2004). Below reviews current software development methodologies available which would be worth using to design and implement the system. Several models exist to streamline the development process. Each one has its pros and cons, and it's up to the development team to adopt the most appropriate one for the project. Sometimes a combination of the models may be more suitable.

**2.3.1 Waterfall model**

The waterfall model is a [sequential](http://en.wikipedia.org/wiki/Sequence) [design](http://en.wikipedia.org/wiki/Design) process, often used in [software development processes](http://en.wikipedia.org/wiki/Software_development_process), in which progress is seen as flowing steadily downwards (like a [waterfall](http://en.wikipedia.org/wiki/Waterfall)) through the phases of Conception, Initiation, [Analysis](http://en.wikipedia.org/wiki/Analysis), [Design](http://en.wikipedia.org/wiki/Software_design), Construction, [Testing](http://en.wikipedia.org/wiki/Software_testing), [Production/Implementation](http://en.wikipedia.org/wiki/Implementation) and [Maintenance](http://en.wikipedia.org/wiki/Software_maintenance).

The waterfall model shows a process, where developers are to follow these phases in order:

1. [Requirements specification](http://en.wikipedia.org/wiki/Software_Requirements_Specification) ([Requirements analysis](http://en.wikipedia.org/wiki/Requirements_analysis))
2. [Software Design](http://en.wikipedia.org/wiki/Software_Design)
3. [Integration](http://en.wikipedia.org/wiki/System_integration)
4. [Testing](http://en.wikipedia.org/wiki/Software_testing) (or [Validation](http://en.wikipedia.org/wiki/Validation))
5. [Deployment](http://en.wikipedia.org/wiki/Software_deployment) (or [Installation](http://en.wikipedia.org/wiki/Installation_%28computer_programs%29))
6. [Maintenance](http://en.wikipedia.org/wiki/Maintenance)

In a strict Waterfall model, after each phase is finished, it proceeds to the next one. Reviews may occur before moving to the next phase which allows for the possibility of changes (which may involve a formal change control process). Reviews may also be employed to ensure that the phase is indeed complete; the phase completion criteria are often referred to as a "gate" that the project must pass through to move to the next phase. Waterfall discourages revisiting and revising any prior phase once it's complete. This "inflexibility" in a pure Waterfall model has been a source of criticism by supporters of other more "flexible" models.

**2.3.2 Prototyping Model**

Software prototyping refers to the activity of creating [prototypes](http://en.wikipedia.org/wiki/Prototype) of software applications, i.e., incomplete versions of the [software program](http://en.wikipedia.org/wiki/Software) being developed. A prototype typically simulates only a few aspects of the final solution, and may be completely different from the final product.

Prototyping has several benefits. The software designer and implementer can get valuable feedback from the users early in the project. The client and the contractor can compare if the software made matches the [software specification](http://en.wikipedia.org/wiki/Program_specification), according to which the software program is built. It also allows the software engineer some insight into the accuracy of initial project estimates and whether the deadlines and [milestones](http://en.wikipedia.org/wiki/Milestone) proposed can be successfully met

The process of prototyping involves the following steps:

1. Identify basic [requirements](http://en.wikipedia.org/wiki/Requirement): Determine basic requirements including the input and output information desired. Details, such as security, can typically be ignored.
2. Develop Initial Prototype: The initial prototype is developed that includes only user interfaces.
3. Review: The customers, including end-users, examine the prototype and provide feedback on additions or changes.
4. Revise and Enhance the Prototype: Using the feedback both the specifications and the prototype can be improved. Negotiation about what is within the scope of the contract/product may be necessary. If changes are introduced then a repeat of steps #3 and #4 may be needed.

**2.3.3 RAD Model**

*Rapid application development (RAD)* is a [software development methodology](http://en.wikipedia.org/wiki/Software_development_methodology) that uses minimal planning in favor of rapid prototyping. The "planning" of software developed using RAD is interleaved with writing the software itself. It is a [software development methodology](http://en.wikipedia.org/wiki/Software_development_methodology) that involves methods like [iterative development](http://en.wikipedia.org/wiki/Iterative_and_incremental_development) and [software prototyping](http://en.wikipedia.org/wiki/Software_prototyping). According to Whitten (2004), it is a merger of various [structured techniques](http://en.wikipedia.org/wiki/Structured_Analysis_and_Design_Technique), especially data-driven [Information Engineering](http://en.wikipedia.org/wiki/Information_Engineering), with prototyping techniques to accelerate software systems development.

In rapid application development, structured techniques and prototyping are especially used to define users' [requirements](http://en.wikipedia.org/wiki/Requirements) and to design the final system. The development process starts with the development of preliminary [data models](http://en.wikipedia.org/wiki/Data_model) and [business process models](http://en.wikipedia.org/wiki/Business_process_model) using structured techniques. In the next stage, requirements are verified using prototyping, eventually to refine the data and process models. These stages are repeated iteratively; further development results in "a combined business requirements and technical design statement to be used for constructing new systems".

RAD approaches may entail compromises in functionality and performance in exchange for enabling faster development and facilitating application maintenance.

**2.4 Development Tools Review**

In this section of the report a discussion will take place with the goal of finding the best suited development tools to be used in the implementation of the project artefact. The final decisions will be documented in the last section of this chapter.

**2.4.1 Database Management System Review**

The three DBMS’s below all have there advantages and disadvantages and if there was more time it would be advantageous to develop a sample database using all of them. This unfortunately is not a feasible option not only in this academic environment, but also in industry. Resources to implement such a test environment are just not available, so an informed decision based on previous experience and recommendations will be made to choose the tool best suited for this project.

*2.4.1.1 MySQL Review*

MySQL AB develops the well known and popular MySQL database server. The MySQL database server was developed solely to provide an open source database tool which is free to use and specifically orientated around use with web development. *“MYSQL has an energetic and loyal following, not to mention a hard-earned reputation for reliability. Though it won't fit every need, this cheap and fast alternative can be a great choice” (MySQL 4.0, n.d.)* This means that there are vast quantities of information available for its use whether that is through published books or through the online developer community. It is programmed in Structured Query Language through a command prompt interface which is not as user friendly as it could be and the researcher has no previous experience with it. So there would be a certain amount of learning required before any development could begin.

*2.4.1.2 Oracle 10g Express*

Oracle is a powerful database management system (DBMS) that has a large feature set. It was produced in the late 1970’s to be used on a variety of platforms from micro to mainframe. Oracle now can run on 80 platforms, and has a Java Interpreter (JVM) which will allow procedures to be triggered by Java instead of PL/SQL. This allows web developers to write applications with database procedures in the same language. Oracle and Microsoft SQL Server are regarded as one of the two most popular database systems available today (Chapple, n.d).

*2.4.1.3 Microsoft SQL Server Review*

Microsoft SQL Server is a RDBMS produced by Microsoft to run on Windows NT or newer versions. The primary language used is Transact-SQL which is an implementation of the ‘Standard Query Language’. SQL Server is used by small to large businesses for their business systems, for example Microsoft Navision. It is also used for dynamic web sites and commonly used with ASP. Microsoft SQL Server requires a license, which can cost a large amount of money, which may result in people using MySQL as a cheaper alternative (Microsoft SQL Server, n.d).

**2.4.2 Web Development Environment Review**

This review contains a detailed examination of a variety of web scripting languages and web servers which could potentially be used to provide the web interface. The web scripting languages are used to produce the code necessary for constructing how a page will look and what it will contain while the web server takes the code and serves it up over the internet as a graphical web page. As it is not an objective of this project, the artefact will not be launched live so the exact server choice is not necessary; however, it is still advantageous to explore the options for the end user.

*2.4.2.1 PHP Review*

PHP is self referentially short for Personal Hypertext Pre-processor. PHP was created in 1994 by Ramus Lerdorf and during 1997 PHP development was also contributed by Zee Suraski and Andi Gutmans who produced the Zend Engine which was used for the core of PHP 4. PHP is an open source HTML embedded scripting language. PHP is used within a HTML document within special PHP tags; the advantage of this allows the developer to jump from HTML to PHP without a large amount of code to output HTML. Users cannot view the PHP as it is server side which is tightens the security of the code. PHP allows websites to display dynamic content held in databases and allows the users to edit and delete this information. PHP can perform the same tasks as any other server side language, but its main strength is the compatibility with many types of databases and it being open source meaning its free to the general public (PHP, n.d).

*2.4.2.2 ASP & ASP.NET Review*

ASP (Active Server Pages) is Microsoft’s Internet Information Services (IIS) based server side scripting language which is used for creating dynamic web pages similar to PHP. ASP uses standard HTML but includes JavaScript or VBScript. ASP creates dynamic web applications because of its interactions with SQL databases to display the data.

Microsoft released ASP.NET which was completely rebuilt on the CLR (Common Language Runtime) framework shared by all .NET applications. The Microsoft .NET platform can be loosely summed up as a set of technologies that allow you to connect people, information and devices together with an unparalleled level of integration. Developers can write ASP.NET code using in C#, VB.NET, JScript.NET, Perl and Python. ASP.NET has performance benefits over many other scripting languages because of it compiling into DLL’s. Dynamic Link Libraries (DLL) is a library of executable functions or data that can be used by a Window’s application. DLL’s can be shared but are usually written specifically for an application. DLL’s make the code securer and make it hard to decrypt to readable code to be reused.

*2.4.2.3 Apache Web Server Review*

Apache is an open source web server which is developed by the Apache software foundation. Apache is released on a free GNU licence and will run on most machines. The nature of its open source licence means there are plenty of help resources available including templates for set up and FAQ’s which assist with installation. Due to its constant development it is felt that Apache is more secure then other web servers as well as having more features on offer. A downside to all this functionality is its complicated set up especially for first time users. The author has used this software before in another university unit so this is an advantage in terms of understanding the basic Apache principles.

*2.4.2.4 Microsoft IIS (Internet Information Services) Review*

IIS is provided by Microsoft with all of its NT based windows operating systems (NT, 2000, XP, Vista, 7). The end users system is XP based and therefore IIS can be used at no extra cost. IIS has a number of user friendly wizards to aid in its set up and runs almost unnoticed on a user’s machine.

“*Windows Server 2008 Web Server Edition is designed specifically for low-end and entry-level Web hosting environments” (Zandri, 2003)* such as the system to be implemented as part of this project.

To ensure that this web server is secure it has to be pointed out that users will have to ensure updates and hot fixes for any security holes are implemented as soon as available to keep the system free from security threats. If ASP is to be selected it would be an advantage to use this software as they are fully compatible.

*2.4.2.5 Web 2.0*

The term Web 2.0 is associated with web applications that facilitate participatory [information sharing](http://en.wikipedia.org/wiki/Information_sharing), [interoperability](http://en.wikipedia.org/wiki/Interoperability), [user-centered design](http://en.wikipedia.org/wiki/User-centered_design), and [collaboration](http://en.wikipedia.org/wiki/Collaboration) on the [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web). A Web 2.0 site allows users to interact and collaborate with each other in a [social media](http://en.wikipedia.org/wiki/Social_media) dialogue as creators (prosumers) of [user-generated content](http://en.wikipedia.org/wiki/User-generated_content) in a [virtual community](http://en.wikipedia.org/wiki/Virtual_community), in contrast to websites where users ([consumers](http://en.wikipedia.org/wiki/Consumer)) are limited to the passive viewing of [content](http://en.wikipedia.org/wiki/Content_%28media_and_publishing%29) that was created for them. Examples of Web 2.0 include [social networking sites](http://en.wikipedia.org/wiki/Social_networking_site), [blogs](http://en.wikipedia.org/wiki/Blog), [wikis](http://en.wikipedia.org/wiki/Wiki), [video sharing](http://en.wikipedia.org/wiki/Video_sharing) sites, [hosted services](http://en.wikipedia.org/wiki/Web_service), [web applications](http://en.wikipedia.org/wiki/Web_application), [mashups](http://en.wikipedia.org/wiki/Mashup_%28web_application_hybrid%29) and [folksonomies](http://en.wikipedia.org/wiki/Folksonomy).

Web 2.0 websites allow users to do more than just retrieve information. They provide the user with more user-interface, software and storage facilities, all through their browser. This has been called ["Network as platform"](http://en.wikipedia.org/wiki/Web_operating_system) computing. Users can provide the data that is on a Web 2.0 site and exercise some control over that data. These sites may have an "Architecture of participation" that encourages users to add value to the application as they use it.

**2.5 Similar System Review**

*2.5.1 Overview*

The goal of any good management information system is to *electronically* manage the different records and data that are generated daily within an organization as fast and efficient as possible. The Ajayi Crowther University management system is a typical example of a MIS managed by the ICT department of the school. It creates and manages students account performing functions like collecting student’s biodata, crediting and/or debiting a student account, among others.

*2.5.2 Limitations*

The main issue that was found with this system was the reliability of its content. The education industry is extremely fast growing and elements change all the time. After consideration it was decided the content could not be considered reliable because a great deal of operations are still carried out on paper. Another issue was the lack of dynamism. The University management information system should be flexible enough to ensure newer operations in the community are integrated into the system without hiccup. Yet this system only incorporated a handful. This pointed out a gap that needed to be filled backing up the need for a management system.

**2.6 Research Resources**

The new system however, will now require a lot of independent research as there is no secondary research available as had been hoped for on a system of this magnitude.

**2.7 Conclusions and Final Choices**

*2.7.1 Database development tool selection*

In order to establish what the best suited database tool would be for this project, Chapple (n.d) a database specialist writing articles for ‘About.com’ suggests answering the following questions and then tailoring your database selection against the answers.

1. Who will be using the database and what tasks will they perform?
2. How often will the data be modified and who will make these modifications?
3. Who will be providing IT support for the database?
4. Will data access be offered over the Internet? If so, what level of access should be supported?

To document this process the table below represents the questions above and includes the answers and reasons why a particular database system meets the requirements outlined.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Answer | MySQL | MSSQL | ORACLE Express |
|  | Researchers and the general public – Certain privileged users will be able to manipulate the data which the general public will only be able view the data and selected queries. | MYSQL provides concurrency up to 100 users as default. As well as multiple user values. | A CAL (Client Access License) is required for each distinct device or user to the multiplexing or pooling software or hardware front end. | Allows for concurrency and users a sophisticated user structure allowing different user access rights. |
|  | Data will be modified regularly. All changes will be made by the end user and administrator | MySQL can be implemented with a web user interface which can be tailored to the user needs. | MSSQL can be implemented with a web user interface. | Oracle allows for two GUI’s either as a web front or through offline dynamic forms. These are user friendly and intuitive |
|  | Administrator or an IT firm consulting for the organization | Command line interface – un user friendly possible difficulty in administration | Both CLI and GUI compatible – easy to administer | Graphical user interface, developed for beginners and easy to administrate. |
|  | The data will be shared online | Well known for its web development support. | Well known for its web development support. 79% of PCs in researcher’s location make use of Microsoft products. | Been developed specifically to help with web development projects. |

*Figure 1: Database Management System Comparison Table*

From the above results and from the discussions in section 2.4.1 and 2.4.2 we can determine which tools to use for this project. It was determined early on that Microsoft Access would not be used. MYSQL and Oracle Express are both developed with the aim of attracting a web development customer base and the MSSQL has a very efficient way of enforcing security. This is advantageous as they all would have been designed with a focus on web integration. With this focus it can be said that they will provide the most support to make the database and web integration easier.

The end user has some database programming experience, so to ensure that the database system is easily updatable in future development, the DBMS that is chosen should be intuitive and user friendly. With this in mind a clear choice would point towards the Microsoft because of its graphical user interface. With this interface a user will be able to administer the database with only limited knowledge. The biggest advantage towards the use of MSSQL is the extensive help that is available to its users which is focused directly at web front user interfaces. The reason for this extensive help is to allow users with limited knowledge to construct there own. With the lack of developer knowledge of web front interfaces the help available is of a significant advantage.

As the functionality of the DBMS’s were almost identical, a decision was made based on the evidence above concluding that the Microsoft SQL Server 2008 would be best suited. The deciding factors for this choice were influenced on the basis that the user friendly graphical user interface would make its maintenance both easier now, and in the future. It also provided positive answers to all of the above elements in figure 1 and thus meeting all of the software requirements. It was found that the help that was provided with this software would be sufficient for what was needed in the web interface stage and this finally tipped the balance in MSSQL’s favour.

*2.6.2 Web Environment selection*

After the selection of the database environment this is more of a formality then a detailed decision making process. With the selection of the MSSQL Server database this omits any opportunity to use PHP as it is incompatible with this database system. Despite this, when comparing scripting languages it was found that ASP did pose more advantages in its portability, speed and the help available over PHP.

The final selection that had to be made was for a web server which would serve up the interface once complete. As this project will not be launched live the web server will not be fully configured as this is outside the project scope. It is however still required to ensure that the pages that are developed can be tested in a real environment. The two web servers which were looked at both had there advantages and disadvantages but the decision that was finally made was to implement the Microsoft IIS. The developer has had some experience with this server and as it is compatible with the other software chosen and was felt it would provide the best overall solution.

**2.7 Summary**

In this chapter we have reviewed a number of software development tools in hope that a development solution could be found which would provide the best tools to achieve the objectives. It was decided that MSSql would form the back end database, ‘ASP on C#’ would be used to code the interface and the IIS would be used to display the results that the previous two tools would output.

In this chapter we also reviewed material relating to the research stages of this project. After conducting a review of a similar system the researcher has identified key areas which need to be improved so that the system will be considered more useful. It was also concluded that the research that needed to be carried out would be more substantial then first thought as there is no secondary research data available for this subject area.

**2.8 Key points**

* Similar projects have been perceived to be not as useful at first thought and a lot of primary research will now have to be carried out as there is a lack of secondary research due to the infancy of the subject area.
* It is important to validate the quality of the research material to ensure it is reliable and trustworthy.
* News articles can be used as a good source for starting research as they point the reader to other more useful sources.
* The final system solution to be implemented will use the following development tools: MSSQL Server 2008, ASP on the .NET framework.