Enterprise System Development in Higher Education

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EXECUTIVE SUMMARY

"One system for everyone" has been an ideal goal for information technology (IT) management in many large organizations, and the deployment of such systems has been a major trend in corporate world under the name of enterprise systems (ES) (Brown & Vessey, 2003; Davenport, 2000; Markus, Petrie, & Axline, 2000). Benefits from ES use are claimed to be significant and multidimensional, ranging from operational improvements through decision-making enhancement to support for strategic goals (Shang & Seddon, 2002). However, studies (Hanseth & Braa, 2001; Rao, 2000; Robey, Ross, & Boudreau, 2002) of the deployment of ES in private sector organizations show that the ideal is difficult to accomplish. This paper reports a case in which a major university system in the US attempted to develop an in-house enterprise system. The system is currently used by more than 4,000 individual users in almost 20 universities and state agencies. This case offers a historical analysis of the design, implementation and use of the system from its inception in the mid 1980s to the present. This case indicates that ES design and implementation in higher education are quite challenging and complex due to unique factors in the public sector — including state mandates/requirements, IT leadership/resources, value systems, and decentralized organizational structure among other things — that must be taken into account in planning, designing and implementing ES (Ernst, Katz, & Sack, 1994; Lerner, 1999; McCredie, 2000). This case highlights (1) the challenges and issues in the rationale behind "one system for everyone" and (2) some differences as well as similarities in IT management between the private and public sectors. It offers some unique opportunities to discuss issues, challenges and potential solutions for the deployment of ES in the public arena, particularly in higher education.

Keywords: academic administration IS; enterprise IS; information system implementation; organizational culture

ORGANIZATIONAL BACKGROUND

The Land Grant University System (LGUS) is one of the more complex systems of higher education in the nation. Currently, LGUS consists of nine universities, eight State agencies and a medical science center that serves over 100,000 students and reaches more than four million people each year through its service outreach mission. Research projects underway by system universities and research agencies total roughly $400 million. The system employs more than 23,000 faculty and staff members located throughout the state and serves all counties in the state. The annual budget for the LGUS is approximately $2.0 billion.

The state established its first college in 1876, and this marked the beginning of LGUS. During the 1970s and 1980s, LGUS experienced tremendous growth in terms of its major activities of teaching, research, and public service. The system experienced a 27% growth in its student population, and more growth was expected. In 1986, the system achieved recognition as one of the top 10 National Science Foundation (NSF) ranked research universities in the US. In addition to teaching and research, LGUS provided significant services to the citizens of the state through practical application of research-based knowledge.

At the outset of our case, in October 1988, LGUS consisted of four universities and seven associated agencies:

1. Central System Administrative Office (HQ) – the university system's headquarters;
2. Big Campus;
3. West Campus;
4. Southeast Campus;
5. South Campus;
6. Agricultural Research Station (ARS);
7. Agricultural Extension Service (AXS);
8. Veterinary Extension Service (VXS);
9. Engineering Research Station (ERS);
10. Engineering Extension Service (EXS);

Table 1: The Land Grant University System

The Universities	The Agencies	Health Science Center
• Big Campus (the largest campus) • West Campus • Southeast Campus • South Campus • Northwest Campus • Four other campuses	• Agricultural Research Station (ARS) • Agricultural Extension Service (AXS) • Veterinary Extension Service (VXS) • Engineering Research Station (ERS) • Engineering Extension Service (EXS) • Forest Service (FS) • Transportation Research Station (TS) • Wildlife Management Service (WMS)	• College of Dentistry (CD) • College of Medicine

11. Forest Service (FS); and
12. Transportation Research Station (TS).

In 1989, LGUS experienced another period of significant growth when three universities joined the system. In 1990, another university (Northwest Campus) joined the system. The growth continued, and in 1996, four additional institutions joined the system (two universities and two research agencies). In 1999, a medical center (MC) was established.

The LGUS itself is relatively new in comparison to many systems of higher education in the US. Many of the system's universities had long histories before joining LGUS, but have been part of the system for a decade or less. The units in LGUS also vary greatly in mission and purpose. Each unit has its own goals, traditions, and culture. The system values diversity and honors the principle that "one size doesn't fit all". Traditionally, there has been a decentralized culture within the system. Even though every unit is under a single umbrella, each is regarded as different and desires to maintain its uniqueness and independence.

SETTING THE STAGE

In the 1980s, three currents of change — technological, institutional and organizational — were gaining momentum in LGUS as well as in the US higher education as a whole. Together, the three forces set the stage for the emergence of the University System-Wide Management Information System (USMIS).

Technological Currents

The USMIS project cannot be properly understood without considering events in the computing industry in the 1980s. During this period, a number of new concepts and technologies, including model-oriented Decision Support Systems (DSS), query and reporting tools, On-line Analytical Processing (OLAP) and Executive Information Systems, emerged and were adopted by many organizations. These were all very attractive to organizations and their management, since they seemed to promise an increase in productivity and efficiency. In the 1980s these computer systems were mainframe-based. Building on the concept of Manufacturing Resource Planning (MRP) that was developed in the 70s and mid 80s, the idea of enterprise-wide software, today called ERP, spread rapidly through the vendor community, and SAP, Baan, JD Edwards, and PeopleSoft, among others, introduced major offerings in this area. The development of the SQL relational database management system in the late 1970s fostered the emergence of the concepts of enterprise-wide integration and enterprise software, which become popular among users that included private businesses and institutions of higher education. One vendor in particular, SCT, was prominent in the higher education sector. Established in 1968, SCT marketed a commercial student records system for higher education. In the 1980s, SCT began to promote the concept of enterprise software for higher education, and in 1989, SCT integrated an ERP system on RDBMS-Banner.

The initial sponsors of USMIS — top officials of Big Campus and the HQ who later served on the IT steering committee — were aware of these technology trends and planned to develop an enterprise information system. The system was intended to support not only financial management but also other administrative functionalities, including contracts and grants management, purchasing, office automation and communication, cashiering, requests for travel advances, enterprise and departmental accounting, state interfaces, ad hoc reporting, and information management. They also planned to create a centralized staff (later called the MIS project team) to develop and maintain this ERP so that each unit would no longer need to dedicate computer/information systems personnel to support its financial information systems. The initial sponsors believed that, with centralized IT staff, modification of LGUS accounting systems to respond to environmental changes such as new state laws and regulations could be handled efficiently and uniformly. This would eliminate multiple, difficult-to-integrate versions created by each unit, as was required by fragmented pre-USMIS systems. One large-scale information system for all units was a very attractive idea to the senior administrators of LGUS.

Calls for increased efficiency and productivity had found expression in a variety of changes in many college and university business and finance programs and practices (Jonas et al., 1997). The LGUS IT plan submitted to the state in 1984 stated:

The application of modern automated information systems' technologies to the solutions of fiscal and administrative problems ... LGUS will continue to take advantage of new technologies to increase efficiency and effectiveness in fiscal operations, administration, programming, and communication.

Prior to the USMIS project, there had been two major IT initiatives: BPP and SIMS. The Budget/Payroll/Personnel (BPP) System is an integrated data management system for human resources, payroll, and personnel operating budgets. The primary users are the administrative functions supported by the LGUS. The design concept for the BPP system was developed in the mid-1970s, with full implementation occurring on July 1, 1979. The BPP system was developed using COBOL and IBM's Information Management System (IMS) data management software. Data from BPP could be electronically transmitted to the State Comptroller's office in batch mode, thus offering the state better oversight of LGUS. By 1986, the Student Information Systems (SIMS) project had also been implemented. The SIMS supports administrative processing of student records for Big Campus and South Campus. The system uses Software AG's ADABAS as the main database system. The main development languages are COBOL and NATURAL. The SIMS later played an important role in USMIS design.

Organizational Currents

During the two decades from 1970 to 1990, the LGUS grew rapidly, attaining an annual budget of $800 million. The LGUS Board of Regents and system administrators felt a pressing need for consolidated information to facilitate coordination and control among (and over) member institutions. However, the existence of separate financial

management systems supporting diverse accounting rules and practices throughout LGUS created a major barrier to enterprise-wide integration. In the mid-1980s, the business offices of the 11 units of LGUS were employing 11 different financial accounting systems. Most were modified versions of an in-house accounting information system developed by Big Campus in the 1970s. Departments within each unit had also developed or purchased their own departmental accounting systems. These functioned as shadow information systems, running in parallel with the main financial systems in each unit.

In the mid-1980s, the President and financial officers of Big Campus initiated a project to develop a large-scale fiscal and administrative information system with capabilities for decision support, executive reporting, online purchasing, budgeting and planning, investment management, and streamlined integration across departments and colleges, among other functions. Initially their idea was to develop this system solely for Big Campus. LGUS administration was impressed by this plan and decided to expand its scope to include all units of the system. One highly-placed administrator at Big Campus commented that this was the most significant change in the history of USMIS. It was a change that later created many political issues and fostered resistance from other units.

Two considerations drove this change in scope. First, there was the issue of development cost. The initial acquisition cost for the Big Campus information system was expected to be over $1 million. At the time, this seemed too high to justify for only a single university. An enterprise system that would serve all units in LGUS was an appealing idea to Big Campus because it would enable the cost to be distributed among all units. Second, the development of an "integrated large-scale fiscal and administrative information system" was part of LGUS's strategic plan, and the expanded enterprise system was viewed by LGUS administration and the Board of Regents as a means of pursuing this plan.

Institutional Currents

Institutional forces also influenced the development of USMIS. In general, public organizations have more legal restrictions on their actions than those in the private sector (Guy, 2000). During the 1980s and through the 1990s, state after state mandated more stringent reporting requirements and accountability for higher education (Ernst et al., 1994). And such a mandate seemed necessary for LGUS. In the early 1980s, State auditors found that several units in LGUS had not followed proper fiscal procedures and that there were inconsistencies in the way the various units reported financial transactions on their annual financial reports.

The use of automated information systems by governmental bodies had strong support in both the legislative and executive branches of the state. Information systems were viewed as a means to improve productivity and efficiency. Financial information systems in particular were regarded as a means to improve coordination, integration and control. Legislators and administrators also believed that a uniform information system could help ensure that state-mandated changes in accounting and other procedures were implemented quickly and uniformly and followed faithfully throughout the state.

In 1987, the legislature mandated the State Comptroller's office to develop a Unified Statewide Accounting System (USAS) for the collection and reporting of statewide

payroll and personnel data. The USAS was intended to meet state agencies' general accounting requirements and thus reduce the number of separate accounting systems. In fact, the ideal scenario would be to have a single financial information system based on USAS which would replace all current financial information systems. However, cooler heads recognized that in reality this was not feasible because of the variability among state agencies in terms of their size and the diversity and uniqueness of their needs. Thus, the Comptroller's office proposed two approaches for state agencies: Either use USAS or maintain your own information systems and interface them with USAS. The latter approach was selected during discussions between the USAS development team and LGUS. This requirement offered a compelling reason to replace existing in-house computer systems with a large-scale fiscal and administrative information system. The USMIS project was welcomed by the USAS project team since it was expected to provide the Comptroller's office with a single channel to communicate with all LGUS units.

These technological, organizational, and institutional currents led the LGUS Board of Regents and chancellor to recognize the strategic role information systems would have in the future of LGUS. They delivered a directive for the development of USMIS that was aimed to insure compatibility and consolidation of accounting and fiscal information, analysis, and reports from all system units. The challenge now was to build it.

CASE DESCRIPTION

Overview

First introduced in 1990 for Fiscal Year 1991, USMIS is an enterprise information system that incorporates financial regulations applicable to the units of LGUS. It integrates 30 databases that function as a unit across five independent modules or subsystems, including a financial accounting system, a purchasing system, a fixed assets management system, a system for sponsored research accounting, and annual financial reporting. The MIS project team has been responsible for the development and support of USMIS since the late 1980s. This team reports directly to the Department of Information Resources (DIR) within the central system administration office (HQ), the DIR in turn reports to the Office of the Vice Chancellor for Business Services who is under the Chancellor, the highest ranking officer of LGUS.

Design Process

The director of the MIS project was hired in October 1987. In November 1987, a survey questionnaire was distributed to all of the units of LGUS and the major departments within each unit to solicit input on their management information system needs. The survey demonstrated wide agreement on the need for substantial improvements in financial accounting management information within LGUS. In March 1988, an implementation team to work on the development of the USMIS was formed. The core members of the team were four senior systems analysts, three of whom had worked on

Table 2: Options for System Design

1. Install a system currently in use at another institution of higher education within State
2. Use the Uniform Statewide Accounting System
3. Install a public domain software accounting system from out-of-State that could be altered to fit the LGUS system's needs
4. Install a general purpose commercial system and adapt it into a college, university, and agency accounting system
5. Install one of the systems currently in use within the LGUS and tailor it to meet the system's needs
6. Do nothing at all
7. Design and develop a system in-house
8. Install a college and university financial system that was designed and written by an outside vendor, with no modifications to the package
9. Modify and enhance a packaged system purchased from a vendor specializing in college and university systems
10. Install a college and university financial system designed and written by an outside vendor but enhanced and modified to meet the LGUS requirements and the Uniform Statewide Accounting System and other State requirements.

SIMS project since 1979 and one of whom worked for the CIS department at Big Campus.

The team's first task was to interview approximately 75 key users. The interviews resulted in the compilation of a Needs Inventory, the baseline requirements for LGUS. Ten alternative approaches to satisfy these requirements were investigated (Table 2).

The team made site visits to other universities and conducted detailed evaluations of existing information systems. Option #10 was selected on the basis of functionality, risk, time to implementation, flexibility, LGUS policy, interface/state, user involvement and technology. According to the former director, the MIS project team was asked to complete the project in one year, which was regarded as a reasonable time frame. The team was required to make regular progress reports to the steering committee, which consisted of 11 top administrators representing the units of LGUS and the Board of Regents.

In June 1988, the team prepared a requirements document which formed the basis of the Request for Proposal (RFP). In October 1988, the team submitted a 300+ page Advanced Certification Document for the USMIS to the state's Automated Information and Telecommunications Council (AITC) for approval. In the same month, the RFP was finalized, and in November, the team received the state AITC approval to purchase a software package.

Following the evaluation of vendor proposals, a contract was signed in 1989 with Information Associates for the Software AG NATURAL/ADABAS version of the Financial Records System (FRS), a popular financial information system among colleges and universities. This represented a three-way agreement among LGUS, Information Associates, and Software AG. LGUS requested this agreement in order to acquire a NATURAL/ADABAS version of the COBOL-based FRS. It was redesigned and re-engineered using NATURAL, Software AG's fourth generation language and the ADABAS data management systems. The redesign of NATURAL/FRS was completed in 1991.

This redesign of FRS was necessary in order to bring it into line with existing information systems and the Big Campus computing environment. As previously noted,

in the mid-1980s, Big Campus made two major information system procurements to support administrative computing: SIMS (the Student Information Management System) and an IBM 3090-200E mainframe. The system underlying SIMS was purchased in 1984 and implemented by 1986. It included processes supporting admissions, registration, student financial aid, billing, grading, transcripts, degree audit, and loan repayment. The system employed Software AG's ADABAS as the principal database system and COBOL and NATURAL as development languages. This procurement cost over $1.6 million. The project was also committed to NATURAL because its system analysts and programmers were trained and experienced in NATURAL from their work on the SIMS project. USMIS also had to utilize the IBM 3090-200E mainframe computer, which was purchased and installed in August 1987 and cost over $8.2 million. This commitment was further solidified by an upgrade to an IBM 3090-400E, planned for 1992. Existing information systems served as critical constraints on the project.

These commitments combined with time pressure from the Board of Regents and the steering committee to produce a rather restrictive development environment. The former project director noted that:

... [p]eople (users) had little tolerance for changing. Flexibility does not mean much to users. It is not something what users want. They want what they are familiar with, so we tried to do as few changes possible ... IS implementation has to be fast. A reasonable time for system implementation to me is one year. Why? Because key players leave and are changed. That's a big problem. You lose focus and then give up.

In late 1988, the administrators of LGUS, Big Campus, and other units grew concerned about delays in the implementation of USMIS. This increased time pressure on the MIS team. Final vendor selection, completed in April 1989, increased confidence that USMIS would be implemented in a meaningful way. After modification of the purchased software package, USMIS went live with the FRS subsystem for three units — Big Campus, HQ, and VXS — in September 1990 for the fiscal year 1991. In September 1990, the Sponsored Research (SPR) subsystem went live with limited functionality. In September 1992, the Fixed Assets (FFX) subsystem went live for four campuses and two research agencies. In 1993, the purchasing system went live for LGUS, and in 1998, the Annual Financial Reporting (AFR) system went live. Following are some of the major milestones for the project:

- 03/88 - Hiring of four Senior Systems Analysts for the Project;
- 06/89 - Contract signed with Information Associates for the Software AG NATURAL/ADABAS version of the software;
- 09/89 - Hiring of four entry-level programmers;
- 11/89 - Initial code delivered;
- 09/90 - System went live with FRS (Financial Record System) and FAR (Accounts Receivable) for three units;
- 09/90 - SPR (Sponsored Research) module went live with limited functionality;

- 09/93 - Commence implementation of first phase of purchasing module at Big Campus Purchasing Department (Requisitioning and Purchase Orders); and
- 02/98 - Commence Budget Module implementation.

Implementation Process

Implementation turned out to be the most difficult task in the development of USMIS. At the outset, the MIS project team and the initial sponsors expected that full implementation of USMIS would take four years. The initial projection assumed an implementation schedule as follows:

- Year 1 – Implementation in Big Campus (Fiscal Year 1990-91);
- Year 2 – Implementation in a second university and one research agency;
- Year 3 – Implementation in a third university and a second research agency; and
- Year 4 – Implementation in the entire LGUS.

As this schedule indicates, the goal was for USMIS to be implemented in all units of LGUS. The advanced certification document explicitly stated the importance of the "full implementation" to realize substantial savings and the many benefits that would follow from USMIS. The initial position — set by the chancellor and Board of Regents of LGUS — was that no waivers of this requirement would be allowed and that no other option for financial management would be offered other than use of USMIS.

In pursuit of this goal, the MIS project team visited each member's institution and informed them of the mandatory nature of implementation for all units of LGUS. However, when Chancellor Jones left LGUS, his successor, Chancellor Smith, decided that implementation of USMIS would be optional, rather than mandatory. Changes in implementation policy, discussed in more detail in the following text, undercut the MIS project team's ability to hold to the schedule. Additional complications were introduced by local politics, leadership changes, resistance from some units, state-mandated rule and policy changes, user requests regarding system maintenance and enhancements, and lack of resources. The diffusion of USMIS through LGUS actually occurred as depicted in Figure 1.

Several of the issues faced by the MIS team have much in common with the experiences of enterprise system development in private sector organizations (Brown & Vessey, 2003; Davenport, 1998; Robey et al., 2002). However, the contexts of IS management in the public sector and in higher education pose unique challenges and also intensifies some traditional private sector problems. Research on public organizations and management indicates that there are some differences between public and private sector organizations in terms of goal complexity, authority structure, accountability, and the role of rules and regulations (Allison, 1983; Guy, 2000; Rainey, Backoff, & Levine, 1976). Research on IT in the public sector also indicates differences in IT management and planning between private and public sectors (Dufner, Holley, & Reed, 2002; Gauch, 1993; Mohan, Holstein, & Adams, 1990; Rocheleau & Wu, 2002). Furthermore, re-

Figure1: USMIS Transition Schedule
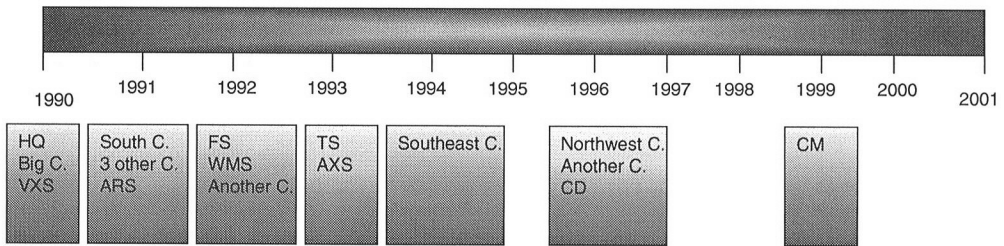
Note: C. denotes campus.

search on strategic planning and IT management in higher education indicates that the contexts of IS planning, development, implementation and use in higher education differ from those in private entities (Ernst et al., 1994; Lerner, 1999; McCredie, 2000). Interviews pointed to four major categories of challenges and issues that have significantly affected the USMIS over the years.

1. Politics and Organizational Resistance to Change: The Battle

The value system in higher education differs from that of the business arena. The guiding principle of the university — long term investment in the educating of citizens — is different from the business's bottom line approach. Unlike the business model, which generally emphasizes a management-driven approach, university management is based on shared governance by faculty and administrators that is for the most part temporarily drawn from the ranks of faculty. A university is a loosely-coupled system in which units and employees recognize the need to work together for a mutually beneficial future, but understand that their differences will often create tensions (Lerner, 1999).

Initially, units of LGUS had two sorts of reactions to USMIS. The smaller universities and agencies, which lacked computer and financial resources, were relatively favorable toward USMIS, since it provided them with an interface with the State's Comptrollers' office, a legislated requirement. However, other units were more negative. Despite the fact that they realized the need for consolidated reports for system level management, they preferred to use their own financial systems and interface them with USMIS.

For example, one campus had just developed a new student information system and a financial information system and did not want USMIS. Two research agencies — Engineering Research Station and Engineering Extension Service — were strongly against USMIS adoption. They advocated the need for maintaining their own information systems based on two arguments. First, they pointed out functional deficiencies in USMIS to support their needs for contract and grant management and other research related functionalities. Their second argument was that as engineering agencies they differed from other units in LGUS.

The Engineering Research Station in particular rejected the vision of "one system for everyone" and expressed concerns about USMIS. Top administrators and the IT manager of engineering research argued that USMIS was inferior to their own computer system, which was based on the Oracle database. During vendor selection in 1988, the MIS project team was less interested in a brand new system, but searched for a system compatible with existing information infrastructure (Star & Ruhlender, 1996), including SIMS, NATURAL, ADABAS and IBM 3090-200E. Engineering research had advocated a different alternative, SCT using Oracle DB. The MIS team argued that SCT was a riskier choice than Information Associates, exhibiting an attitude toward IT planning characteristic of the public sector. In general, public sector organizations tend to be more cautious and more concerned with rules and regulations, whereas private organizations tend to be more comfortable with risk (Bozeman & Kingsley, 1998). Competition is much less significant in the public sector, which tends to be concerned with service delivery and continuity, as well as with protecting the public interest (Rocheleau & Wu, 2002). The view of IT in private and public organizations also tends to be different. For the public sector IT is not a proprietary resource to be exploited for competitive advantage (Dufner et al., 2002), but more often is regarded as a cost-cutting device, a way of doing more with the same number of staff (Rocheleau & Wu, 2002). Risk avoidance is evident in public IT management (Mohan et al., 1990).

Engineering research also argued that the MIS team and steering committee initially designated research (e.g., research contract and grant management subsystem) as a low priority in the implementation plan. A top administrator of the engineering research agency insisted that "we will be asked to pay for a system we do not need nor want. We will be asked to pay for a system that at the very best will be mediocre." A top administrator of a different research unit emphasized the importance of autonomy and distinctiveness in LGUS in a memo to the HQ:

*It is important to clarify the directives of the LGUS Board of Regents ... **Centralization** seems to be effective in smaller state systems with less diversity of missions. But the size and complexity of LGUS make centralization a formidable task at best ... Traditionally, the HQ had maintained a very workable interpretation of its role by providing overview and governance where a global perspective is necessary and where shared services reap benefits to the LGUS members. But the autonomy of the System members to exercise their authorities and means in order to do a good job is one that members have long cherished. In my opinion, the current USMIS **philosophy** threatens the traditional role of the HQ and threatens to share service even when such services are costly to some system members. Such a change in philosophy could not be implemented overnight. If such as a change was in order, then it should be communicated as such and simply not be the results of the [USMIS] initiative ... the **autonomy** of the LGUS members is their strength and their means of attaining their goals.*

Most respondents recognized the conflict between these agencies and the MIS project team and HQ over the issue of USMIS adoption. They referred to it as "The Battle". The result of The Battle was that in 1995 two units, engineering research and engineering extension, and the newly joined Northwest Campus were officially allowed to establish an interface with USMIS rather than adopting it as their primary system.

2. Top Management Commitment: Leadership and Politics

The Battle was tightly interwoven with changes of leadership in the system. Among many events in the history of USMIS, the resignation of the former director of the MIS project team had significant impacts on the process of USMIS implementation. The former director had been in charge of the MIS team from the beginning in 1987 and left LGUS on July 1991. His resignation caused serious problems in the continuation of USMIS implementation. A second leadership related event compounded the difficulty of USMIS implementation. One of the initial sponsors of USMIS, the Executive Deputy Chancellor, left LGUS. This loss of two key sponsors led to a loss of direction in the implementation effort. These departures made it more difficult for the MIS team and LGUS leadership to resist the efforts of units that wanted to opt out of USMIS.

Another complicating factor was change in chancellors. From 1986 to present, there have been five chancellors. Each chancellor had different visions for USMIS, and these had significant impacts on USMIS implementation (Table 3). One interviewee noted that "Every time a new chancellor is in office, things change. USMIS shifts depending on who the chancellor is at that time. The vision of chancellor is a powerful influence."

The MIS project was officially established during Chancellor Smith's regime. The chancellor and the board were very supportive of USMIS design and implementation. He strongly supported a mandatory policy for USMIS implementation. In 1990, three units implemented the USMIS as it went live.

In 1991, Chancellor Jones, formerly the Deputy Chancellor for Engineering of Big Campus, assumed office. One of the initial sponsors of USMIS noted that:

Chancellor Jones initially saw USMIS as bad, and I had to convince him not to stop what we had done so far. After becoming the chancellor, he changed his view a little bit and put his foot on both sides (us and engineering). He tried to take a neutral position but understood the engineering side more. That's why the two research agencies could avoid using USMIS.

Unlike the first chancellor who advocated USMIS, Chancellor Jones was not as strong an advocate of USMIS, and this weakened pressure for implementation. During

Table 3: Policy of USMIS Implementation and Change of Leadership

Chancellor	Background	Term	Policy on USMIS Implementation
Smith	Formerly Dean of College of Agriculture at Big Campus	1986-1990	Mandatory
Jones	Formerly Dean of College of Engineering at Big Campus	1991-1993	Favorable to engineering agencies and neutral toward USMIS
Brown	Formerly President of Big Campus	1993-1994	Mandatory
White	Formerly President of Northwest Campus	1994-1999	Favorable toward Northwest Campus and neutral toward USMIS
Green	Hired from outside	1999-Present	No Interest

Chancellor Jones's term implementation of USMIS was widely regarded as optional. However, the HQ and the MIS team continued to push for adoption. In 1991, six more units of LGUS became users of USMIS, and in 1992, three units implemented it.

The optional status for USMIS implementation changed dramatically when Chancellor Brown, formerly President of Big Campus, took over. Brown had been on the steering committee of the original MIS project at Big Campus and thus was very supportive of USMIS. He made implementation mandatory again and announced that all units must be on USMIS. This led to conflict between HQ and the MIS project team and those units that wanted to avoid using USMIS. A top IT administrator at one university campus recalled that "it was not a happy time for everyone".

However, Chancellor Brown's term lasted for only one year. In 1994, the Board of Regents appointed the president of the newly added Northwest Campus as the fourth chancellor during the period of LGUS implementation. Chancellor White stressed the importance of uniqueness and autonomy of each university and agency in LGUS. While White was not against USMIS implementation, he decided that units could choose not to use USMIS. Notwithstanding, acceptance of USMIS continued to spread. During Chancellor White's term of office, all units except the two engineering agencies and the chancellor's former university implemented USMIS as their primary financial and accounting system.

This led a number of those involved in the development and implementation of USMIS to believe that USMIS implementation was very "political." Several respondents said, "If you want to understand USMIS implementation you need to see how politics has played over time in the history of USMIS ... A lot of local politics was played in USMIS adoption ... Politics was very powerful in the implementation of USMIS."

While the importance of top management commitment for large IT projects in the private sector can never be overstated (Brown & Vessey, 2003), the complex, often discontinuous, and fragmented power and leadership structure intensifies the challenge in obtaining continuous top management commitment in the public sector (Watson, Vaught, Gutierrez, & Rinks, 2003). In the private sector, the process of setting objectives and carrying them out are closely integrated, whereas in the public sector these processes are loosely coupled (Rocheleau, 2000). The loosely-coupled structure of public organizations impedes consideration of operational issues at the time objectives are established. For example, an objective might be "management information systems that will insure compatibility and the ability to consolidate accounting and fiscal information, analysis, and reports from all system units". When elected top administrators negotiate to set objectives such as these, feasibility and operations aspects may not be fully considered (Dufner et al., 2002). Detailed IT issues and related topics have often not been considered relevant for consideration by university presidents or chancellors (Ward & Hawkins, 2003). Experience with developing EIS shows that "In the private sector, once the chief executive wants an EIS, it will move. In the public sector, wanting is not enough. Movement can stop at any of a number of stages" (Mohan et al., 1990).

3. Rules and Regulations from a Public Constituency

Public organizations have many legal restrictions on their actions and operate under public scrutiny (Guy, 2000). Higher education faces calls for increased accountability and regulations imposed by multiple social institutions and governing bodies, including legislators and Generally Accepted Accounting Principles (GAAP) (Ernst et al., 1994; Jonas et al., 1997).

In the 1980s and 1990s, several state audits had shown deficiencies in LGUS and other universities, and many new rules and policy changes were mandated by the state. These were very influential in the design and implementation of USMIS. The USAS that went into effect on September 1, 1993 for a number of small state agencies has been influential in the maturity stage of USMIS implementation. Since this date, all units of LGUS had to report information to the central USAS database daily. This database, controlled and managed by the State Comptroller's office, was designed to maintain accounting data consistent with GAAP and National Association of College and University Business Officers (NACUBO) standards. The system provides accounting services to all state agencies using a *uniform* chart of accounts. Also, USAS reflects any changes in the state legislatures and policy. Thus, in the implementation and maintenance of USMIS, priority had to be given to processing requirements and maintenance requests that were mandated by law or policy changes.

For instance, in 1999, the Governmental Accounting Standards Board (GASB) Statements No. 34 and No. 35, "Basic Financial Statements" and "Management's Discussion and Analysis for State and Local Governments and Public Colleges and Universities," were issued. For the first time, accrual accounting was required for all government activities and all capital assets had to be depreciated. Starting in fiscal 2002, the state is required to implement these new rules. In response to this requirement, USMIS had to develop depreciation capabilities to report the depreciation of fixed assets. Priority had to be given to these sorts of mandated requirements and policy changes rather than user requests.

USMIS was also required to respond to state auditors' recommendations of management controls. The sate audit report in 1995 pointed out that USMIS did not provide useful information at the departmental level. USMIS responded to the audit's recommendations in a number of ways. Immediately after the state audit the MIS team began the implementation of departmental download capability. LGUS finalized licensing agreements for a software package that allowed end users to download USMIS data to their microcomputer environments so that data could be processed to meet the end user's needs. In 1998, USMIS began the implementation of budget and automated Annual Financial Report (AFR) subsystems. Recently, there has been an effort to convert the BPP system to the same processing environments (ADABAS) as the USMIS system in order to develop the interface between the two systems.

4. Diversity of Internal Constituencies and Their Needs: No CIO?

Like other public organizations (Guy, 2000; Rainey et al., 1976), LGUS serves a large number of constituencies whose goals and needs are diverse and sometimes even

compete with one another. As the original objective of USMIS — one IS for everyone — indicates, USMIS was directed by a desire for centralization. The Board of Regents and the initial sponsors of USMIS believed that one IS for all units in LGUS was desirable and could be realized. However, as the design and implementation were proceeding, the size and diversity of LGUS emerged as a critical issue.

Every unit had its own chart of accounts, and the accounting practices throughout LGUS were very diverse. Few wanted to change their accounting. Some feared losing control. USMIS had to adapt to the diversity of their accounting practices. Also each unit had different priorities. For example, the research agencies required contracts and grants/research accounting capabilities in order to administer programs and to assure compliance on sponsored research projects. Big Campus, which had initially made a significant investment in the acquisition of the software package for USMIS, used this leverage to request that many other functionalities and subsystems (e.g., purchasing, department-level accounting, and administration) be added into USMIS.

The diversity of needs and requests and their sheer number resulted in problems in attaining the full design and implementation of USMIS. According to the state audit report in 1996, as of 1995 there was a backlog of over 250 user requests for system maintenance and enhancement, some of which dated back to 1990 and 1991. From September 1995 until June 1996, the USMIS support staff had completed 219 service requests. During the same period, an additional 271 maintenance items were identified by various system users. Similar to the situation in the broader public sector (Mohan et al., 1990; Rocheleau & Wu, 2002), most academic institutions have a shortage of IT related resources and skills for user-support and system maintenance (Ernst et al., 1994).

Needs at the top of LGUS also forced the MIS team to adapt. One of the original objectives of USMIS was to provide the capability of executive information systems to meet the information needs of system-level users, such as the Board of Regents and the Central System HQ. However, the 1996 state audit of management controls at LGUS pointed out the lack of a comprehensive management information system. The report recommended that:

System management should reevaluate the overall intent and purpose of USMIS and how best to meet the management reporting needs of the board and executive management. Consideration should be given to the depth of accounting functions that USMIS will provide, including general ledger, project accounting, and management reporting. Alternative methods for meeting management reporting needs should be fully identified and evaluated.

To respond to the recommendation that alternative methods be adopted, LGUS initiated the data warehousing project to develop an executive information system, rather than altering USMIS. This system went into operation in 2000. The system is loosely-coupled with USMIS and other systems at Big Campus and the system-level. Also, there are several other needs that USMIS does not support such as departmental financial management and reporting. Thus different parts of LGUS had developed or purchased "shadow information systems" to make up for the deficiencies of USMIS to meet their specific, local needs.

Until 1991, the 11-person steering committee, composed of members from universities' fiscal management, system units, and the MIS team, set priorities for development. Starting in late 1991, a different committee consisting of the five top administrators from the university fiscal management, HQ and the USMIS team, took on this task and tried to set priorities for USMIS. However, the complex and interwoven elements in USMIS design and implementation made it difficult for the group to perform this task. This is partly because every unit in LGUS, including Big Campus, wanted their project to be the top priority. However, it was difficult to manage prioritization because the group did not have the same authority as a CIO in the corporate world. Public managers tend to have less authority over subordinates and less decision-making autonomy (Rainey et al., 1976). A top IT administrator in LGUS commented:

Higher educational institutions differ from the private sector as far as IS is concerned. The university is governed by committees so the attitude is "convince us" of why we need such an information system. Therefore design and implementation become tougher. There is a lot less commitment by members.

Since 1991, the MIS team's position has been that priority was to be given to those projects that result in improved reporting and/or processing for all users of USMIS. With the recognition of the diversity of LGUS the MIS team adopted a "customer-oriented" rather than "enforcing" approach and tried to accommodate different needs of different members. The diversity of LGUS led the MIS project team to design an "average" system for all units, no matter whether they were large or small universities or research agencies, while different parts maintained "shadow systems" to meet local needs not satisfied by USMIS. The research agencies over that USMIS is for universities, not for them, while the smaller universities say it is too big for them. Reflecting on this, a key initial sponsor of the project commented "one system for everyone is nothing for nobody."

CURRENT CHALLENGES & PROBLEMS FACING THE ORGANIZATION

As finally-realized, USMIS diverges considerably from the grand vision of the project initiators and the Board of Regents. The final system is not the fully integrated large-scale information system the MIS team set out to build, but it has certainly served critical functions for LGUS. After more than a decade of service, USMIS is now regarded as an aging legacy system. Currently LGUS and the MIS project team face the same three sets of forces — technological/functional, organizational and institutional — which demand important decisions and actions on the future of USMIS. The critical question is whether USMIS needs to be replaced or extended; if extended, in what way; if replaced, when is the right time and by what?

Technological Issues

Aging administrative, financial information infrastructure is one of the most critical challenges to universities today (McCredie, 2000). Functional pressures that raised doubts about the instrumental value of USMIS came from both inter-organizational and environmental levels. At the inter-organizational level, different user groups had pointed out functional deficiencies with USMIS. At a more general level, users complained that USMIS was not user friendly, did not utilize advanced databases, and had slow response time. At the environmental level, the emergence of new technologies such as GUI, fourth generation programming languages, and client-server architecture led to functional pressures. More recently, there have been some other functional pressures due to changes in the environment. For example, the industry has clearly moved to embrace SQL as the standard query language. SQL databases like Oracle and Microsoft SQL Server are becoming much more popular than ADABAS. Also it is very difficult to find programmers familiar with ADABAS. Currently LGUS is engaged in an effort to replace SIMS, the payroll system, and the human resource system with an ERP, which is expected to cost approximately $35 million. This project is becoming another source of technological/functional pressures to either replace USMIS with an ERP or significantly enhance it through utilizing web technologies. Most recently, the project team is considering the utilization of middleware technologies such as the EntireX Broker for web-based services for USMIS.

Organizational Issues

Given the state of the US economy in 2003, the number-one IT-related issue in higher education is funding (Crawford & Rudy, 2003). LGUS is no exception. Considering the magnitude of the ERP project, LGUS has concluded there is no way to replace USMIS in the short term. Key decision makers noted that people agree that "USMIS plays a large role in reporting to the state ... USMIS works." However, a backlog of requests for functional improvements from departmental and individual user groups and cumbersome user interfaces ("Green Screens") are acknowledged as major issues. Currently, the organization has decided to keep the legacy system, but the remaining question is for how long? And how can the USMIS be extended and renewed to meet new users and business requirements? Another issue may arise when LGUS decides to replace USMIS in the future. A top administrator commented:

Some people have been talking about the replacement of USMIS, but they don't know what they are talking about. In my opinion, they have no idea of the complexity and scope of USMIS. If they knew it they would never talk about the replacement of USMIS. You know what? **USMIS cannot be easily pulled back. It has its own life!***"*

In the late 1980s and early 1990s, USMIS was recognized as an alternative to the individual systems running in different units of LGUS. However, USMIS is now perceived to be part of the installed base, something that is exogenously given and resistant to willful change.

Institutional Issues

Institutional pressures have come from the state and the higher education community. Over the last decade, the state audit reports pointed out several limitations of USMIS, including lack of departmental support and reporting capabilities. They have questioned the appropriateness of further developing and maintaining USMIS since the mid-1990s. As an example, the state audit report of 1996 recommended that:

System management [of LGUS] should reevaluate the overall intent and purpose of USMIS and how best to meet the management reporting needs of the Board and executive management ... Implementation of USMIS at other system components should continue to be delayed until decisions are reached about the overall intent and purpose of USMIS ...

In addition to the state, the recent trend of deploying ERP in higher education is another powerful institutional pressure. Today information technology is increasingly becoming important for higher educational institutions to remain competitive (McCredie, 2003). ERP implementations are among the single largest investments in dollars and resources ever made by higher education institutions. Almost half of the major universities are using ERP systems. Of those that have not implemented an ERP, 10% are currently or will implement in a year, and an additional 25% are expected to do so within the next three years (King, 2002). A member of the steering committee for replacing SIMS with an ERP estimates that the replacement of USMIS will cost almost $50 million.

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APPENDIX

- **Information Associates:** The Information Associates software, a company based in New York State, is now owned by the SCT Corporation (www.sct.com) since 1992.
- **Software AG NATURAL/ADABAS:** Launched in 1979, NATURAL now has an installed base of more than 3,000 corporations. It was designed specifically for building mission-critical applications. Natural applications support many leading platforms and can be integrated with many major database systems (ADABAS, DB2, Oracle, etc.). Developed in 1969 by Software AG, ADABAS is a popular database management system, which is currently installed on many organizations including FBI, EPA's Office of Information Resources Management, UPS, Merrill Lynch, and University of Texas.

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