Design and implement of a university archives management model

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Abstract

Recent years have seen instructional technology and online learning join academic computing, administrative computing and library services as a major focus of investment and planning on campus. Many universities are now embracing the use of Information and Communication Technologies (ICTs) in search for more efficient and competitive processes both in delivery of lectures as well as in administrative processes. This paper shares the experiences of a public University of China in implementing an archives management System (AMS), challenges faced, how it tackled these challenges, what has been achieved so far and important lessons learnt in the process. The paper concludes by proposing improvements in implementing similar systems in other institutions in the continent.

Keywords: ICT, JUT, archives management, model

1 Introduction

Acosta [1] notes that the effects of emerging technologies, more so ICTs, are being felt across the world, in various business organisations including universities. African universities have since realized that to improve efficiency and quality of service, they will need to adapt to using ICTs. Academic institutions are now automating core functions such as student admission process, estate management, fees payment, examination records management and library services among other functions.

For the last decade, universities have been grappling with the growing complexities arising out of the pervasive influence of information and communication technologies [2-4]. The underlying preoccupation has been with the means of managing the IT infrastructure supporting academic computing, administrative systems and library systems. Each domain has had its own particular challenges with issues of reliability and cost-effectiveness being constant themes [5]. The growing interdependence of the various systems environments led to a focus on organisational restructuring as a solution to a range of political and functional problems.

Towards the end of the decade, it becomes apparent that organisational restructuring in itself was not the answer. Put simply, the bringing together of libraries, IT services, management information systems and (sometimes) flexible learning centres has not necessarily lead to better service outcomes [6-8]. There have been many examples of tightly converged organisational structures which have failed to demonstrate noticeable changes in existing service cultures and, conversely, there have been examples of rather disparate organisational structures demonstrating highly innovative service solutions.

Reference [9], in particular, have often been buffeted by the wind of organisational change and, have suffered enormously by being effectively down-graded in the drive for IT efficiencies. The general conclusion to be drawn from this past decade is that no amount of organisational restructuring can overcome the deep cultural and political perspectives inherent in the respective service domains. Librarians, IT personnel and those leading the teaching and learning support services, still have very different world views of the means by which services should be organised. Underlying this ongoing cultural and professional struggle are four key concepts, namely, the nature of the learning experience, service convergence, interoperability and sustainability. All four concepts deserve some comment as part of this analysis.

The onset of Information and Communication Technologies (ICTs) is changing the way universities work. Customers (student, sponsor, employer or supplier) are demanding for more accurate information and faster services. Students, for example [10], would like to check for their fee balances, enrol in their respective courses, pay fees and maybe print their results on-line away from campus. Acosta [1] agrees that the demand to automate university processes is becoming important in line with university quality assurance. However, with the high costs of Integrated Academic Management Systems (IAMS) on the market, Chinese Universities must find alternative ways of meeting their customers' expectations within their constrained budgets.

2 Raw data aggregation from the academic archives of the Chinese public university

The Jingchu University of Technology (JUT) is a full-time public university duly approved by China. The university engaged a consultant to collect requirements throughout the university departments and document them into a university requirements document. From these requi-

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rements, seven sub-systems or modules were identified that needed to integrate towards meeting the university needs. These seven sub-units formed the JUT Management and Monitoring System (JMMS) project. At this time, the archive accommodates levels of aggregation appropriate to the type of data being recorded. Each night at 3 a.m., the 20 second data are aggregated to 5 minute data. These data are appended to a table for the relevant month. The data are also aggregated to 1 hour and appended to a table which contains data for an entire year. Future plans call for other levels of aggregation as the need is demonstrated. In addition to total volume, average occupancy and average speed, the 5 minute and 1 hour tables also include calculated values of vehicle miles traveled (VMT), vehicle hours traveled (VHT), delay, and travel time. These calculations depend on the highway segment length associated with each loop detector. These segments, or loop detector influence areas, are defined as the segment of the freeway extending halfway to the next upstream station and the segment extending halfway to the next downstream station. Where no next station existed, the detectors influence extended to the end of the highway. The calculations are as follows:

$$VMT = volume \times segmentLength, \tag{1}$$

$$VHT = \frac{VMT}{averageSpeed}, \tag{2}$$

$$Delay = VMT\left[\frac{1}{averageSpeed} - \frac{1}{V}\right], \tag{3}$$

where V is the target speed. We are currently using 60 mph to test the delay calculation. In the future we envision that the user could specify a desired value of target speed so that results could be compared.

$$TravelTime = \frac{segmentLength}{averageSpeed}. \tag{4}$$

The volume delay functions used in Metro's travel forecasting process are a modification of the widely used BPR functions Equation (6). The generalized BPR function has the following form:

$$f_{BPR}(x) = 1 + (x)^{\alpha}, \text{ where } x = \frac{v}{c}. \tag{5}$$

JMMS uses a slightly modified version of the BPR congestion function in their EMME/2 model which takes the following form:

$$f_{EMME/2}(x) = 1 + 0.15\left(\frac{v}{0.75c}\right)^{\alpha}. \tag{6}$$

Setting Equation (5) equal to equation 66 and solving for x results in:

$$x = \sqrt[\alpha]{0.15}\left(\frac{1}{0.75}\right)\left(\frac{v}{c}\right). \tag{7}$$

JMMS uses an alpha value of 6 to represent freeway segments in the model. When alpha = 7 solving for x in equation 7 results in:

$$x = 1.0168\left(\frac{v}{c}\right). \tag{8}$$

This modified BPR function adequately represents the relationship between travel time and v/c ratio for volumes up to capacity. Realistically, volumes should not exceed the actual capacity of the road for long periods of time. However, during the trip assignment process, the function values for v/c ratios of 5 or greater are sometimes necessary in calculations to converge to an equilibrium trip assignment. With large alpha values, the BPR function increases very rapidly where the v/c ratio is above 1. This causes inefficiencies in model convergence.

To address this inefficiency in model convergence, JMMS uses a conical volume delay function of the form:

$$f_{CONICAL}(x) = 2 + \sqrt{\alpha^2(1-x)^2 + \beta^2} - \alpha(1-x) - \beta, \tag{9}$$

where $x=v/c$ and $\beta = (2\alpha - 1)/(2\alpha - 2) = 13/12 = 1.0833$

3 Strathmore university requirements

From Figure 1, the Academic Management Sub-system (AMS) was considered to be at the heart of all the other sub-systems and was awarded the highest priority. This paper dedicates to discuss in detail the implementation of this sub-system at JUT.

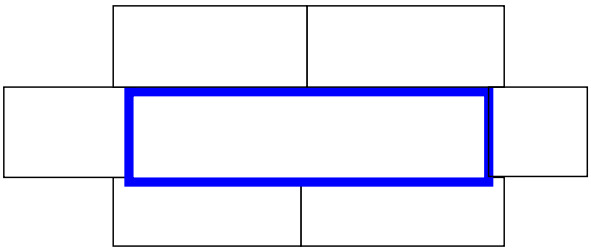

FIGURE 1 JUT Management and Monitoring System (JMMS)

The university requirements document generated by the consultant exposed the following problems with the current semi-automated system that was in use by then.

- Three systems existed side by side and were used to capture data on students. The FoxPro School System was used to capture and process data for professional students, MS Access system for capturing data on degree students, while MS Excel was used extensively to capture data that was not handled by either system. The lack of integration of data resulted in duplication of effort and problems in reporting.
- The systems used were limited in terms of the information captured. This resulted in some information being unavailable when needed and required tedious extraction from manual records when need arose.
- The systems were not trusted as there were many cases of corruption of data. This meant lack of integrity that resulted in the need to keep manual records just in case data was corrupted.

- The systems were supported by low-end database management systems (FoxPro and MS Access), which could not handle the amount of data and security levels expected for university systems that were used to manage student examinations.
- There were cases of duplication of records. Student's data was captured whenever the student applied for a different course. This resulted in duplication of students in the system and issuance of multiple student ID cards to students. This also led to duplication of students' debtors in both the FoxPro System and the Pastel Accounting System that was being used at the moment.
- The reports available from the systems were hard coded and limited in terms of their ability to provide adequate information to management.
- The FoxPro system captured all information on student billing and payments. The data was then exported into the Pastel System. This process was tedious and time consuming and fraught with problems.
- Lack of effective students' records management resulted in lack of effective control of the processes in the University including lack of effective tracking of payment of fees and the possibility of loosing money.
- Lack of appropriate management information resulted in inefficient management processes and frustrations of management staff of the University.

4 Selecting the System to Implement

After a thorough study of Strathmore university requirements, the university advertised for tenders. Five companies were short listed and using a 12 point criterion as depicted in Table 1, the tenders were analyzed and classified as either reject or accept.

TABLE 1 A12 point selection criteria for qualifying tenders for the JMMS project

	Criteria	**Points**
	Understanding aim of the contract	
1	Clear understanding of SUMMs modules	4
2	Concept of Implementation period	2
3	Benchmarks for acceptance criteria	2
4	Project module layout	2
	Total	10
	Project's Management structure and procedures	
1	Management/Development plan or schedule	3
2	Staff abilities	2
3	Self/Consortium	2
4	Source code availability for future maintenance	3
	Total	10
	Response to Tender Scope	
1	JMMs Priority Identification and costing	4
2	System Security	2
3	Platforms and number of concurrent users	2
4	Support and training	2
	Total	10
	Grand Total	30

5 Implementing the Academic Management System at the JUT

The consulting team was given one year in which they were to customize the Jingchu system to fit JUT needs in line with the documented user requirements.

The development team identified five main tasks with the Jingchu system that needed attention:

- Fully translate the system from Chinese to English;
- Develop an admissions module that was lacking in the JMM system;
- Adapt the system to JUT's diploma and degree evening courses that run on tri-semesters as opposed to semesters;
- Adapt the system to university examinations policy and guidelines;
- Adapt the system to the university fee payment plans;
- The Management Board formed two committees to work with SRCC towards meeting their objectives. The steering committee comprised heads of academic and finance departments and was chaired by Deputy Vice Chancellor (DVC) Academic Affairs and mainly dealt with policy matters. The functional committee was led by the director of ICT and comprised representatives from all affected departments. The functional committee met every week to monitor progress and communicate feedback to their heads. The functional committee submitted their findings every month to the steering committee for deliberation and direction. This approach allowed the involvement of all stakeholders in systems implementation with a high success factor.

6 System costs

It is hard to fully quantify all the costs expended on this project. The project is still undergoing further enhancements to integrate it with other subsystems mentioned in Figure 1 of the JMMS project.

A server was setup that supported Oracle 9i, the necessary tools such as PHP and Java were also acquired and the infrastructure was optimized for the project. Programming work then began on the system systematically addressing a module at a time. The admissions module was developed and tested, then the academic programme planning, the lecturer module, the financial module followed by examinations module and finally the mentoring module. Each of these modules were fully tested, files converted and integrated with existing modules before moving to the next module. Using the phased changeover made it much easier to handle training and system user resistance.

7 Challenges

The project experienced a number of challenges relating to user expectations, costs as well as project coordination. Users expected "a magic box" kind of a system that solved all their problems at a click of a button. It has taken a while to convince most of the users that system implementation takes long before it can reach the 100% efficiency mark. Incremental development approach of customizing the system required very good coordination and project management skills. This was provided by the consulting company (SRCC).

- Users had to adapt to a totally new system with a new way of working that required new skills. Continuous training has helped the university achieve this goal.
- There were high system development and training costs with part of the training being conducted in Spain. It is more difficult to plan accurately for system

customization because of the many unexpected eventualities that increases risk to failure. Maximum support and direction from top management helped minimize risks.

- There was need to change the existing IT infrastructure to support the system on a fully web based platform. The university increased the bandwidth and acquired other IT resources such as servers and computers for end users.
- It is often bureaucratic to change existing policies in an organization and yet some of the university policies needed to be reviewed and changed to allow automation of certain procedures. To deal with this challenge, the university set out a planned change management process that was addressed through change management seminars and workshops. These workshops also doubled as user involvement technique to verify the procedures of each department and hence minimize resistance to change, speed up implementation and improve quality.
- On-line academic management systems often pose security challenges especially with student examination management. Fortunately the system already had strong inbuilt security functionality.
- There were fewer local academic management systems that developers would benchmark their work in development. The problem was however addressed by the help we got from our partners in Spain and by using a phased changeover that facilitated learning from past mistakes.

8 User perception Survey

After the system had been in operation for a year, a user perception survey was carried out in November 2006 involving 8 administrative staff and 20 lecturers. The survey addressed system functionality, accuracy of data, eases of use, and learns ability, user support, system availability, work simplification, speed of processes and overall user satisfaction.

The analysis of results as depicted by the radar chart in Figure 2 showed that 56% of the users accepted the system while 24% felt there was need for further enhancements to the system. 20% of the users perceived the system as being satisfactory. The survey findings were considered as being below expectation by the Management. More user feed-back was collected and used to re-work on areas that required enhancements in completing the project.

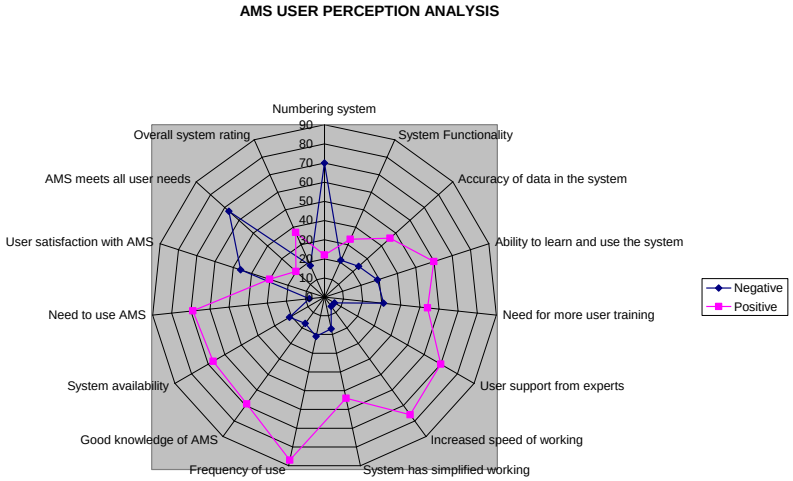

FIGURE 2 Summarized findings of the user perception survey of the AMS (adapted from the survey findings of JAMS 2012)

9 Achievements of the AMS project

The university ICT development policy is to encourage the use of open source platforms with the advantage of a wider expertise and user involvement at lower costs. In line with this policy, the university has since installed the KOHA library system and KUALI system for financial support. Though AMS is not fully open source, the university has unlimited access to the source code giving it the ability to customize the system in line with other users' needs. This will allow it to support other interested universities in the region. The Academic Management System at the university has since been completed and supports the following functionalities;

- The admissions module is complete and allows for both off-line as well as on-line admissions processing of applicants.
- Academic programme planning for all university programmes is complete, where courses are created and lectures assigned to courses to manage class attendance, student coursework and final examinations.
- Students can now self register for subjects in a given semester. The system then raises invoices based on the selected subjects. The invoices seen by cashiers in the system are then used to facilitate payment.
- The system allows students to query their debtor status on-line away from campus.
- The system can fully manage the examination process from the time the student enrolls to the time they graduate and produces both transcripts as well as certificates.
- The system can support the mentoring process by allowing the director of mentoring to allocate mentors and produce statistical reports on mentors. Mentors are

allowed to view progressively the academic performance of their tutees.

- The system is being enhanced to allow students to secretly view their performance on-line once the results are approved by the academic council
- Since installation of the system, users have experienced an increased improved level of benefits that include;
- More efficient and faster processes related to the entire student life cycle
- Greater management control in line with university strategic plans over the processes at the university that have resulted in higher performance in all areas.
- Increased customer satisfaction due to faster processing and accurate data capture and analysis
- Better performance in collection, management and reporting of student debtors.

10 Lessons learned

- Successful implementation of an Information System requires that one gathers detailed and accurate requirements. These requirements will help determine the level of quality in the system in line with Deming's definition of quality (Deming 1986), "quality is satisfying the user".
- It is important to formulate a strategic plan that gives a clear vision and mission of the areas to be automated. The university vision helped to identify who we are, where we are, where we wanted to go and how to get there. This guided the university in setting clear objectives for the academic management system in line with the university ICT strategy.
- It is important to involve users at all levels to reduce the possibility of system rejection or failure especially when major policy changes are inevitable.
- Change management procedures are important to allow for a shared perception of the change from all stakeholders.
- It is important that everyone including top management get committed to the project especially in areas of approval of funds and management direction.
- A modular approach to problem solving allows for gradual learning and appreciation of the system in a systematic format. Piecemeal delivery allows for stepwise learning that avoids mistakes at subsequent stages
- It is beneficial to foster strategic partnerships. The partnership the university has fostered with other institutions has brought a rich experience to the university.
- User training is important and is best when it is spread out through the development life cycle of the system. New users will join the institution and or new functions will be added that will require re-training of users.

11 Conclusions

The use of ICTs will become inevitable in institutions of higher learning and their successful installation will depend on strategic partnerships between such institutions. We have shared our experiences, challenges and lessons learned at university on selection and installation of economically viable ICTs.

Academic institutions with ICTs will benefit from improved efficiency, accuracy and speed in serving the customer as well as foster information sharing across them. This will in turn satisfy the customer and eventually create a competitive advantage over those without ICTs.

JUT has already partnered with some institutions in China to share their knowledge and expertise in developing and installing these systems. It is our intention that institutions of higher learning will not only use ICTs as end user tool but will strategically align their ICTs with their business objectives to maximize benefits.

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