UNIVERSITY MANAGEMENT SYSTEM IN SYSTEM-z MAINFRAME

(zMS)

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ABSTRACT

Ability to perform multiple tasks simultaneously 24 / 7 is very essential in order to maintain a system's integrity and accessibility. University Management System in System-z Mainframe (*zMS*) is information management system done in the mainframe environment for the system operators to create a batch type input and output system. The system is designed using System-z as the operating system, to ease the tasks of the system operator to browse for records and view it in a formatted file. It will make use of the logical partition of a mainframe, to run the managerial operations. This report will discuss on the preparation, analysis, development and discussion based on the development cycle of this system. A complete reference and research details have been furnished in this document. This document will be a quick reference to refer on the specification and requirements of the system.

ABSTRAK

Keupayaan untuk melaksanakan pelbagai tugas secara serentak setiap masa adalah sangat penting untuk mengekalkan integriti dan aksesabiliti sesuatu sistem. Sistem Pengurusan Universiti dalam 'Mainframe' Sistem-z (zMS) adalah sistem pengurusan maklumat yang dilakukan dalam persekitaran 'mainframe' untuk para operator menghasilkan input dan output berjenis 'batch'. Sistem ini direka menggunakan Sistem-z sebagai sistem operasi untuk memudahkan urusan carian maklumat, dan memaparkan dalam bentuk yang telah diformatkan. Ia akan menggunakan konsep 'logical partition' dalam 'mainframe', untuk menjalankan operasi pengurusan. Para pengguna akan mengakses sistem melalui pelayar web yang diingini, dengan sambungan internet yang stabil dan memanfaatkan perkhidmatan yang disediakan. Laporan ini akan membincangkan mengenai penyediaan, analisis, pembangunan dan perbincangan berdasarkan kitaran pembangunan sistem ini. Rujukan yang lengkap dan butir-butir penyelidikan telah disertakan dalam dokumen ini. Dokumen ini boleh digunakan sebagai rujukan spesifikasi dan keperluan sistem.

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CHAPTER 1

INTRODUCTION

This chapter presents an outline of the entire project, describes the background of the project and the introduction into problem statements, objectives, scope and thesis organization. It gives an overview of the research conducted.

1.1   Background

Today, mainframe computers play a central role in the daily operations of most of the world's largest corporations, including many Fortune 1000 [1]. Many of world's top banks and retailers rely on the mainframe to help secure sensitive business transactions [2], which can support multiuser concurrently. As such, universities also should make use the service of the mainframe, for uninterrupted access of students, lecturers and administration personnel. The term reliability, availability and serviceability (RAS) is a defining characteristic of mainframe computers [3].

University Management System in System-z Mainframe (z*MS*) is an administration system, which comprises of several applications, namely *Student Profile, Subject Registration, Course Results and Lecturer Evaluation*.

Currently, the Management System in Universities is done using servers. This zMS is a concept of making use of a Logical Partition of a Mainframe, for University Management. Since mainframes generally functions in an environment which requires thousands of users to access the system simultaneously, it should be able to balance the workload for a system, and make it always available for any number of users. Balancing is a very important element of a system as adequate balancing ensures that the whole system works at full capacity [4].

Since this is the first university management system developed in a mainframe environment, only few applications which needs high attention is included.

Student Profile application is initially created by the system admins as a batch job, when a student enrolls into the university. It contains particulars such as Student ID, Name, House Address, Contact Number, Majoring Course Details, Faculty Name and Academic Advisor Name. System admin will update their particulars, if there are any changes.

Course Results key in method used currently is automated, but it is done by inserting one at a time, by the operators. Thus, this method of inserting data is tedious and can be time consuming. Operators will insert particulars such as Student ID, Session, Course Code, Course Name, Credit, Result, Grade, GPA and CGPA. zMS, by making use of the part of mainframe, tends to avoid this problem by allowing simultaneous input as a batch job, to save time and minimize human errors.

For *Subject Registration*, students details that are needed are Course Code, Course Name, Lecturer Name and respective Student ID. The report will show what are the courses taken by the students, in that semester. Unreliable internet connection causes delayed write in updating the subject registration info. Mainframe users will not face such problems, as the course selection system allows a large number of students to select course online at the same time [6].

Current method of *Lecturer Evaluation* is done manually by filling up questionnaire forms by students. Some students just simply rate the questions, without even reading the questions. The accumulated marks over 50, is recorded in the system, together with the Lecturer Code, Lecturer Name and Course taught.

1.2 Problem Statement

Currently, University Management System implemented in University Malaysia Pahang is being automated. But, there are a few drawbacks in the current system.

i) The details required in the University Management System, such as students, course and lecturer particulars are being entered manually into the database.

ii) For the operator, they are only allowed to make single entry at a time, which is time consuming.

iii) The details which are inserted into the database are in the form of unformatted data, which makes the operators have difficulties in reading the information.

1.3   Objectives

This system is developed with several objectives, which are;

     i)   To create automated data entry into the database via COBOL.

     ii) To create a batch type input and output system.

     iii) To generate a formatted report stored in an independent flat file as output.

1.4   Scope

This System is intended for two types of users only, which are the

i)   Operator

System Operators would need to login to the system using appropriate UserID and corresponding password, in order to perform their tasks. This group of user will access the system to update profile, register subjects, view course results and evaluate lecturers. As it is designed only for the system operator, they would not need GUI, to save the bandwidth.

ii)   System Admin

Admins will have the full rights on the system. They can insert, update and delete record as well as browse for data. This group of user will access the system to do modification on student profile, subject registration, course results and lecturer evaluation. Admins and operators will share the same UserID and password. Their access privilege is restricted by their knowledge on the system.

1.5   Thesis Organization

This thesis contains six chapters. **Chapter 1** gives an overview of the research conducted. **Chapter 2** explains about research that is done regarding to this project. This chapter divided into two major parts namely, research on the existing system and about techniques and technologies that is related to this project. In **Chapter 3**, the approach or overall framework about the development of project are discussed. This includes techniques, methods, or approaches that is used to develop and implemented throughout the project development. **Chapter 4** will document all the process that is involved in the development of the projects. It includes all the implementation and testing done for the project. **Chapter 5** will discuss about the findings or result that is obtained and analysis of the data, constraint and suggestion for improvement. Finally, **Chapter 6** will conclude overall project that was developed. This includes the project summary, the summary of the data that is obtained and the effectiveness of data obtained with the objectives and problem statement.

CHAPTER 2

LITERATURE REVIEW

This chapter briefly describes the review on existing techniques related with "University Management System in System-z Mainframe" that will be developed later. This chapter comprises two sections : The first section describes the comprehensive review on existing related system. The second section describes the review on method, equipment and technology previously used in the same domain.

2.1   University Management

The smooth running of a company — even the execution of the most basic tasks within it, hinges on its management information system (MIS), the system that manages and stores all the information about the company's business processes [15]. Every organization needs a proper planning and management in order to accomplish its business goals and achieve its vision. Without a well organized management, everything will be in a mess; staff record is in a place and students record in elsewhere. Systems not integrated will likely cause more overhead and wastes a lot of time. Function of a university management system as stated by Haselbacher in *Informatica* is that the system mainly does partition of the maintenance of resource-information between departments and the administration group and to incorporate the major rules and constraints that are needed for maintaining resource-data [18]. This is further supported by Lupu et al., 2008 that the implementation of an information system dedicated to the university management is nowadays a fundamental option for the greatest majority of the universities that understood the new trends at international level [17].

2.2   Existing Systems

The systems compared in this literature are the traditional paper based system, automated system and mainframe based system. Traditional system refers to the era where computers were just invented and not much people have the knowledge on its existence and usage. When computers become popular, management processes were automated, and then gradually upgraded with the development of internet technology. Server based systems are implemented in many enterprise to facilitate business. Mainframe based system adds further enhancement to the online system, in terms of security, data storage, accessibility, reliability and availability.

System / Features	Paper Based System	Automated System	Mainframe based System
Course Registration Process	Students will have to come to university office, read the course catalog given, fill up the registration application form. Then, students come again to verify the approved subjects.	Students read the course catalog available online, fill up the registration online, from their house or hostel, and waits for the approval. Once approved, students will be able to view the results through their university webpage.	Students read the course catalog available online, fill up the registration online, from their house or hostel, and waits for the approval. Once approved, students will be able to view the results through their university webpage.
Storing record	Filled up forms, records and related documents are filed and stored in rack.	Data in the form of softcopy are stored in the database	Data in the form of softcopy are stored in more secured database
Data modification	File need to be searched manually, following name or student ID. The form is replaced by the new one, or data is erased.	Record can be search by techniques implemented, faster than paper based system. Data is replaced by overwriting.	Record is searched by implemented searching techniques. Faster than the automated system. Data is replaced by overwriting.
Network access	N/A	May be slow depending on available bandwidth and number of users	Stable network regardless of number of users and concurrent access
Administration of the System	Only involved staffs have the full access to the data. Higher authority can access the data, manually.	Only involved staffs have the full access to the data. Higher management with authority can access the data, by logging in.	Selected personnel can access the data. High security features can block the system if there is unauthorized access.

Table 2.1 : Comparison on Selected System's Features

2.2.1 Traditional University Management System

Traditionally, management system in a university was in the form of paper based. For Students Registration, each student will have to manually fill up the registration form and submit it to the administration staff. The staff will then file and store it in a record room. When details of a particular student is needed, or certain amendments need to be made to the given data, the administration staff will search

for the file, following the student's name or student ID.This is supported by Lu et al. where the traditional selection method is to ask students to fill in a form, and then to the Registry for data processing, the final results will be announced [6]. Following the needs of users, projects were started with the aim to reduce the time and workload of the registering students, administrative clerks, and supervising instructors, by giving students an easy-to-use integrated facility [25]. Supported through the statement that the driving forces behind this movement are the demands from customers for quick response, the demands from management for cost reductions, and the requirements from the users for better tools for logistics, scheduling and planning.University Management System mostly gives emphasize on course registration process. In constructing weekly timetables, most of the students were observed to put in the required courses first, fill in other time periods on the same day, and then choose those courses whose instructors are popular and whose credits are easier to obtain [25].

For example, Chubu University's course registration system requires each student to come to school on three separate days before the beginning of each semester. First, to receive the course orientation, second, to do the initial registration by marking with a pencil on OCR mark sheets the courses they want to take, and thirdly, to correct errors and to change entries for the classes rejected as results of lottery selections [25]. Graz University of Technology also had this method implemented where the administration staffs has to collect or manipulate data on different resources for different reasons, and this was done mainly by paper that often lead to incorrect or unsatisfying results. Checking constraints on data collected or manipulated by paper forces immense additional work [18].This method was very time consuming, and burdens the staffs.

2.2.2 Automated University Management System

Then, improvements were made to this method, the details in the registration forms were keyed-in into the computer by the administration staff. So, whenever required, the staff could find for the student's details by typing the keyword. Things were going on smoothly until there was an increase in the number of users. Inability to store large amount of data causes the invention of server based systems. Here, data

of students were stored in large database. Program such as Microsoft Access was suitable for this task.

There were also some automated system, which is used to manage the university, but without having the modules integrated. It is evident by research done by Lupuet. al., 2008 that almost every faculty or department has its own software applications, developed in-house, applications that use various operation systems, tools, databases and protocols, managed by that specific faculty/department and it doesn't offer an integrated view over the activities developed in the university [17]. Integration is essential, which is further supported by Howard, H. John that is the integrated computing environment was to allow local control of resources but to permit easy and widespread access to all existing and future computational and informational facilities on campus[16].

According to Shibanda, 2002, the six major areas targeted for information communication and technology application at the university include; academic affairs, human resources, records management, library, communication and office automation. It is also conceived that multimedia oriented packages will provide for integration and accessibility of information remotely and also provide an appropriate platform for the required format of information in image, graphics, sound, voice and videotext [19]. Further supported by Gunasekaran and Love, 1999, where multimedia is described as the blending of images, graphics, sound, voice, videotext and tubular information within a human information interface that uses capabilities to access and present information [21]. The registration courses were now able to beinstantly verified, analyzed, classified, and their credits are summed up and added to the previously obtained credits.

According to Davias (1999), there are also real problems with moving to web based teaching delivery. The main concerns for this area were grouped into three main areas. Firstly, developing and learning web technology. Except for a few "trend setters" the bulk of the teaching staff had reservations on spending the time and effort in learning how to produce and author web based material. Next, problems on making use of existing materials and resources. Most staff had developed over the years, considerable amount of material in traditional form (typically quizzes, notes

and slide presentations). Finally, problems on technology and network issues. The typical concerns being student access, bandwidths, multiple passwords to access various websites and available computer facilities [11].

As the number of users continue to increase, the need for a reliable and multi user supporting system was extremely required. With more and more students at school, the creation of courses extensive and diverse, the personalized needs of teachers and students more and more obvious, we must consider the establishment of a convenient, fast and fair selection system. The web-based selection system had become the preferred option in the majority of colleges [6]. Moreover, almost all tasks are available online nowadays. Ranging from shopping for clothes to renewing company registration, all of them are done through automated system. This increases the high risk for bottleneck performance. Kun, 2008 also mentions in the current internet platform, there are someserious problem such as data instability andconcurrency problems [6].Considering these problems, university management system needs to be managed using mainframe.

Kun, 2008 also states that the students selection system based on common Web technology are generally operating in Personal Computer (PC) servers, often peak in the selection phase, due to too many classes of students, parallel operation of too many servers vulnerable to congestion, or even collapse of the state. Elective System cannot be caused by normal use, students often can't get they want to select or classes election failed so that delay the selection time, but also allows schools in the organization of courses on a part of this to lag, to bring certain teaching management in a mess. Clearly, the performance of the selection system has a direct effect on the selection system can truly play its role. As such, classes must take into account many factors, such as the selection process, methods of operation, the wishes of teachers, students' needs, school resources and teaching management [6]. Kun, 2008 further adds that a good system structure and the corresponding software has become a major factor in the decision of system performance. Developing a reasonable framework, in high-reliability systems classes of students, is the only way to solve the current problems [6].

2.2.3 University Management System in Mainframe

Mainframes (often colloquially referred to as "big iron") are powerful computers used primarily by corporate and governmental organizations for critical applications, bulk data processing such as census, industry and consumer statistics, enterprise resource planning, and financial transaction processing [22]. A mainframe is a computing system that a management use to host the databases, servers, and applications that require a greater degree of security and availability than is commonly found on smaller-scale machines (Eisen, 2007). The power of a mainframe provides computing speed and capacity, enabling it to perform high volumes of processing. The mainframe can process a mixed workload of jobs from different time zones and of different types [13].

Several implementations have been carried out using mainframe servers in university management. According to Wells (1992), computer-mediated communication have been started to use by several institutions as an aid in the delivery of distance-education courses since 1988. But, due to some reasons, the system was reviewed and changed back to server based. The main reason is that mainframe handling is quite hard, and it needs prior training of the personnel. Thus, the users especially students find it difficult to learn and requires more technical guidance compared to server based system [26].

Mainframe based management system was successfully implemented in Dalian University of Technology. The foreground WEB interface is friendly and convenient, the background is running in mainframe Customer Information Control System (CICS), stably and reliably. CICS Transaction Gateway is used to access mainframe resource by WEB.CICS Transaction Gateway (CTG) is software provided by IBM, which is designed for the application integration of traditional CICS applications. CTG allows users to integrate the Web application and the back-end business application running in CICS. It can provide the most convenient, efficient and scalability connectivity for the application running on the CICS server.At present the system is running well, students have a good response and the senior schoolaffirmed [6].Mainframe environment was also carried out in University of Maryland, when experimenting a new database called ADMS. Roussopoulos N.,

1987 states that the architecture of the database utilizes the workstation's local processing and uses the global mainframe for sharing and maintenance of consistency [23]. In Consultation Liaison Psychiatry, mainframe was used as an alternative storage. Method for analyzing data from file is that the operator can take theentire patient file or the created batch file andtransmit this by modem to a mainframe computer [9]. The outcome was a standard, serviceable, inexpensive, and highly accessible hardware and software elements, and developed management / research system with amaximum of input from the people who would be usingit [9]. Columbia Presbyterian Medical Centre was also making use of the mainframe services since 1987. In order to improve the quality of performance, research was done to develop clinical and library applications that are integrated with the existing hospital and university administrative and research computing facilities [9].

Mainframe based systems were also implemented in Georgetown University Library Information System (LIS). LIS' functional components consist of eight "user-friendly" modules: catalog, circulation, serials, bibliographic management (including Mini-MEDLINE), acquisitions, accounting, networking, and computer-assisted instruction. The hardware needed was easily narrowed to a basic PDP 11/34 minicomputer with an ANS MUMPS operating system. The local PHILSOM III file is independently stored in the minicomputer for technical functions, and it shares data with the LIS serials module for the catalog and circulation functions. The LIS programs are written to achieve integration with a "wrap-around" approach. The interface with the circulation component allows barcoded items to circulate actively. This approach enabled the library to mount a serials component easily and quickly. Bibliographic management, an extremely useful component of LIS, allows librarians to generate special bibliographies. The result is very successful, where an interesting change in "mind set" has occurred: no one seems to shy from the computer terminals.The LIS design complementsGeorgetown University's accounting system andsatisfies the library's need to record all income andexpenses.Discrepancies previously handled manually are now less frustrating and less timeconsuming to resolve [8].

Specifically we are concerned with networks of personal computers linked to a few file-servers which provide the services such as access to a library of software

packages, an e- mail system, bulletin boards or shared directories which containing course materials and the shared programs, data and documents of various work-groups such as research project teams or the administrative staffs of programs or departments, Gateway access to the campus-wide network that provides mainframe and other specialized computing services, access to library catalogs and services.

The University of North Carolina also was having its management system running on the mainframe back in 2006. In the plan of replacing all the aging administrative systems, the university decided to upgrade systems such as Department Accounting System, Financial Reporting System, Payroll System and Student Information System. The operating system on the Information Technology Services (ITS) mainframe was upgraded to z/OS version 1.7. This was a major upgrade of z/OS that now supports new security standards, increased availability and enterprise-wide workload management[24]. Another change that was done was in terms of storage media. The current configuration consists of seven tape libraries totalling 58 tape drives. The new configuration consists of two enterprise-class tape libraries totalling 35 tape drives. In addition to space savings, the new tape drives have approximately five times the capacity and speed of the older tape drives[24].

Access Customer Telecommunication company had also implemented mainframe technology for their success in organization. The primary problem they faced was that the customer cannot inquire into the status of their request without calling the support centre or their account manager. The solution worked on was a project which will provide the Access Customer with a new service that gives them the capability to inquire into the status of an order any time during the workday without having to contact the company directly. Success of this project provided the basis for additional mainframe-based Web applications and helps to control the rising costs of hardware. The technologies used to provide a Web interface required installation of additional components, such as HTML coded hyperlinks, WAS software, Unix System Services, Java Servlet Engine, JavaServer Pages (JSPs) and Integrated Development Environment (IDE). The advantage of a Servlet is that it does not require the overhead of CGI programming and is more robust and thread capable. The use of JSPs and Servlets will provide the ability to quickly modify the application. The IT department believed that mainframe Web servers were going to

be a strategic component in the future and they will back this project 100 percent. As a result, the intangible benefits gained include increased customer satisfaction, increased goodwill and support of the goal to be the "easiest company to do business with". This project also proved to the company that the mainframe is viable contender when choosing a server platform and can actually be much cheaper than creating a new client/server environment [20]. Kun, 2008 also supports thatmainframe is the very platform that are able tonormally process tens of thousands data accessesrequest at the same time, which makes the process forclient request and server management highly efficient [6].

2.2.4 Several Migrations from Mainframe based System

Along with some successful implementations, there were also a few failures. Mainframe based e-learning approach was implemented in the late 80's in University of Victoria, for bulletin board systems for computer-mediated communications in distance education courses. The system was experimented for the course *Computing Tools for Management*, using 24 students for two years, but the result was undesirable. The mainframe system was then switched to personal computer based system due to few drawbacks. Among them are lack of user-friendliness for students, excessive staff time in operating help desk functions are needed to guide students' problems, difficult to learn, high cost and installation was quite hard [27]. As stated by Muzio, 1992, some technical problems were actually caused by student unfamiliarity with the computer-mediated communication, student hardware problem (incompatibility of equipment) and students' inability to establish contact with the University's mainframe [27].

For an instance, over the past decade, University of Navarra Engineering School's academic management system evolved from a mainframe environment to a Windows based client-server architecture and then to a Web environment [10].Aiming for independence from vendors, these developers adoptedopen-source solutions for their Web applications and were delighted with the results. In 1996, the developers' team rewrote this application to a Web environment, avoiding installation on each local machine and allowing students to register via the Internet [10].