Potential MIS contribution to institutional strengthening at the Open University of Sri Lanka

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The OUSL partially computerised its student records more than a decade ago, with the creation of a simple transaction processing system to hold details of students' course choices, marks and grades. However, this system was never transformed into a management information system, its reporting capability remaining limited to simple student lists of one sort or another, and its data coverage remaining exclusively focused on student data. Neither was the database ever extended to include demographic student information which would be useful, for example, in analyses of programme take-up for forecasting and planning purposes. Staff participation in the 3-year DfID/OUSL Distance Education Project highlighted database inadequacies in terms of its potential as an information resource for educational research. But the inadequacies have affected all staff in the university, most of whom continue to function in increasingly difficult circumstances in this paper-based environment. In order to help address the problem the DfID agreed to fund the design and development of an integrated management information system for the university. The principal purpose of this paper is to identify some of the benefits that can be expected from use of the management information system for university management and administration, teaching, learning and assessment, and educational research.

Introduction

The Open University of Sri Lanka is a dynamic organisation, which has made significant growth in terms of student numbers and curriculum offerings since, it was first established almost 20 years ago. Today, its three academic faculties offer a wide range of academic and professional programmes to almost 20,000 students drawn from all over the island.

The OUSL was the first university in Sri Lanka to develop an electronic database system to manage its large volume of student records. This was a simple transaction processing system, developed in the late 1980s to handle academic programme applications, course registrations and examination mark processing. Unfortunately, this important initiative was not further pursued. The electronic database was never extended to embrace a broader coverage of student-relevant information, nor to include records about staff, library holdings, budget, and so on. Neither was the system software further developed to produce any kind of summary reporting. In consequence, university staff have been constrained to continue functioning without the benefit of readily available student data and management information, while coping with ever increasing student numbers.

Among others, Fielden & Simon (1998) have identified the growing importance of an effective MIS in university management. At this point in its history, the OUSL could undoubtedly benefit from access to a modern management information system, to meet the current and future information needs of its managers and administrators as well as those of its materials developers, teachers, tutors and students.

Assistance in the design and development of a comprehensive management information system was one of the thrusts of the three-year D/ID/OUSL Distance Education Project, a project funded by Britain's Department for International Development (D/ID) until December 1998. Originally, this particular component was planned to be an essential support for other lines of development within the project as a whole: assisting academic staff to improve their educational research and evaluation skills, helping the university to improve student support, and contributing to management training for senior administrative staff. But for a number of reasons the MIS component within the larger project was significantly delayed. Initial database design was undertaken only during the autumn of 1997 (Johnson & Johnson, 1997), while system programming and new database build-up began as late as the spring of 1998, with the appointment of a young, dedicated and

temporary software development team to be trained and supported by external *DfID* consultants.

Despite a number of difficulties, important progress had been made towards new system development during the few months which remained between the creation of the software development team and the end of the parent project (Johnson & Johnson 1998a, b, c). And since then the university has been able to continue supporting the MIS software development through its own resources.

The planned information system comprises nine subsystems: Academic, Applicant records, Student records, Personnel management, Library management, Plant management, Equipment management, Stock management, Finance and Payroll. It is based on an extensive relational database of 150+ data tables, containing information about students, staff, programmes and resources. The purpose of this paper is to describe the potential impact of the new MIS on the effectiveness and efficiency of the Open University, in the three broad areas of university management and administration, teaching, learning and assessment, and educational research and evaluation.

Management and Administration

As in other types of organisation, senior university staff typically have a variety of managerial and administrative functions and responsibilities during the course of their work (Handy, 1985; Rumble, 1986). They *facilitate* in the sense that they ensure that resources are available as needed to enable their departments to function. They *monitor and control* in the sense that they oversee operations, and take remedial action should problems arise. They *plan* for the short-term, medium-term and long-term, the temporal scope of their planning responsibility depending on their level of seniority within their departments and the institution at large. The effective execution of all these functions depends critically on the ready availability of accurate management information, and the new MIS can be expected to have a significant impact here.

Staff and students, applicants and graduates

The new database has been designed to contain all the information needed to enable the OUSL to communicate efficiently with its staff, to manage its payroll, to allocate and monitor staff responsibilities in the areas of teaching, tutoring, materials development, administration and committee work, to efficiently organise work schedules for part-time staff, and to maintain and quickly access staff performance histories.

The new system should equally improve university communication with applicants, students and alumni, allowing more frequent, targeted and personalised mailings. If appropriate software is produced, lists of various sorts could become newly and rapidly available: 1st quarter enquirers, 1998/99 applicants, employed students, companies employing current students, married students, etc. In addition, the database has been planned to contain all the prior attainment information needed for determining appropriate study levels and course exemptions during student registration.

As students progress through their OUSL programmes, it is anticipated that further information will be added which will be essential for effectively monitoring academic progress. This includes course registrations, assigned academic counsellors, attendance at day classes and laboratory sessions, use of study materials and library resources, continuous assessment results, and final examination marks and grades. Finally, students' opinions about their educational experience and resource provision might be sought from time to time through questionnaire enquiries, and documented in the database.

The result of this collective data gathering will be the new availability of a powerful tool for monitoring the quality of the university's educational provision and academic support, but also a very rich educational research resource.

Programmes and courses

The OUSL offers its students a wide variety of programmes and courses, both academic and professional, from foundation level through first degree to postgraduate. Sequential learning paths mean that some courses are essential prerequisites for others, and students can be awarded course exemptions on the basis of prior learning experience and qualifications. Course materials are typically print-based, supported in some cases by audio or video enrichment components. Students are given further learning

support through face-to-face day class instruction and tutoring. Student evaluation is through continuous assessment, using home-based assignments, classroom tests and other assessment formats, along with formal final examinations.

All this variety of information has been anticipated in the database design, for access by staff, students and, in some cases, the public at large. Menu-selectable reports are expected to include full descriptions of academic programmes and of individual courses within these. At the start of each academic year a complete list of course offerings can in principle be made available for printing, along with the planned schedule of day classes, each broken down by faculty, department, programme, study level and centre. Lists will be available identifying the day class responsibilities of individual staff members. Comparative day class attendance reports, along with trend charts, should show the picture over the academic year to date.

Of particular importance in the context of ongoing institutional management and future strategic planning, we envisage that course enrolment patterns will be available on-line for consultation by authorised staff, and future demand forecasts produced on request.

Course materials development, production and distribution

The OUSL differs significantly from more traditional universities in that its academic staff are heavily involved in developing and updating the self-instructional course materials supplied to their students. In an ideal world, the university would be keeping inventory records of its materials development, documenting staff involvement in this crucially important activity, and monitoring production costs and student usage, but this is difficult to do in any systematic way in a paper-based record system. The new database has been designed to allow extensive record-keeping in this area and, in consequence, to offer numerous report possibilities which have never before been quickly or easily available to OUSL staff.

The system should help, too, with planning course materials production and organising efficient materials distribution to students. The university has been experiencing recurring problems with both aspects. The reason is easily identified, since there is no mechanism at the present time for scientifically estimating appropriate production volumes for printed course materials, nor is there an automated system of stock control. There is an urgent need to provide the university with a facility to better estimate appropriate

production runs, whether these are for study materials or for application forms, fee vouchers, examination papers, or whatever. The new MIS is designed to serve this need, by providing immediate access to relevant data of value in needs forecasting and production planning.

In addition, the university needs an automated system of stock control, so that at any point in time department heads might know exactly how much stock is available for any particular study material, and where this stock is located. The inventory monitoring mechanism incorporated into the new MIS design relies on bar code swiping to adjust stock records as students claim their course materials: a bar code system has already been under trial for this purpose.

Equipment and resources

The university library already benefits from computerised records of its holdings, and maintains dynamic records of student borrowing. There is also a computerised book ordering system in operation. In the design of the proposed new university database it was planned to incorporate these same records, in order to offer the same managerial facilities to library staff but within a larger integrated system. Through the new database design, links will be possible to other kinds of university information, in particular to student information, which should significantly extend the value of the library data itself. These links will offer new potential for analysing borrowing patterns, allowing trends to be quickly identified and taken into account in decisions about future holdings development.

Like all educational institutions, the university makes available to its staff and students a large variety of equipment, for use both in administration and in teaching and learning. The university needs not only to keep track of these resources, but also to record the location of the equipment, particularly given its national network of regional and study centres. Breakdowns should be recorded, as should repair times and costs, both to monitor functional availability over time and to allow evaluation of equipment suppliers. In addition, the university needs a facility to process and track equipment orders, and to make automatic budget adjustments as items are newly acquired.

The MIS has been planned to enable university staff to automate the process of equipment requisitioning, to track equipment orders, to access current budget balances and future expenditure estimates, to monitor the periods

involved in the entire ordering process, to evaluate equipment and suppliers, and to keep a check on the degree of availability of functioning equipment both to staff and to students.

Strategic planning

Strategic planning is a vitally important management activity for any forward-looking organisation. The OUSL needs to take stock of its current situation from time to time, and to identify appropriate paths for future development. This involves reviewing the institution's internal strengths and weaknesses, along with external opportunities and threats, and on this basis deciding how to build on strengths and/or overcome weaknesses in order to exploit the development opportunities (Holt, 1993). Given the breadth of data planned for inclusion in the system database, the MIS can be expected to aid the strategic planning process significantly, by newly providing senior university staff with a wide variety of summary information about the university's current situation and functioning, and by offering forecasting possibilities based on analysed data trends. Senior staff had no access to this kind of support when they produced their current strategic plan.

Teaching, Learning and Assessment

There are numerous ways in which the new information system can be expected to impact beneficially on teaching, 1earnign and assessment. We here offer just three examples: course materials distribution; evaluation of course materials and complementary learning support; assignment turnaround and eligibility determination. The improvements which the MIS can be expected to bring about in these areas should together serve to improve student support. This in turn should help maintain learning motivation among OUSL students, raising achievement and reducing the risk of dropout (Rowntree, 1992; Threlkeld & Brzoska, 1994. Moore & Kearsley, 1996).

Course materials distribution

Students are given some of their required course materials when they first register for their courses. They receive further materials during two or three subsequent distributions at later points in their studies. In the absence of accurate and readily accessible stock records and demand forecasts, university

staff continue to face real difficulties trying to match stocks to demand at the three regional centres, through which instructional materials and other learning resources are distributed. As mentioned earlier, a stock monitoring system has been incorporated into the MIS design. This, if necessary in conjunction with a facility for authorised downloading of course materials, should significantly ameliorate the problem, if not entirely resolve it.

All university-produced materials are to carry bar codes in the future, as will student ID cards. Bar code swiping will then enable stock records to be automatically and immediately adjusted as students pick up their course materials, and as these are returned by those students who later decide to drop certain courses. Stock production by the University Press, and stock movements from one distribution centre to another, will also be recorded. As a result, those responsible for materials distribution will have accurate knowledge of current stock levels, in all relevant stock locations. In addition, provided they have access authorisation, course coordinators, day class instructors and student counsellors will be able to check which students have or have not claimed their materials at relevant times. Analysis of stock rundown, along with trend-based predictions of future student demand, will be useful in signaling the need for stock transfers from one·distribution centre to another, or for new print runs.

One expected benefit is a reduction in the number of students frustrated by stock shortages at critical points in their courses, and at the same time educationally disadvantaged by the absence of this crucial study support. This can only serve to improve learning. Another benefit concerns students at risk of dropping out of particular courses, or out of their entire programme of study. It should be possible to identify these individuals much earlier than has been possible in the past, through a simple cheek on course materials take-up, along with a check on assignment submission and day class attendance. A third important benefit will be a significant financial saving for the university, since improved knowledge about stock levels should eliminate the previous need for emergency printing of materials when stocks were thought to have been depleted. This saving could be channelled into further improving learner support.

Evaluation of instructional materials and other learning support

In addition to the on-campus production of self-instructional print-based course materials and enrichment audio and video components, the university further supports many of its courses through face-to-face interaction with

teaching staff. This interaction comes in several forms, including day classes, laboratory and workshop sessions, seminars and tutorials. Course coordinators are naturally concerned that sufficient classes, seminars and tutorials are provided to support their students adequately, and that these are of high quality. They are equally concerned, however, that resources should not be wasted on over-provision in an absence of perceived need.

Voluntary student take-up of these kinds of support is a useful indicator in this context. Detailed attendance records are routinely kept at the present time. However, in the absence of any resource support it has been practically impossible for staff to store the data electronically, and a great deal of effort is spent in the manual production of summary statistics for committee scrutiny. Much of this effort can, we hope, be obviated in the future by producing these statistics directly from the system. Moreover, analysis of the cumulative attendance data could provide dynamic management reports, highlighting potential problem areas for course coordinators and academic deans, in terms of instructor absence and/or decreasing student attendance.

In addition to holding attendance data of this type, the new database has been designed to receive instructor and materials evaluation data on an ongoing basis. Should students be given the opportunity from time to time to offer their perceptions of the quality of their course materials, and of the value to them of the face-to-face support they receive to complement self-study, their opinions can be entered into the database for later retrieval and analysis. The data would be available for review by academic deans and course coordinators, for single sessions or over a period of time, providing them with a good basis for deciding whether to continue the given provision or to initiate change for the benefit of their students.

Assignment turnaround and eligibility determination

As mentioned earlier, the university operates a system of continuous student assessment. Students are subjected to a variety of different kinds of assessment at various times throughout their courses. These assessments include timed classroom tests, workshop exercises, oral presentations, fieldwork reports and home-based assignments, preceding the final examination. The marks for these various assessments are weighted and averaged to produce an eventual course mark and grade. Different courses have different combinations of these types of assessment, different numbers of assessments within any type, and different weighting criteria.

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The one thing courses have in common is that in every case students are assessed towards the end of the course for their "eligibility" to attempt the final examination. Students who do not achieve a criterion minimum mark after appropriate weighting and averaging of all prior assessments are not allowed to take the final examination, and must re-take the course concerned.

The new information system can be expected to improve student assessment and hence benefit students in three main ways: by helping to track and reduce the turnaround time for tutor-marked assignments; by providing rapid and ongoing processing and reporting of assessment results, particularly eligibility determination; and eventually by enforcing a degree of standardisation in assessment criteria across courses and programmes.

It is widely acknowledged among distance education practitioners that students should receive rapid and quality feedback on submitted assignments, in order to maintain learner motivation and study persistence (see, for example, Rowntree, 1992; Robinson, 1995). An information system can certainly help monitor the speed of feedback, if staff are prepared to enter date information conscientiously. The new OUSL database has been designed to hold date records, so that student assignments can be tracked from the date of submission to the date of return to students.

Analysis of this data should help academic deans and course coordinators to identify bottlenecks in the system, and on this basis to take appropriate action to ensure that time delays are minimised.

As far as the processing of assessment results is concerned, we expect benefits to arise from readier staff access to students' grade records, speedier eligibility analysis, and timelier feedback to students on their progress and current status. The timely reporting of eligibility status has been a particular problem area for the OUSL in the past. There are a number of reasons for this, including inefficient procedures for the keyboarding of assessment results and an inappropriate strategy for recording frequently changing eligibility criteria (embedded in program code, requiring the ongoing services of IT staff in effecting time-consuming and potentially error-prone modifications). Both features have consistently resulted in time delays in data analysis, with serious consequences for some students.

The new database has been designed to hold eligibility criteria in such a way that authorised academic staff will be able to enter and modify these criteria themselves. Provided only that eligibility criteria are accurately recorded in the database, and that students' marks are also entered accurately and

promptly, both academic staff and students should benefit. Deans and course coordinators will be able continually to monitor the progress of individual students. Non-submission of early assignments, and low marks for early submissions, will signal potential dropouts in need of help. Students, for their part, will have more rapid grade feedback than has been possible in the past.

The greater transparency associated with staff access to the networked system will inevitably raise awareness among academic staff of the large variety of assessment criteria that are in operation in the institution at the present time. Questions will be raised and a degree of standardisation will inevitably result over time, an outcome which can only benefit students.

Educational Research

Just as innovative production companies invest in product research and development, the OUSL needs to be involved in researching the processes and products of distance education. The principal goals of the university are to provide relevant educational opportunities to its students, in Colombo and elsewhere in the country, and to help them to take the fullest advantage of these opportunities. This means providing relevant and interesting courses, supported by high quality course materials, effective day class instruction, competent academic counselling, fair assessment procedures, and adequate access to necessary equipment and other learning resources, such as computers and laboratories. As we have tried to illustrate throughout this paper, the new MIS will significantly help the university to monitor and evaluate the degree to which it succeeds in these aims.

But learning success is not dependent on university provision alone. It depends too, and quite critically, on the characteristics of its students. Different individuals are capable of exploiting the same educational opportunities to quite different degrees, as a result of differences in attitude and motivation, and family and career responsibilities, as much as of inherent differences in intellect or prior levels of knowledge or skill.

It is never easy to investigate the processes of education. For this is a complex area, involving the interaction of numerous different variables. But the new MIS will offer academic staff a powerful data resource to support their educational research activity. This is in stark contrast with the present database system, which is incapable of providing even simple demographic

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breakdowns for the students enrolled in particular courses or programmes, such as those presented in Jayatilleke *et al (1997)*, without intervention by systems maintenance staff

By the time those students who persevere to the end of their academic programmes have done so, a variety of different kinds of information will have been gathered about them and documented in the new database (see Figure 1).
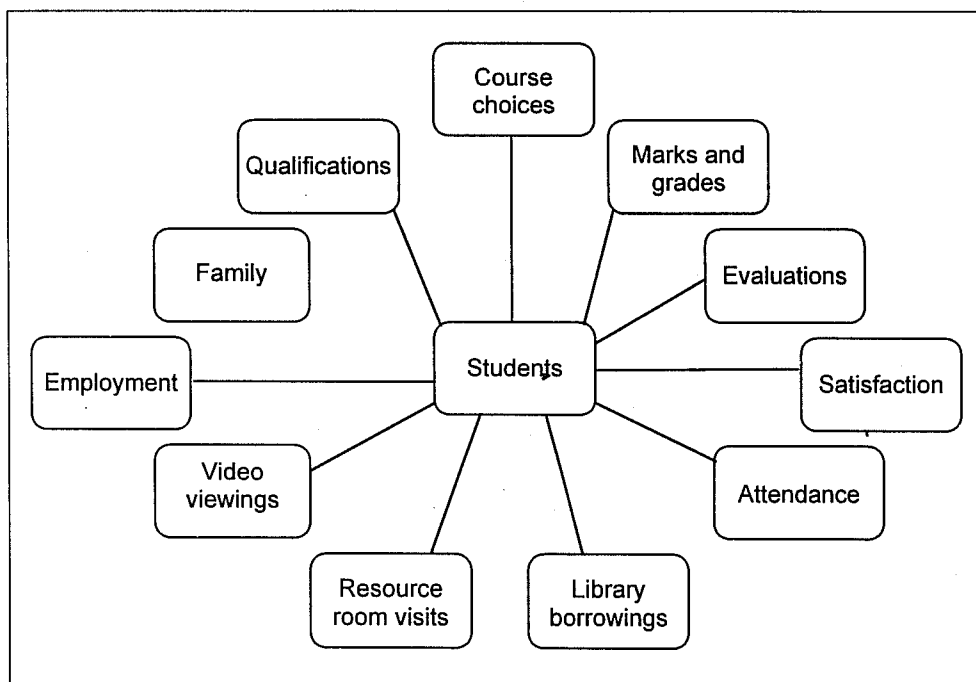

Figure 1 - The potential educational research data resource

As students progress through their academic careers, their course choices are recorded, as are their assignment submissions, examination attempts, and resultant marks and grades. Through course codes and assignment records the students' day class instructors and assignment markers can be traced. Attendance at day classes and laboratory/workshop sessions, recorded manually at the present time, will be documented in the new database, along with visits to regional centre reading rooms. Any use students make of enrichment videos and library books could equally be recorded and stored for later retrieval: database design anticipates this.

In addition, it is hoped that the student survey experience gained by some OUSL staff through participation in the *DfID* project will be capitalised

upon, and that the university will organise periodic questionnaire enquiries among its current students and alumni in order to gather feedback information of value in its own self-evaluation. As suggested earlier, current students could be invited to offer opinions about their educational experience, in the form of judgments about the quality of study materials, about the effectiveness of day class instruction, and about the adequacy of the university's resource provision and general support services. The new database has been designed to accommodate this kind of information.

Many interesting educational research investigations will be possible using this growing data set. For example, one might attempt to relate qualifications and family and employment circumstances to the likelihood of programme drop-out and indeed to eventual levels of academic achievement. One might attempt to quantify the effect of day class and laboratory session attendance on eventual examination success. One might explore the relationship between speed of assignment turnaround and nature of commentary feedback on study persistence and on grades. One will be able to search for any differences in grading standards between markers. And one might explore links between resource availability, resource usage, resource evaluation and eventual examination performance.

Numerous possible avenues of exploration are open. It will be for individual academic staff members to identify areas of particular interest to them, and to exploit the fresh horizons in educational research opened up by access to the rich source of data afforded by the new information system.

The system can easily be adapted to the needs of researchers by providing them with specific data subsets in the form of exported data files (for example, in Excel or dbase formats) ready for immediate import into desktop applications packages (such as Excel and SPSS). We have proposed that the system should eventually provide this facility in the form of a menu-selectable file export option. 'Marks and grades', for example, could result in an exported file containing student demographic data along with assignment and examination marks and grades for focused analysis. The system would locate the relevant tables, de-normalise the relevant data, and create and export the ready-made data file for immediate use. The data file, again at the user's request, could be filtered in various ways: for example, by academic year, gender, programme, course, etc. 'Course evaluations' could provide student questionnaire responses for particular courses, in one academic year or over time. 'Course evaluations and grades' could provide evaluation responses and final course grades, perhaps with some prior summarisation of

evaluation comment. 'Attendance' could focus on class attendances for particular courses, instructors, students, academic years, or whatever. There are many possibilities. The system has been designed and structured to make them extremely simple to implement once researchers and system developers have agreed on the appropriate choices.

The main purpose of such a provision is to save researcher time and effort, in merging data drawn from several different data tables, as well as allowing staff without the necessary technical expertise to undertake this task nevertheless to have ready access to the data they need. The only limitation in the foreseeable future arises from the continued narrow range of data which will be available for analysis. Unless concerted efforts are made to computerise those thousands of paper-based student records which contain demographic information, researchers will necessarily be frustrated by the new availability of this powerful research tool without an adequate base of relevant data with which to work. This is because it will take several years for the recently-begun acquisition and keyboarding of 'student profile' data to result in a cumulated set of data large enough to offer genuinely interesting research analysis opportunities in this sense.

System Development Challenges

A number of challenges were faced during the first year of system development activity, and more will be faced as development continues and the new system is eventually introduced. Early challenges centred essentially on staffing and resourcing, table population and information strategy formulation.

New temporary staff appointments were made in order to create a system programming team for initial software development. The main challenge here was to encourage the young inexperienced programmers to adopt appropriate team working practices. This was not a particularly easy task given the inevitable infrequency of consultancy visits, the regular departure of team members to better paid jobs in the private sector, and delays in necessary equipment acquisitions, particularly as regards the local development network infrastructure. By the end of 1998, however, software development was progressing well.

Table population, on the other hand, proved to be a continuing problem. It is one thing to construct an electronic database structure. It is quite another

thing to create a useable database by populating database tables. Yet no information system, however competently and professionally designed and programmed, can be credible or fully functional with an incomplete base of data. We have already referred to the likely frustrations of the university's educational research staff in this regard.

Transferring existing student records from the old database into the new one was a manageable if complex and time-consuming process. The bigger problem concerned the computerisation of previously paper-based records for database incorporation, records which in the case of students could be counted in tens of thousands. Indeed, in some cases no records of any kind were available, or were not readily retrievable, since no systematic record keeping system, manual or electronic, has previously been in operation in the university (other system designers, for example Bell, 1996, have uncovered similar situations during the design stage, in quite different areas of application). Despite a universally high commitment to the MIS development project among university staff, it appeared difficult for the university to mobilise the necessary computerisation effort. This particular challenge continues for the OUSL.

Another challenge which continues to face OUSL management is development of a formal information strategy, which will determine how the new information system is to be used. During the system design phase, discussions about the information needs of various groups of staff and of students were based initially on information use within *current* practices and procedures, practices and procedures which had inevitably evolved over time to suit a paper based administration. While it was interesting to identify the principal information needs of functional units in this context, and to attempt to identify appropriate paths of information flow, it was more interesting to identify ways in which current patterns of information flow might appropriately be changed once staff have networked access to the new information system.

University policy makers were encouraged to give consideration to the possibility of re-allocating responsibilities for data production and use, and to begin formulating a strategy both for information flow and for access authorisations. In other words, the information needs analysis inevitably began the challenging and vital process of agreeing an information strategy for the institution (see, for example, Coopers & Lybrand, 1996; University of Glasgow, 1997).

As the system implementation phase approaches, additional challenges will arise (CHEMS, 1997; Fielden & Simon, 1998). These include replacement of the existing student records system (when and how to achieve this: a priority in the MIS development plan), implementation of the university's newly determined data security policies, staff training and system evaluation. IT staff will need to be trained for continued new system development and ongoing maintenance, while academic and administrative staff will need help in adapting quickly to their new working environment and, in some cases, in successfully assuming new data quality responsibilities.

Despite the difficulties, if the design effort overviewed in this paper is capitalised upon, and the challenges outlined above are successfully addressed, the result should be a powerful new information system for the OUSL, which will effectively serve the management and research needs of staff, and the information and learning support needs of students, well into the future.

Acknowledgements

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