Towards an integrated management information system: A case of the University of Mauritius

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Abstract. The University of Mauritius completed the setting up of a modern Local area network in September 1996. Having successfully implemented traditional services such as e-mail, Internet browsing and sharing of resources, the University developed and implemented an Integrated Management Information System in order to support an increasingly dynamic academic and administrative environment. This paper describes the various processes involved in the building of an Integrated MIS for a University in a small developing country that faces serious economic challenges. A background of the motivations for introducing a computerized MIS is provided followed by the decision-making process of whether to build an in-house MIS or to procure one. The paper also explains the methodology used and the systems that have been developed and integrated in a prioritized and phased manner using economic principles.

1. Introduction

The University of Mauritius was established in December 1965 but became operational in June 1968 as a developmental University. The main thrust was the provision of trained manpower for the development of the island after its independence in March 1968. Initially, there was heavy emphasis on sub-degree teaching concentrated in the areas of agriculture, administration and Industrial Technology.

Over the last decade, the University of Mauritius has gradually moved from a predominantly teaching institution to one with an increased emphasis on research. It is presently the hub of higher education on the island with five faculties and six centres. It offers a variety courses, some of which are adapted to the Mauritian job market, an example being the recently introduced part-time BA in Police Studies [1].

In 1989, the University of Mauritius Computer Centre was established, with funding assistance from the British Council. The Computer Centre comprised of both an IT Services section and an academic unit for the delivery of diploma and degree courses. In 1991, the Centre was significantly expanded [2]: space was quadrupled; support staff sizes doubled, and the number of computer systems increased to over 100. In 1992, a dial-up 2400 bps connection was established on a 386 PC to Rhodes University in South Africa for email connectivity via the FidoNet System. This allowed faculty members to communicate off campus via electronic mail. The first local area network (LAN) at the University of Mauritius (UoM) was set up at the Computer Centre itself in 1994. The LAN was based on Category 3 cabling with a dial-up connection with EuNet in the UK twice a day for e-mail. As from Jan 1996, the extension of
the LAN to all buildings on the University Campus was undertaken with the setting up of a central, high-bandwidth Ethernet Switch and fibre optic cabling. In November 1996, the UoM was connected to the Internet through a 64 kbps line. Academic, technical and senior administrative staff could do web browsing, send and receive e-mail and access other Internet and network services from the PCs found in their offices. The phenomenal growth of the UoM LAN led to an increased use of IT resources at the University which resulted in the split of the Computer Centre in September 1997 into an academic department of Computer Science and Engineering at the Faculty of Engineering and a semi-autonomous Centre for Information Technology and Systems (CITS). The actual transfer of staff into the two units was effected in March 1998.

The vision statement of the CITS spelt out in the CITS Strategic Action Plan [3] (1998–2003) of April 1998 is as follows: “The Centre for Information Technology and Systems of the University of Mauritius seeks to be a leading edge, high quality provider of computer-based network services and Management Information Systems (MIS), fully responsive to all stakeholders in a dynamic academic and proactive administrative environment, while assuring that the basic infrastructure is widely available to all users and the MIS content to authorized users only”. The CITS Strategic Action Plan also defined the organization structure of the CITS with two line functions namely the IT Services department for end-user support, network management and support and procurement and the MIS department for the development of an Integrated MIS for the University.

The two departments would be headed by Managers who report to a Director whose office would be responsible for the duties of Administration, Information Security and Quality Assurance. A lecturer transferred from the Faculty of Engineering acted as the Officer in Charge of the IT Services Department.

Since the development of an Integrated Management Information System (MIS) is part of the vision and strategic plan [2] of CITS, an MIS Strategic Action Plan [4] was developed in August 1998. The plan focused on the prioritized needs of the University in terms of Information Systems. Given that the UoM LAN was well established and users were familiar with the browser interface, the MIS department undertook to develop the University MIS on a web-based Intranet Platform.

2. Existing university structure

The objectives of the University of Mauritius, as described in ‘The University of Mauritius (Amendment) Act, 1992’ are inter-alia:

– to provide facilities for and to engage in teaching and research and thereby, to promote the advancement of learning and knowledge;

– to provide a university education responsive to the social, administrative, scientific, agricultural and technological needs of Mauritius;

The University of Mauritius has a committee structure with the Court being the ‘supervisory body’; the Council as the ‘executive body . . . responsible for the management and administration of the revenue and property of the University’ as well as having ‘general control over the conduct of the affairs of the University’; and the Senate as the ‘academic authority’ responsible for the academic of the University both in teaching and research, the award of degrees other than honorary degrees, diplomas, and other academic distinctions and the regulation and superintendence of the education and discipline of students’. This committee structure is shown in Fig. 1. From Fig. 1, it is noted that those committees also have sub-committees all of which are serviced by the Registrar’s Office with most information retrieved from manual information systems initially. Computer-based information systems came into play with an Admission System developed in 1994 and a Student Records System developed in 1996.
3. The motivation for an integrated management information system

The University of Mauritius, which started off in 1965 as a developmental University, grew into a full-fledged University, offering a significant number of degree courses in line with the economic progress made by Mauritius as of 1985. The number of students in 1985 was about 600 mostly following diploma courses. This climbed to nearly 4000 in 1995 and the current enrolment is nearly 6500 students.

The growing number of students and the advent of the modular/credit system in 1992 could not be handled manually by administrative staff of faculties. A computerised system, developed in-house for students records management in 1996 was carried out on a stand-alone system mainly for processing of student marks. Moreover, the development of an admission system was outsourced in order to handle the processing of applications of an increasing number of applicants at the University of Mauritius. The admission system was also implemented as a stand-alone system in 1996. The integration between these two systems had to be done manually using Microsoft Excel as the bridge. This was grossly inefficient and error-prone. This necessitated an integrated system on a cost-effective platform and an integration model was proposed as shown in Fig. 2.
Figure 2 also shows two systems, namely, the Human Resource System (HRS) and the Assets and Inventory Systems (AIS), that had to be developed from scratch. The growing number of staff at the University called for a better management of staff information in a number of areas:

- Staff bio-data;
- Staff development activities;
- Leaves and Passage Benefits and
- Research and Consultancy Activities.

Furthermore, the HRS needed to be integrated on the MIS platform for authentication of users in the AS and SIS. The AIS was required as a workflow system, to be integrated with the HRS, for better control of the University Purchasing, Stores and Finance Sections. Two additional systems have been proposed for integration to the University MIS, namely a Financial Management System, to be obtained under a (Tertiary Education Commission) TEC funded project and a Services and Resource System (SRS) to be
developed in-house as a workflow system.

The Integrated MIS was developed to improve the effectiveness and efficiency of the application and student management processes. The decision-making processes were built into the systems. The HRS and AIS were developed for fast information retrieval and better control and monitoring of specific activities. These systems were also suggested in annual reports by the Government Auditors in 1996 and 1997 and made the work of auditors – both internal and external – more efficient. Being on a scalable platform, new systems such as the SRS and Financial Management System can easily be integrated to the MIS.

4. CITS: Strategic MIS related objectives

The Strategic Action Plan [3] of the Centre for Information Technology and Systems (CITS) of the University of Mauritius, developed in April 1998, one of the strategic objectives was to:

“Assist in improving the internal efficiency of University administration and management through the development of an Integrated Management Information System.”

This was to be carried out by:

– Studying business functions;
– Analyzing business processes;

Accordingly under another strategic objective:

“Develop and maintain in-house Management Information Systems for University administration” (underpinned by the above objective) the action plan stated that the:

– “systems to be developed and implemented were:

  * Student Admission System modified by March 1999;
  * Human Resource System by end 1999
  * Finance System to be integrated by mid 1999;
  * Services System (Transport, maintenance, security) by end 1999; and
  * Resources System (Building, Audio visual, IT resources) by end 1999.

– above systems were to be integrated by end of 2000

  * Compute Unit Cost for Students (overall and by faculty)
  * Scheduling Reports (timetable, examinations)
  * Staffing requirements based on a full time student equivalent formula (FTSE) for academic, administration and support staff.”

The Strategic Action Plan presented and analyzed two ways of setting up the University MIS: Procurement and in-house development. The advantages of each case are outlined below:

**MIS procurement:**

– it may be possible to get the system up and running in shorter time;
– customization might not be difficult if the University Management functions and processes match the procured system designed procedures; and
– less dependent on staff turnover.
**MIS in-house development:**

- Source code readily available; and hence alterations, modifications and enhancements are easier to effect;
- High degree of integration between modules can be built into the system at the design stage;
- Capacity building in software design, development and implementation is enhanced and practical experience in software engineering is gained;
- Possible to achieve a greater match between management processes and information system processes assuming the former can be re-engineered if inefficient; and
- Increase potential consultancy and training services in MIS.

An expenditure analysis in the Strategic Action Plan revealed that the net difference in cumulative expenditure for in-house MIS development vis-à-vis MIS procurement over a period of ten years was MUR 15.98 million (20 MUR was equivalent to 1 USD in 1998).

The advantages pointed out for in-house development of the MIS and the MUR 15.98 million savings were the determinant factors that led the University to recruit additional technical staff at CITS and appoint a Manager, Management Information Systems to lead the MIS team and to design and develop the University MIS in-house.

In August 1998, CITS staff produced the MIS Strategic Plan for the University [4]. The document presented the vision of the MIS department of the CITS as follows: “The vision of the MIS department of the Centre for Information Technology and System (CITS) of the University of Mauritius is ’to develop a fully secured, user-friendly, well maintained, Integrated Management Information System with the aim of improving the internal efficiency of the University administration and management’ ”.

The document also elaborated:

- Existing University Infrastructure
- The modules in the proposed Computer-based Information System
- Business process re-engineering implications
- Recommendations
- Project Schedule
- Staff/Project Allocation
- Human Resources and
- Systems Development Methodologies & User Involvement.

Before the MIS Strategic Plan was developed, a presentation on the University Structure and forthcoming MIS was made to University Management Consultative Committee (MCC) by the Director of CITS on 24 March 1998. Following this, approval was given for the in-house development of the University MIS and led to the setting up of the University MIS Steering Committee.

**5. University MIS Steering Committee**

The University MIS Steering Committee was set up on 5th August 1998 with the following composition:

- Chairperson to be appointed by the Vice Chancellor
- Registrar’s representative for Human Resource System
- Budget Director’s representative for Assets and Inventory System
Registrar’s representative for Student Information System and Admission System
Three project leaders at CITS;
Secretary to be provided by Registrar’s Office

The terms of reference of the University MIS Steering Committee were put forward as follows:

1. To review the MIS development strategy proposed by CITS particularly with regard to areas of priority supportive of the University mission and Strategic Plan.
2. To facilitate the development of the University MIS in a planned and integrated manner
3. To authorize access to necessary principles, procedures, reports and data on a confidential basis
4. To identify key liaison personnel and set up a reporting infrastructure between the systems development teams and users
5. To monitor progress of MIS development and implementation according to plan
6. To co-opt members as required
7. To deal with any other related matters delegated to the Committee by the University.

In accordance with item 1, the MIS Steering Committee on 3rd September 1998 prioritized the systems to be developed and integrated in order to meet the most immediate needs for University Administration and Management in terms of improved effectiveness and efficiency. The systems were:

- **Human Resource Systems (HRS)**
  To be started from scratch and to include the subsystem Employee Registration, Staff Development, Leaves and Passage Benefit Management, and Research and Consultancy.

- **Assets and Inventory System (AIS)**
  To be started from scratch and to include:
  * Assets Management,
  * Stock Item Processing,
  * Non-item Processing, and
  * Purchase order Management

- **Student Information System (SIS)**
  To revamp the stand-alone computerized system built in-house in 1996 on the Uniface Platform and to integrate it with the HRS and AIS. The new SIS had to include:
  * A Student Record and Management System,
  * Processing of Student Marks, and
  * Posting of marks by internal examiners using the University Intranet.

- **Admission and Nominal Roll System (ANS)**
  To revamp the stand-alone computerized system built in-house in 1994 on the Oracle platform and to integrate it with the HRS, AIS and SIS. The new ANS had to include:
  * An application system,
  * Database driven Selection criteria,
  * Efficient reporting mechanisms especially for statistics, and
  * Data linking mechanisms with the Mauritius Examination Syndicate (MES).

A full description of the new ANS configuration is provided in Fig. 3.

The meeting also decided on the 3rd September 1998 that the other earmarked systems namely:

1. Services Systems (to be developed in-house)
2. Resources Systems (to be developed in-house) and
3. Financial Information System (to be procured by the Tertiary Education Commission),

would be phased in the University MIS in an integrated manner once the four priority systems have been developed and fully deployed to the end-users.

6. Phased MIS development

As of 2nd March 1998, CITS had one Systems Analyst and one Technician acting as Programmer, both working on the Student Records System. The Systems Analyst who was expected to spearhead the MIS project left the University on 6th April 1998. In August 1998, the CITS had on its establishment one Technician to act as programmer and one Lecturer co-opted to act as Project Coordinator for the MIS Projects. It was essential that CITS recruit Systems Analyst and Analyst/Programmers in order to start the planned MIS development activities. However, due to the long lead time in creating posts and recruiting staff at the University, a parallel strategy was adopted in order to jump start the process.

In August 1998, four final year Computer Science and Engineering students were assigned final year projects for the development of the Human Resource System (HRS) and the Assets and Inventory System (AIS) in teams of two. The other lecturer who was acting as Officer-in-Charge of the IT Services department and who became the Manager, IT Services in May 1999 was given the additional task of being project leader for the AIS. The four students were placed under the supervision of the lecturer (also Project Leader for the HRS) who coordinated the preliminary investigation, analysis and design, development and testing, implementation and maintenance of the two systems as well as the new SIS and ANS which were being undertaken by the Technician acting as Programmer. Concurrently, the
Table 1

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manager MIS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Systems Analyst</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3. Analyst/Programmer</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4. Database Administrator</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

recruitment exercise to build the human resource capacity to sustain the development and deployment of MIS System at CITS was well underway.

In May 1999, when the four students submitted their projects to the department of Computer Science and Engineering, the core of the business rules were already implemented in the HRS and AIS. Their projects were A-rated by the external examiner in Computer Science. CITS then sought and obtained University approval to appoint the four students as Research Assistants for a period of three months mainly for the testing, maintenance and the documentation, training and deployment of the systems to the end-users. Development of the HRS and the AIS was successfully completed on 30th September 1999 including documentation of all development stages, testing, writing of user manuals and the deployment of the software. The HRS and AIS were both developed on web-based intranet platforms that allowed easy deployment on the one hand, and a rapid growth of usage by end-users due to the familiar browser interfaces on the other hand.

In the mean time, the analysis and design of the new SIS and ANS were completed and the recruitment of two Systems Analyst (one post being filled by the technician acting as programmer and another post by one of the Research Assistant) in October 1999 and two analyst/programmers in February 2000 led to the successful development of the two systems by August 2000.

The initial data entry efforts on the HRS and the AIS as well as maintenance on these systems in order to be fine-tuned to the appropriate business processes were completed after several end-user meetings by the MIS project coordinator and the end-users in January 2001. During the course of the data entry stage it became apparent that further intensive training of the end-users in small groups was necessary to get the implementation schedule back on course. End-user acceptances for the HRS and the AIS were recorded in February 2001 almost a year and a half after the deployment of the software. It is to be noted that the new SIS and new ANS have also been successfully deployed in the first semester of academic year 2000-2001 as hybrid client/server and web-based systems respectively. For example, academics of the University and part-time lecturers use the SIS as a web-based intranet system to post their marks each semester whilst faculty and administrative staff use a client/server system to process marks in batch mode.

The MIS project coordinator was appointed Manager, MIS at the CITS in October 2000. Table 1 shows the phased recruitment of human resources in the MIS department of CITS.

7. MIS technical aspects

7.1. Architecture

The MIS has been designed as a federation of different systems fully integrated on a common and cost effective hardware/software/database management system platform.

Integration has been achieved through the complete separation of data into different databases and applications that implement the business rules for each system. This two tier approach has been
implemented on a common relational database management system (RDBMS) platform result in the fact that the required data can be accessed at any time using both client/server technology and web-based intranet systems.

Indeed through the complete separation of data and applications for each of the developed system, cross-functional queries from the different system presents information in an integrated manner to university administration and management to facilitate timely and effective decision making.

7.2. System software design

The analysis and design of the four systems were carried out based on the methodologies of De Marco [5] and data models of Chen [6] and Smith [7].

The analysis and design were documented in the following reports:

2. Assets and Inventory System (AIS) Analysis and Design Report, see [9]

7.3. Salient features and usage

Summaries of the salient features of the four systems that have been developed are provided as shown in Tables 2–5.

8. Cost implications of University MIS

The cost implications of University MIS are shown in Tables 6–7.

9. Contextual issues

Buy v/s Build

The University Management initially favoured buying an MIS such as the Banner system based on Oracle RDBMS. At a presentation made by the Director of CITS to University Management Consultative
Table 2  
**Human Resource System (HRS)**

<table>
<thead>
<tr>
<th>Brief Description</th>
<th>The Human Resource System has been designed and implemented on the University of Mauritius intranet platform and can be accessed via any standard browser. The HRS has been developed to support University Administration in – Employee Registration – Staff Development; – Leaves and Passage Benefit Management and – Research and consultancy records management. It should be noted that all conditions of service have been parameterized and stored on the HRS database such that any changes can be effected by the end-user without alterations in the application program.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Database Platform</strong></td>
<td>SQL Server 7.0</td>
</tr>
<tr>
<td><strong>Database Name</strong></td>
<td>MisDB</td>
</tr>
<tr>
<td><strong>Access Type</strong></td>
<td>UOM Intranet</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Web-based Active Server pages</td>
</tr>
<tr>
<td><strong>No of tables</strong></td>
<td>100</td>
</tr>
<tr>
<td><strong>No of Records</strong></td>
<td>878</td>
</tr>
<tr>
<td><strong>No of users</strong></td>
<td>23</td>
</tr>
<tr>
<td><strong>Data Entry</strong></td>
<td>– Central Administration for employee records and leaves – Finance Section for the Passage Benefit System</td>
</tr>
<tr>
<td><strong>Volume of Data entry</strong></td>
<td>Very high load of 878 records with more than 100 fields of initial data entry. Quite low load on a day-to-day basis.</td>
</tr>
<tr>
<td><strong>Frequency of use</strong></td>
<td>1. Day-to-day for data entry. 2. Batch processing for leaves annually in the first week of January. 3. Batch processing for passage benefits annually at the end of financial year.</td>
</tr>
</tbody>
</table>

Committee (MCC) on the 24th March 1998, the issues of Business Process Re-engineering (BPR) was raised as being essential to successful implementation of an MIS. However, management advised decoupling of the linkage as restructuring of the University was considered sensitive while internal or workflow processes could be streamlined. The University MIS Steering Committee took this on board.

**Staff**

The earlier development of computer-based information systems were made on an ad-hoc basis starting with the Admission System outsourced in 1994, under the control of the Registrar and the Student Records System developed in-house by a Systems Analyst recruited in 1996, based at the Centre for Distance Learning.

After the CITS was established, various personnel were transferred to it in March 1998, including the Systems Analyst and one Technician to act as Programmer. This constituted the staff available for MIS development.

After the decision to build the MIS in-house was made on the 24th March 1998, the Systems Analyst expected to spearhead the MIS project resigned on the 6th April 1998. Coming barely two weeks on this was perceived to be a big set back for the project given the loss of a key player and the anticipated lead times for recruiting a suitable replacement. However, a Lecturer attached to CITS was assigned the project co-ordination responsibilities on the 5th August 1998 and given that he was an academic was able to supervise the final years students’ projects related to systems analysis and design, see section 6 above. Having successfully seen the project through to quite an advanced stage the said Lecturer was formally appointed MIS Manager, just over two years later. Thus with hindsight the initial setback was a blessing in disguise.
Table 3
Admission and Nominal Roll System (ANS)

| Brief Description | 1. The Admission and Nominal Roll System processes and selects the best applicants for all undergraduate programmes at the UOM. Furthermore, the system developed extracts data of student’s Cambridge ‘A’ level results from magnetic tapes of the Mauritius Examinations Syndicate (MES). This process saves up to 80% of the data entry.  
2. Nominal Roll system to generate statistics to support top management in decision making processes  
3. Completely parameterized admission criteria. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Database Platform</td>
<td>SQL Server 7.0</td>
</tr>
<tr>
<td>Database Name</td>
<td>ASDB</td>
</tr>
<tr>
<td>Access Type</td>
<td>UOM Campus Network</td>
</tr>
</tbody>
</table>
| Application       | 1. Client/Server application on VB 6.0 for Admissions  
2. Web-based Active Serve pages for Nominal Roll |
| No of tables      | 65 |
| No of Records     | 5117 |
| No of users       | 5 |
| Data Entry        | Only 20% for non-Cambridge ‘A’ level results |
| Frequency of use  | 1. Once every academic year for admissions.  
2. Batch processing done for each programme being offered  
3. Nominal roll is used as and when required all year round |

Table 4
Assets and Inventory System (AIS)

<table>
<thead>
<tr>
<th>Brief Description</th>
<th>The Assets and Inventory system (AIS) has been designed and implemented to support the processes involved at the stores section for stock item and non-stock item management, at the purchasing section for purchase order management and at the finance section for assets management. The AIS has been developed on the UOM intranet platform and would eventually dovetail into a financial information system.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database Platform</td>
<td>SQL Server 7.0</td>
</tr>
<tr>
<td>Database Name</td>
<td>MisDB</td>
</tr>
<tr>
<td>Access Type</td>
<td>UOM Intranet</td>
</tr>
<tr>
<td>Application</td>
<td>Web-based Active Server Pages</td>
</tr>
<tr>
<td>No of tables</td>
<td>59</td>
</tr>
<tr>
<td>No of Records</td>
<td>2295</td>
</tr>
<tr>
<td>No of users</td>
<td>16</td>
</tr>
<tr>
<td>Data Entry</td>
<td>Main store, Purchasing section, Finance section</td>
</tr>
</tbody>
</table>
| Volume of Data entry | 1. Very heavy initial data entry for stock items, non-Stock items and respective balances.  
2. The load of data entry at purchasing is about 10 to 15 purchase requisitions for non-stock items per day.  
3. The load of data entry at the main store is about 10 store form file (SFF) per day |
| Frequency of use  | 1. Every day  
2. There is no batch processing |

End-user resistance to change

Problems with data entry, which delayed the full operation of the modules developed under the MIS by nearly one year were encountered at the Main Stores for the AIS, at the Establishment Section for the HRS and at the Finance Section for the Passage Benefit subsystem under the HRS.

The end-users were quite happy during the development phase but, later on, became reluctant to carry out the initial data entry until financial incentives were introduced. Also resistance at the Finance Section was a major problem and categorization of stock items was stalled until a new Senior Stores Officer was appointed in early 2000.
Table 5
Student Information System (SIS)

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brief Description</td>
<td>The Student information system (SIS) supports the processes of the administrative faculties of the University of Mauritius for student records management and the processing of marks after the semester examinations. The SIS provides reports and statistics for decision making at the board of examiners, faculty boards and senate. The SIS also allows the examiners (both full-time and part-time) to post their marks directly to the respective databases via the intranet platform. This cuts down nearly all of the volume of data entry at the faculty office for faculty administrative staff.</td>
</tr>
<tr>
<td>Database Platform</td>
<td>SQL Server 7.0</td>
</tr>
<tr>
<td>Database Name</td>
<td>SisDB</td>
</tr>
<tr>
<td>Access Type</td>
<td>UOM Campus Network</td>
</tr>
<tr>
<td>Application</td>
<td>1. Client/Server application on VB 6.0 at the Faculties</td>
</tr>
<tr>
<td></td>
<td>2. Web-based Active Server Pages for posting of marks by examiners.</td>
</tr>
<tr>
<td>No of tables</td>
<td>73</td>
</tr>
<tr>
<td>No of Records</td>
<td>130,428</td>
</tr>
<tr>
<td>No of users</td>
<td>30</td>
</tr>
<tr>
<td>Data Entry</td>
<td>Done by internal examiners via the UOM intranet platform</td>
</tr>
<tr>
<td>Volume of Data entry</td>
<td>Very heavy for all 2004 modules every semester (after examination)</td>
</tr>
<tr>
<td>Frequency of use</td>
<td>Twice yearly for posting of marks after each examination series</td>
</tr>
</tbody>
</table>

Benefits of the MIS to the University

- Calculation of vacation leaves which took nearly one day manually is obtained in a matter of seconds on the MIS;
- Calculation of Passage Benefits, which is based on the leaves taken by employees, the salary and the length of service is obtained within seconds by the Finance Section. Previously, it took the Finance Section nearly three days to get the information and carry out the calculations.
- Easy access to information and statistics by Senior Management on Admissions and Enrolment at the University
- All calculations for examinations are automated. Reports, with all the rules and regulations concerning examinations are generated for Board of Examiners, Faculty Boards and Senate without any manual interventions
- Better control and monitoring of University Purchases and Stocks through a completely automated workflow system, and
- The University of Mauritius Web Site mines data concerning staff information programme structures and faculty information from the MIS thus considerably reducing the need for maintenance.

Critical success factors

- Development of a Strategic MIS Action Plan. This enabled the goals to be set, the phased resources required to be stipulated and the actual progress to be measured against the action plan. Since the plan was derived from the CITS Strategic Action Plan which rationalized in-house development as opposed to outsourcing, it became an essential document. Furthermore it facilitated performance appraisal.
- Management Support from the offices of the Vice-Chancellor, Pro-Vice Chancellors and the Registrar given that the initial intention of senior management was to outsource. Furthermore, authorization to automate sensitive areas of central administration such as the establishment and personnel sections required careful assurances of confidentiality of content.
- Training of end-users – bridging the gap between technology and people. This involved the writing of end-user manuals, regular demonstrations of developed prototypes, and intensive sessions in the utilization of the systems so that end users could appreciate the benefits in their workplace and overcome their initial apprehensions be they technical or simply wanting to maintain the status quo.
Table 6
Capital Expenditure (on-off) – 1 US$ = Rs. 30

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Equipment</td>
<td>Rs880,000.00</td>
</tr>
<tr>
<td>MIS Server</td>
<td></td>
</tr>
<tr>
<td>Hardware</td>
<td></td>
</tr>
<tr>
<td>NCR Dual Processor Pentium III Server</td>
<td></td>
</tr>
<tr>
<td>With 512 MB RAM and 63 GB RAID</td>
<td></td>
</tr>
<tr>
<td>Hard Disks</td>
<td></td>
</tr>
<tr>
<td>Software</td>
<td></td>
</tr>
<tr>
<td>Microsoft Back office 4.5 with Window NT 4.0</td>
<td>Rs 93,143.60</td>
</tr>
<tr>
<td>7 Server 7.0</td>
<td></td>
</tr>
<tr>
<td>Internet Information Server 1.1</td>
<td></td>
</tr>
<tr>
<td>55 User licenses (once-off)</td>
<td>Rs 82,280.00</td>
</tr>
<tr>
<td>Antivirus Software and Licenses</td>
<td>Rs 2,344.10</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>Rs1,057,767.70</td>
</tr>
<tr>
<td>2. Human Resources</td>
<td>Rs 132,840.00</td>
</tr>
<tr>
<td>4 Research Assistants for 3 months</td>
<td></td>
</tr>
<tr>
<td>Sub-Total</td>
<td>Rs 132,840.00</td>
</tr>
<tr>
<td>Grand Total</td>
<td>Rs1,190,607.00</td>
</tr>
</tbody>
</table>

Table 7
Recurrent Expenditure (Annual)

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Maintenance for MIS Server</td>
<td>Rs 70,600.00</td>
</tr>
<tr>
<td>2. MIS Development Recurrent Budget</td>
<td>Rs225,000.00</td>
</tr>
<tr>
<td>3. Personal Emoluments for 5 staff</td>
<td>Rs790,000.00</td>
</tr>
<tr>
<td>(1 Manager (MIS), 2 Systems Analyst, 2 Analyst/Programmers)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Rs1,085,600</td>
</tr>
</tbody>
</table>

Project coordination resulting in team spirit and teamwork. Using a mix of bonafide staff and undergraduate students on the systems development side and the deployment and utilisation of the systems involving end-users of varying computer skills respectively required not only sound technical project management skills but also good interpersonal skills that enabled one see and appreciate the end-users’ perspective so as to build confidence and sustain partnerships; and

Supervision and close monitoring of the initial data entry whilst the various systems were being deployed. The initial arms-length approach resulted in delays in systems utilization. It would have been easy to say that the end-users were responsible for the data entry and leave it at that but functionally this was unacceptable.

Developmental impact

The University of Mauritius decided in 1997 to restructure the original Computer Centre and this resulted in the creation of CITS as outlined in Section 1 above. The Strategic Plan of CITS [3] set out the development of the University Integrated MIS as a strategic objective (see Section 4). Thus the champion for the integrated MIS was CITS. The University of Mauritius later on developed its strategic plan [8] in 1999 and incorporated ICT into its strategic objectives.

On completion of the MIS, the University invited the Minister of Information Technology and Communication in June 2001 for a demonstration. The Minister was sufficiently impressed by the in-house IT and software development capacity to suggest that CITS staff assist, vide a Memorandum of Understanding, the ongoing National IT Project currently chaired by the Prime Minister and comprising of three task forces:

- E-government;
The main areas of assistance being negotiated between the Ministry of Information Technology and Telecommunications and the University covered, interalia, the following areas:

- Government On-line Centre;
- Incubation Centre;
- E-Procurement;
- Virtual Recruitment Centre; and
- Training (Web development for staff of various ministries, CISCO Regional Academy amongst others)

This broad developmental impact has given the University additional credit for its expertise in the field of Information and Communication Technologies.

10. Recommendations

During the development of the University of Mauritius Integrated MIS, a number of ‘lessons’ were learned by both University Management and the development team. Some of the pertinent points are listed below:

- Initial data entry is an important cornerstone for the success of an MIS, although technically the system can be very solid. Incentives have to be given (monetary or otherwise) to staff who are involved in the initial data entry phase.
- End user requirements have to be fully analysed and documented in appropriate preliminary investigation, analysis and design reports. An MIS that does not meet end-user requirements would most certainly fail.
- MIS end-users should clearly see the benefits that the system is bringing to their work. If they see the MIS as an additional burden to their work, they will resist it at all cost.
- Development of an in-house MIS, especially in an academic environment, allows a fully customised system to be obtained which can be upgraded and updated very easily. This can, however, be done if a proper set up team is recruited and trained.
- An in-house and trained MIS staff at a University can also be involved in consultancy and training activities for income generation.
- University Management and Administration should be involved in the development of the MIS. This facilitates access to information and to people who have to be consulted.
- Regular demonstrations of developed prototypes help in end-user involvement in the development of an evolving system and greatly reduce resistance to change especially when benefits are shown.

11. Conclusion

The University of Mauritius Integrated Management Information System developed in-house by the Centre for Information Technology Systems was not only financially advantageous but also allowed effective monitoring, deployment and maintenance of the systems comprising the MIS. Indeed, it took more than one year for the required data to be entered by the respective departments in the Human
Resource System and the Assets and Inventory System after the systems were successfully developed. The monitoring and supervision of the data entry by the Manager (MIS) and other MIS staff was one of the critical success factors for the University MIS. Resistance to change of the manual processes especially encountered at the Main Store for the AIS and by academic staff for posting their examination marks on the SIS have also been important aspects that had to be managed through consultations during the development phase, training of end-users and appropriate documentation during the deployment phase. It was essential to show the benefits that the users would obtain by using the system as, for example, in the case of the SIS, where the internal examiners just have to type in their marks and the system carries out all the calculations. Once the end-users saw the benefits there was a smoother acceptance of the system. Building an Integrated University MIS is not only about Information System development and the underlying technology but also about people who on both the development side and the end-user side have to make it work.

References

[1] S. Govinda and A.J. Rodrigues, Electronic Distance Education and Enabling Technologies in a Small Island State, Colloquial on Distance Education and Technology, Santiago, Chile, November 1999.


About the authors

A.J. Rodrigues was Professor of Computer Science and Director of the Centre for Information Technology and Systems at the University of Mauritius from 1997 to 2001. He received his BSc (Electrical Engineering) from the University of Manchester and his M.Sc (Theory and Practise of Automatic Control) and PhD from the University of Manchester Institute of Science and Technology. He has worked in various capacities at Makerere University (1972–1974), University of Nairobi (1974–1997) and at the University of Mauritius (1997-2001) whilst on leave from the University of Nairobi returning to the latter’s Institute of Computer Science in 2001. He has been involved in the management of Information Systems and Technology in developing countries since 1985.

S. Govinda holds a BTech(Hons) degree in Electrical and Electronic Engineering and an MSc in Digital Communications. He is presently the MIS Manager of the University of Mauritius and is the advisor of the Director of the Centre for Information Technology and Systems on Information Security related issues. He has worked as a Systems Engineer at Mauritius Network Services and has been a lecturer in Computer Science and Engineering at the University of Mauritius. He is presently registered for a PhD on Integrated Data Security Environments for Wired and Wireless Networks.