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# Client - Serve Yourself

**Sorel Reisman, California State University, Fullerton, USA**
**Roger G. Dear, California State University, Fullerton, USA**
**Amir Dabirian, California State University, Fullerton, USA**

*Dr. Sorel Reisman is a professor of Management Science and Information Systems in the School of Business and Economics and is Coordinator of Academic Technology for California State University, Fullerton. Dr. Reisman is a member of the Publication Board of the IEEE Computer Society, editorial board member and columnist of Perspectives in the new IEEE publication, ITPro. Dr. Reisman's publications focus on hardware, software, systems, management issues and methodologies. His recent publications include the book, Multimedia Computing; Preparing for the Twenty First Century, and papers on cost/benefits of software engineering, computer platform conversion, and mainframe to client/server migration.*

*Amir Dabirian is a part time lecturer of Management Science and Information Systems in the School of Business and Economics and is Head of Systems and Information Technology in the University Library for California State Unviersity, Fullerton. Mr. Dabirian received B.S. degree in Electrical Engineering from California State University, Fullerton in 1984, a M.S. degree in Electrical Engineering from California State University, Fullerton in 1988, a M.S. degree in Computer Science from University of California in 1998 and is currently a Ph.D. student at University of California, Riverside. His research interests are self-similar network traffic and the challenges of information technology.*

*Dr. Roger G. Dear is a Professor of Management Science/Information Systems in the School of Business and Economics at California State University, Fullerton. Dr. Dear received his Ph.D. in Operations Research from Massachusetts Institute of Technology's Department of Electrical Engineering and Computer Science in 1976. His research interests include database management systems, computer simulation, sequencing and scheduling, and queueing theory. Dr. Dear has published numerous research papers such topics as protocols for availabiliy, reliability, and consistency of replicated files, and strategies for managing platform conversions. Dr. Dear is a member of numerous professional organizations including the Association of Information Technology Professionals.*

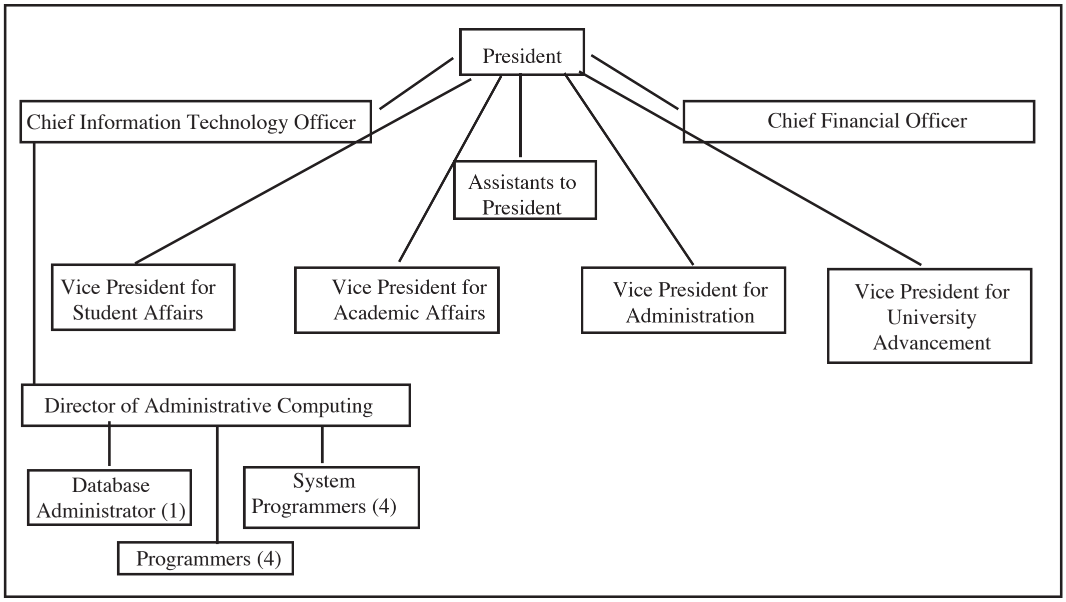
## EXECUTIVE SUMMARY

The Office of Information Technology at California State University, Fullerton is responsible for campus administrative mainframe and programming support, as well as for all mainframe applications such as the student records and financial accounting systems. Two campus organizations, University Extended Education and the Office of Analytical Studies rely heavily on the timeliness and accuracy of administration and student record data. These organizations have identified process improvements that are best met by client/server database applications. Due to limitations in the university's Office of Information Technology support capabilities (budgetary and legacy system related), both University Extended Education and Analytical Studies have opted for internal database development while still relying on the Office of Information Technology's mainframe data. This approach has resulted in increased local capabilities without the uncertainties related to working within an overloaded campus-wide Information Technology organization. Whether this approach is advantageous from an enterprise perspective remains to be seen.

## BACKGROUND

California State University, Fullerton (CSUF) is one of 23 universities in the California State University System. Located approximately 30 miles southeast of Los Angeles (and about 8 miles north of Disneyland), CSUF provides instruction in a wide array of full- and part-time undergraduate and graduate degree programs to over 24,000 students. There are four Vice Presidents, a Chief Financial Officer, and a Chief Information Technology Officer who report directly to the President

***Figure 1: Top Level Organization Chart***




of the University (see Figure 1.)

The Office of Information Technology (OIT) has four main divisions: Administrative Computing (AC); Campus Help Desk; Data Network; and Telephone Services. Administrative Computing is responsible for campus administrative mainframe and programming support as well as for all mainframe applications such as the student records and financial accounting systems. AC currently has nine staff members who are responsible for all administrative computing tasks. The staff includes a database administrator, four application programmers, and four system programmers.

### *OIT Business Process Redesign Activities*

Over the past few years OIT has supported the President in a series of major initiatives that include:

1) New desktop computers for all full-time faculty and staff
2) Email accounts for all students, faculty and staff
3) Campus Help Desk for students, faculty and staff support
4) Remote computer access for all students, faculty and staff
5) Expansion of main campus student computer laboratories

From an information systems theory standpoint, these initiatives fall under the category of business process redesign (BPR), since BPR consists of "radically transforming organizational processes through the optimal use of information technology to achieve major improvements in quality, performance, and productivity." (Raymond, et. al., 1998.) BPR is innovative. Participation tends to be top-down, with a broad, cross-functional scope. (Davenport, 1993.) These characteristics are consistent with the implementation activities at CSUF where the OIT successfully worked with the university community to implement these major campus-wide initiatives. In fact, the degree of innovation of some of these initiatives can be seen through the fact that within the CSU System, CSUF was the first campus i) to have a state-of-the-art computer and telephone network; ii) to place networked Windows NT Pentium II computers with Microsoft Office/Outlook on the desktop of all faculty, staff and administrators (in Spring 1998); iii) where every student is now given a permanent e-mail address while enrolled at CSUF; iv) where Web-based registration will take place (scheduled for a Spring 1999 implementation); and v) where most correspondence with students will eventually be accomplished via e-mail.

These initiatives were successful for a variety of reasons. First, the President spear-headed these changes, and top-level support is a necessary, but not sufficient condition for success. (Caron et. al., 1994). The President ensured that adequate financial/resource support was available. Second, OIT was operating in new territory and was not restricted by current/past practices. Processes and procedures were created, not revised. Existing infrastructures related to the mainframe environment were not impacted, other than to free up resources (such as when the VAX-based campus e-mail system was replaced.)

### *OIT Process Improvement Activities*

Technological changes over the past decades have changed the fundamental way that computers are used. In the past, nearly all requests from administrative units were developed and performed on mainframe computers. In today's environment computation has been decentralized. Change requests tend to request AC to supply data rather than to perform computations. These requests are better classified as process improvement projects since they typically focus at the process level and do not include the entire value chain. (Recardo, et. al., 1997.) These are essentially incremental changes to existing processes where participation tends to be bottom-up, with a narrow functional scope. (Davenport, 1993.)

From an accounting standpoint, CSUF's OIT staff does not operate a charge-back system for campus consulting and support. Instead, the entire OIT operation is funded by the President. While each administrative unit has its own computer support team, the total number of employees campus-wide in these positions is fewer than 30. The OIT is relied upon to manage and oversee these process improvement projects. Procedures developed by AC require requests for new application development and report generation to be submitted to AC through a formal meeting of interested parties resulting in a specific development proposal. An approved proposal is scheduled for implementation in a priority order that does not depend on the requesting organization's ability to fund. These projects tend to be less successful than the BPR initiatives. One possible reason for this situation is that the existing AC infrastructure and small staff emphasize support for the mainframe applications with little time to support external requests. The absence of a charge-back system increases the likelihood that priorities shift as other projects take on greater urgency based on campus-wide objectives. Thus a project originally estimated to take three months may be pushed to 6-18 months, depending on the workload and priorities of the programmers.

In their defense, AC staff face several obstacles that hamper their productivity. There are several legacy systems that are difficult to maintain. These systems typically have cumbersome/limited/outdated user interfaces. Also, customized code must be tested (and often revised) whenever operating systems or applications are upgraded. Moreover, since most of the campus applications require COBOL programs to manipulate the master databases, the test/revision process is particularly inefficient because much of the code is not well written and/or is poorly documented. These applications are well entrenched and there are no plans for replacing them in the foreseeable future.

Organizationally, AC sees itself as the "keepers of the data," and, since AC is responsible for time-critical campus-wide systems there is a natural reluctance to investigate solutions that impact their applications. One fundamental issue behind the success/failure of process improvements is the centralization/decentralization of data and information processing. Both approaches have advantages and disadvantages. Centralization offers standardization and data integrity. Decentralization offers greater innovation and faster response. An enterprise-wide perspective is needed to resolve these issues. Presently, however, AC offers two options to users needing access to their data: database duplication or screen scraping. Database duplication is an off-line method of data processing which downloads the data periodically and uploads the updates, with potential synchronization problems (Raghavan, 1997). Screen scraping takes place at a terminal screen when user-entered data are "scraped" out of data entry fields before the transaction screen is transmitted to the main application. Screen scraping does not affect the processing of the main applications. Although these solutions might not be globally optimal, the users are left with no other options.

The problems confronting Administrative Computing and its end-users are not unique. In recent years one of the key issues in the development of information systems has been "building a responsive IT infrastructure" (Brancheau *et al.*, 1996). Unfortunately, unless sufficient resources are expended, legacy systems in large organizations often impede responsiveness. The perceived dissatisfaction with delays and the inflexibility of the traditional IS department has resulted in the emergence of end-user computing (Kawalek *et al.*, 1997). In the past, corporate cultures determined the priority that computer centers gave to departmental requests for information services (Basu *et al.*, 1995, Watson *et al.*, 1998). More recently, however, the corporate trend has been towards leveraging information technology to gain a competitive edge, and information service priorities, more and more are being directed towards business opportunities that contribute to the bottom line (Wheatley, 1998).

## *Setting the Stage*

Historically, like most large institutions, CSUF performed all of its administrative computing using large mainframes. The mainframes varied from the IBM 3090 to the recent IBM 9672. The current campus mainframe utilizes an IBM legacy operating system MVS (recently re-released as OS390) and has the following configuration: IBM 9672-R32 (Approximately 36 MIPS - 3 Processors each @ 12 MIPS), 512MB Memory, 160 GB Disk Space (RAID with Hardware compression 4:1). A primary responsibility of Administrative Computing is the operation and maintenance of the student services applications which use a third party product called SIS+ (Information Associates, 1991), which was developed by SCT, a software company that specializes in enterprise solutions. SCT Software Groups include SCT Education Systems, SCT Utility Systems, SCT Manufacturing and Distribution Systems, and SCT Government Systems. At CSUF, the SCT applications are time-critical, and system administrators continually monitor the mainframe so that auxiliary applications do not impact its performance. Campus legacy systems are scheduled to remain intact for the foreseeable future, accompanied by all of their associated maintenance difficulties.

Two organizations requiring AC support are University Extended Education (UEE) and the Office of Analytical Studies. For both of these organizations AC may be considered the “server” while UEE and Analytical Studies may be considered to be “clients.” This case study describes how both of these organizations cope in this “client-server” environment. The unifying theme between the two organizations is their desire for expanded computing capabilities and a reliance on AC to provide data. As will be seen, both UEE and Analytical Studies have selected the data duplication option over screen scraping.

UEE, which reports to the Vice President for Academic Affairs, offers credit courses to matriculated students during the intersession (January, and June through August), mainly for students who wish to accelerate their graduation. Non-credit courses are offered throughout the year to members of the community. All programs offered through UEE must be financially self-supporting. Thus the organization strives to operate as effectively and efficiently as possible, like a business in the private sector, or a non-profit organization in the public sector. UEE was established in the early 1980s, and during its first decade the department remained relatively small, focusing mainly on servicing intersession credit courses. A more aggressive approach was adopted in the early 1990s, and as of 1996/97 CSUF’s University Extended Education program consisted of more than 125 full- and part-time employees (not including instructors) offering 950 non-credit courses, 45 certificates, and more than 55,000 extension enrollees.

UEE has its own Marketing department with a set of responsibilities that are unique for most publicly funded universities, but less so for private colleges and fund raising arms of public sector organizations. Marketing in UEE is responsible for promoting new (non-credit) courses and certificates that meet the needs of the local community. Their activities include market research, advertising, promotions, production, etc. To accomplish their goals, the Marketing department must operate in a traditional marketing fashion, one that requires a significant amount of data upon which to base their proposals for new instructional offerings. Programs that are undertaken by UEE, based on Marketing projections and proposals, are turned over to UEE Academic Programming staff to develop, offer, and maintain. UEE also has its own Student Services staff, Accounting department, and Information Systems (IS) staff to support all its academic functions.

Analytical Studies is an all-university central resource for institutional facts and figures, methodological advice, and related problem-solving. The office is responsible for organizing and presenting research results, models, alternative scenarios, and other information essential to campus policy formulation, academic planning, resource allocation, assessment and quality, and institutional effectiveness. Within Analytical Studies' purview are enrollment trends and forecasting, student and faculty demography, recruitment and retention, resource allocation and utilization, Academic Affairs' budget and faculty flow, curricular change and student learning, and any other topic relevant to documenting and improving institutional effectiveness. The Office of Analytical Studies consists of a Director and a small staff. A substantial amount of information generated by Analytical Studies is derived from data sources under the aegis of Administrative Computing. As with UEE, a need for added data requirements, etc. must be coordinated with AC.

## CASE DESCRIPTIONS

### *Case 1 - University Extended Education*

Approximately four years ago, with the advent of a new Dean, UEE decided to expand its instructional offerings and its associated marketing activities. A new director of marketing determined that there was a need to gather data about its potential "customers" in the local community. An apparent likely source of data was the student record database that had been accumulating for years via the student registration system, SIS+. SIS+ was originally designed as an online student registration, billing, and grade reporting system for full-time credit students registered in 'traditional' undergraduate or graduate programs. SIS+ had previously been modified by Administrative Computing to permit UEE to also register students into non-credit extension programs.

When the UEE Information Systems staff examined the feasibility of using the existing student database for marketing purposes, it soon became obvious that the nature of student records in the database was unsuitable. There were essentially two types of student records in SIS+. The first consisted of the academic record of an undergraduate or graduate student from initial enrollment in the university through the granting of a degree (or withdrawal). The second type consisted of information necessary to register and invoice non-credit extension students.

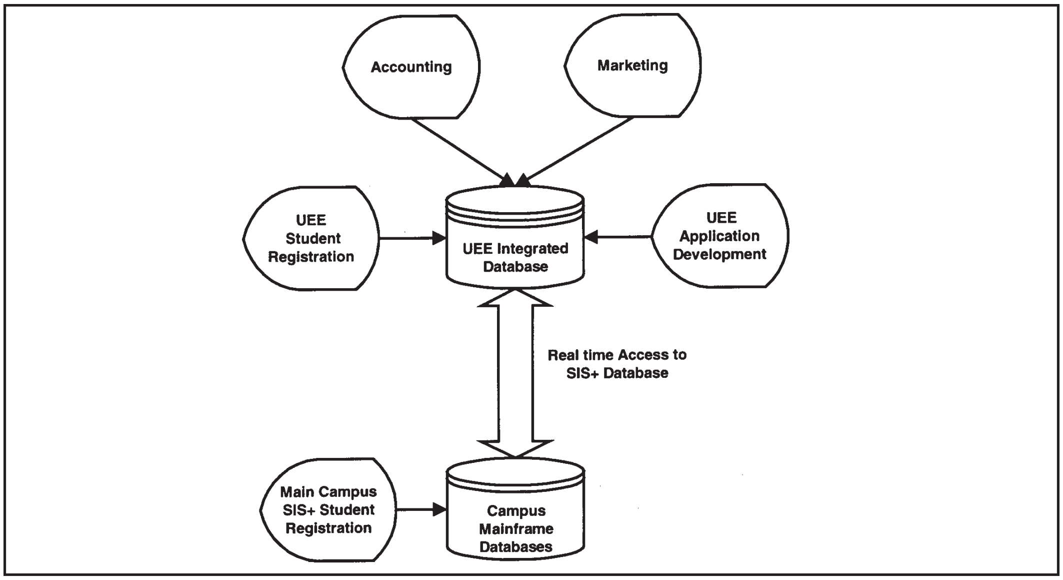
For the most part, extension students do not require detailed student records that track an academic career through multiple semesters/years. Extension courses are often not part of lengthier programs where more extensive tracking towards a degree is required. One exception is a non-credit certificate program that is comprised of a series of courses in which the monitoring of academic success is far less stringent than that of a degree program. In the case of these certificate programs, SIS+ had been modified slightly to track student progress towards successful completion of all courses in a certificate.

The single greatest drawback of the SIS+ student database, however, was that there was no facility for relating credit and non-credit students. This meant that a previously registered credit student's record could not be made directly available to UEE if that student returned to the university and registered for UEE-offered non-credit courses or certificates. In an effort to address this deficiency, discussions were undertaken between UEE's IS group and Administrative Computing to determine how the system could be altered to track a student's history from first registration, past withdrawal or granting of a degree, to also include future non-credit program registrations. UEE was informed that this was not technically possible, and even if it were, the task would take an inordinate amount of time to complete.

UEE's IS staff suggested other solutions, such as a variety of inelegant sorts and merges of student records, but Marketing had more grandiose plans to provide an easy-to-use, integrated system for targeting students/customers, and for determining demographic and academic trends. In particular, Marketing was interested in building student records that tracked the complete history of every student that ever took a course, credit or not, at CSUF. In addition, Marketing wanted to be able to add to that record, every instance of contact made by that student to UEE, in which the student/customer contacted the institution and requested information concerning a UEE instructional offering.

One of Marketing's primary sales strategies, typical of university extension programs, is "focused" mailings of promotional catalogs and brochures. In addition to purchasing mailing lists, Marketing wished to be able to access the university's own database to develop proprietary mailing lists for special CSUF events and offerings. This required the development of a facility that would

*Figure 2: Proposed System Implementation*




capture "call-in and mail-in" requests by potential students for information regarding non-credit instructional offerings. AC and UEE determined that, without a massive overhaul, the SIS+ database would not be able to provide these additional data elements.

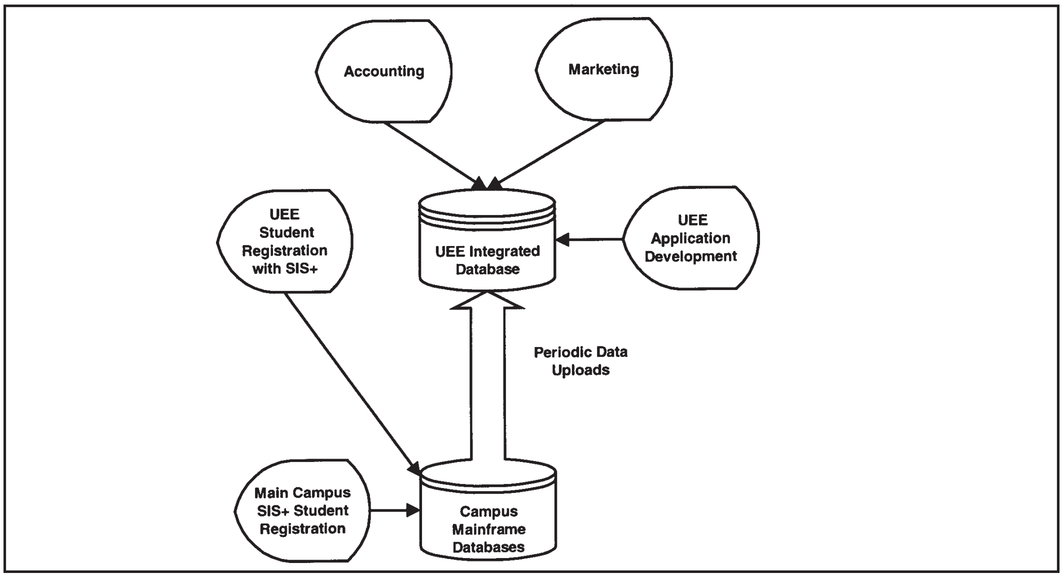
During the time that the analyses of SIS+ student records was taking place, other parts of UEE's operation were being examined to determine if other information systems needs could be addressed in order to improve UEE's overall operation and to provide improved service for students and instructors. The analysis, which was conducted over a three-month period, determined that UEE's operation could indeed benefit from a complete system overhaul. Accordingly, a structured analysis of the entire operation was undertaken wherein all the functions of the organization were examined. An extensive set of data flow diagrams was produced reflecting all of UEE's procedures as well as the relationship of UEE subsystems to those of the main campus systems. After careful examination of all the information, the UEE IS director decided that the UEE operation required complete reengineering, focusing on the development of an integrated client-server database management system. While a decision like this may seem to be a dramatic one, in fact, in many ways it was obvious from the beginning that this strategy would likely be required.

Figure 2 illustrates the client-server architecture that was proposed to address UEE needs. In this proposal, UEE would create a single integrated proprietary database accessible by the each of the organization's functions. The database management system that would support student registration of both credit and non-credit students as well as the development of additional database applications specific to the operation of all the functions within UEE. It would also provide UEE with the ability to create new applications such as "call-in" or "mail-in" data capture, data mining into the UEE database, etc., as the organization's needs expanded.

One of the key differences between the proposed system and the then current operation was the requirement that a proprietary online student registration system would be required. The proposed system would capture all credit and non-credit student registrants, and append, modify, and build new records in the integrated database. In this way, student records containing all main campus data elements as well as any data elements required by UEE could be built and maintained with no interference from the main campus system.

However, given main campus' requirement to provide mission-critical information processing for applications such as online student registration, the proposed design was problematic. As Figure 2 illustrates, the proposed system required a direct, high speed connection from the UEE proprietary DBMS system to the campus' mainframe-based SIS+ application. Functionally, this meant that students, who were able to register, add, and drop courses at any of the SIS+ online registration booths

*Figure 3: Actual System Implementation*




on campus, should also be able to obtain the same service at UEE. This level of IS service placed a burden and responsibility onto UEE that the organization was unwilling to support.

UEE's Marketing department concluded that their data requirements were not time-critical, unlike student registration information where SIS+ data entry operators are able to add and drop students in real time based on up-to-date class loading data. Accordingly, the IS staff proposed a different architecture (Figure 3).

In the new proposal, the UEE system would not be responsible for registering students. Instead, SIS+ would continue to be the online student registration system, operating from within a GUI-based window on a UEE user's workstation, connected directly to the campus mainframe-based student database. All other UEE functions would be developed and supported directly via the UEE database management system and the UEE database. In the new system, however, student record data elements would have to come from two different sources: UEE proprietary application input, and input from the campus SIS+ database. This would require periodic uploads of records from the campus database to ensure the timeliness of UEE student records. Uploaded student records would then be joined to UEE student records to provide a more complete student record database in the UEE integrated database.

This requirement for campus uploads of data would not be problem-free. Besides Administrative Computing's limited resources, uploads of data from the mainframe could affect mainframe performance, particularly if they were required to be frequent and/or during peak system use. In order to maintain a cordial relationship with the AC, UEE decided that uploads could be performed as infrequently as once per week, but more often if possible. The reason for this latitude on the part of UEE was that it was obvious from the proposed system architecture that except for student records, all UEE-specific information would be available from within the UEE client/server database as needed. Week-old student records would be almost as accurate as more up-to-date information for market analysis purposes.

## *Project Status/Current Challenges*

The UEE client/server hardware and software have all been installed and deployed. An IBM NetFinity multiprocessor server running Microsoft Back Office is currently supporting a SQL-Server database. Applications written in PowerBuilder and Visual Basic have been developed and are currently supporting all the Academic Programmer applications, almost all the Marketing applications, and many of the Accounting applications. During the system implementation phase of the system development, the university's Financial Affairs department implemented new campus-wide

***Table 1: Examples of Standard Report Statistical Categories and Classifications***

| Statistical Categories | Classifications |
|---|---|
| Headcount | Level (Freshman, Sophomore, etc.) |
| FTES (Full-time equivalent student) | Enrollment Type (Full-time, Part-time) |
| GPA (grade point average) | Enrollment Status (continuing, new, transfer, etc.) |
| Majors | Sex |
| Degrees Awarded | School |
| Age Distribution | Department |
| Ethnicity | |
| Citizenship | |
| Residence | |

***Figure 4: Example of a standardized report***

CALIFORNIA STATE UNIVERSITY, FULLERTON 1.30.2.98
OFFICE OF ANALYTICAL STUDIES
CENSUS DATE SUMMARY OF SELECTED REGISTRATION STATISTICS:
SPRING, 1998

| | HEADCOUNT | | FTES | |
|---|---|---|---|---|
| | NUM | PCT | NUM | PCT |
| 1. TOTAL | 24137 | 100.0% | 17600.5 | 100.0% |
| 2. SEX: | | | | |
| MALE (M) | 10098 | 41.8% | 7317.3 | 41.6% |
| FEMALE (F) | 14039 | 58.2% | 10283.2 | 58.4% |
| 3. LEVEL: | | | | |
| FRESHMEN | 3637 | 15.1% | 2583.9 | 14.7% |
| SOPHOMORES | 2247 | 9.3% | 1943.3 | 11.0% |
| JUNIORS | 5916 | 24.5% | 4625.0 | 26.3% |
| SENIORS | 8079 | 33.5% | 6158.4 | 35.0% |
| GRADUATES | 4258 | 17.6% | 2289.9 | 13.0% |
| 4. ENROLLMENT TYPE: | | | | |
| SIX OR LESS (PART-TIME) | 6191 | 25.6% | 2005.1 | 11.4% |
| SEVEN TO ELEVEN (PART-TIME) | 3254 | 13.5% | 1975.3 | 11.2% |
| TWELVE AND OVER (FULL-TIME) | 14692 | 60.9% | 13620.1 | 77.4% |
| 5. ENROLLMENT STATUS: | | | | |
| CONTINUING | 20732 | 85.9% | 15756.9 | 89.5% |
| RETURNING | 242 | 1.0% | 127.3 | 0.7% |
| RETURNING TRANSFER | 53 | 0.2% | 35.3 | 0.2% |
| TRANSFER | 1352 | 5.6% | 993.9 | 5.6% |
| FIRST-TIME FRESHMEN | 53 | 0.2% | 44.5 | 0.3% |
| FIRST-TIME GRADUATES | 768 | 3.2% | 418.9 | 2.4% |
| OTHER/TRANSITORY | 937 | 3.9% | 223.7 | 1.3% |

ENROLLMENT STATUS:

CONTINUING:
STUDENTS WHO ALSO ENROLLED IN THE IMMEDIATE PRIOR SEMESTER AND THOSE UNDERGRADUATES WHO "STOPPED OUT" FOR ONE SEMESTER.

ALL OTHERS:
CATEGORIES OF NEW STUDENTS, I.E. THEY FILED AN APPLICATION IN ORDER TO ENROLL THIS SEMESTER. ENROLLMENT STATUS DOES NOT MATCH STUDENT LEVEL FOR FIRST-TIME FRESHMEN, WHICH IS A MIX OF FIRST-TIME AND TRANSITORY.

standards for financial and accounting operations. That decision set back some of the UEE schedule and precluded full deployment of the UEE system.

At the present time, AC is providing periodic uploads to the UEE database management system. For the time being, the frequency of the uploads is sufficient to support the application service necessary for UEE to move forward in its expansion plans. However, it may be necessary at some point for UEE to develop its own student registration system as was originally proposed, in order to achieve the required levels of system performance and functionality.

### *Case 2 - Analytical Studies*

Analytical Studies produces reports tend to fit into one of two categories; standardized or *ad hoc.* Standard reports are typically published biannually and consist of information relevant to each semester/academic year. *Ad hoc* reports document studies that are developed in response to specific questions asked by the academic community, and, if applicable, may evolve into standard reports. Approximately 25 standard semester reports provide profiles of statistical categories of interest broken out by various classifications (Table 1).

Other reports provide trending information over multiple academic years. Examples of ad hoc reports include retention studies for student athletes and forecasts of future faculty requirements. Figure 4 presents an example of a standardized report which summarizes selected registration statistics.

The data used to generate the reports are provided by AC in the form of flat files from the mainframe computer. These files are produced at designated intervals using COBOL programs that were written decades ago (and were revised to extract data from SIS+). The file structures change from time to time as new fields are mandated by the Chancellor's Office, the body that oversees all the universities in the California State University system. Other changes also reflect new additions/ interpretations to existing fields/code tables, such as the creation of a new major. Some changes are procedural. For instance, students were previously tracked by uniquely assigned student IDs, but currently they are tracked by their Social Security Numbers. These files are produced at different times - grade data following the completion of a semester, enrollment data after the "census" date for a semester, etc. There is considerable redundancy in these files - student names, addresses, birth dates, entrance exam scores, etc., may appear in multiple files in the same semester, and also across semesters. Course titles, department names, instructor names, and numerous other fields are replicated as well.

The following is a description of the general process which was used to produce the standard reports prior to the redesign of the system described in this case study.

"Official" files were produced using production COBOL routines and stored in designated datasets on the mainframe. Analytical Studies was notified of the availability of these files and a series of SPSS-X stored procedures was executed to identify any obvious data field changes. If necessary, AC was contacted regarding these issues and the impacted "official" files were regenerated with necessary enhancements/corrections. Additional SPSS-X procedures were then executed using the finalized versions of the "official" files to tabulate the great variety of data required for the reports. These SPSS-X procedures required their own revisions when changes in the data structure/ interpretation impacted the tabulations. Hard copies of the SPSS-X output were then used by data analysts to manually prepare spreadsheet reports. The spreadsheets were designed to perform side calculations and to produce summary lines as needed. Headers and footnotes were revised each semester. Occasionally data structure/interpretation changes would result in a spreadsheet redesign. Finally, a comprehensive review was undertaken to eliminate errors prior to publication.

While the process to produce standardized reports from Analytical Studies has been successful, it did suffer from a number of drawbacks. The entire process was labor intensive, especially the data transfer from SPSS-X hard copy output to PC spreadsheets. This data transfer was performed by student assistants who typically work for Analytical Studies for only one or two semesters. This created learning curve problems, and the sheer volume of data contributed to quality control problems. When changes were required to the SPSS-X procedures they were completed by the Director of Analytical Studies, the only employee in the organization knowledgeable about SPSS-X .

Another drawback had been the long development time typically required to generate new information and new reports. In addition, certain types of reports were just too cumbersome to be produced using the current approach. For example, one existing report presented a student ethnicity profile for the entire university. A similar report for each department and school (84 departments in

*Table 2: Initial Analytical Studies Process Improvement Goals/Objectives*

| | |
|---|---|
| 1) | Reduce mainframe usage |
| 2) | Eliminate SPSS-X dependency |
| 3) | Improve validation capabilities |
| 4) | Streamline report development |
| 5) | Simplify report generation |
| 6) | Expand reporting capabilities |

7 schools) would have been useful, but the amount of labor required under the legacy process was prohibitive.

During the Spring, 1997 semester the Director of Analytical Studies determined that the existing approach needed an overhaul. Administrative Computing was consulted, but it was quickly determined that AC did not have the manpower nor the desire to develop an entirely new application for Analytical Studies. The Director of Analytical Studies approached one of the authors to assist in a process improvement project. Following a detailed analysis phase process, the Director's improvement goals and objectives were defined (Table 2).

Additional long-term objectives were also developed. The goal is to empower recipients of the reports (primarily Deans and Department Chairs) with the ability to generate their own reports based on "official" data. This empowerment is expected to provide parameterized queries in a decision support environment. Because of the need for standardization and the potential for data definition misinterpretation, it is expected that users will not be able to develop their own queries.

*Table 3: Analytical Studies Client/Server Implementation Phases*

| | |
|---|---|
| I. | Design/Develop Relational Database |
| II. | Develop mainframe import, change identification and validation procedures |
| III. | Create "Standard" reports |
| IV. | Design secure Client/Server user interface |
| V. | Develop parameterized queries/reports for end users |
| VI. | Complete Client/Server application |

All of the initial and long-term process improvement goals and objectives could be met by developing a Client/Server application utilizing a relational database management system (RDBMS). Since the Spring 1998 university-wide initiative placed networked Windows NT Pentium II computers with Microsoft Office on the desktop of all faculty, staff and administrators, Microsoft Access was selected as the application program. "Official" (COBOL-generated) files are still generated by, and reside on, the mainframe, but all processing is performed by the RDBMS – thus eliminating the need for SPSS-X procedures. Using the features of Microsoft Access, the enforcement of referential integrity facilitates the data validation process, and the query/report capabilities greatly improves quality control and shortens development lead time. Table 3 presents the implementation phases of the redesign.

### *Project Status/Current Challenges*

Implementation Phases I, II, and III of Table 3 have been completed for the standardized reports and partially completed for *ad hoc* reports. Three Microsoft Access databases were developed. The first is used for importing and validating mainframe files. The second consists of condensed data tables that contain only those fields that are relevant to report generation. The third is linked to the condensed data tables and contains the forms, queries, code modules, and associated reports.

Initially the reports were produced by exporting data into preformatted Excel spreadsheets. This approach was used because the spreadsheets already existed. While this approach reduced the initial development stage, it proved unsatisfactory because minor variations in data (new departments, majors, etc.) required major spreadsheet redesign – without any guarantee that a redesign would not be required the following semester. The reports were subsequently designed within Microsoft Access to respond dynamically to the inevitable variations in data and to eliminate the need for continual redesign. Significant improvements have been realized. Prior standardized reports often took one or two months to complete with the potential of significant data entry errors. With the new system, after a new semester's data have been validated, less than one hour is required to generate and print all standard reports without data entry or computational errors. Additional reports, such as the 90-plus page department/school student profile that in the past was desirable but impossible to produce practically, have also been completed.

Challenges that remain include the development of additional ad hoc reports, including some that are quite sophisticated (e.g. comparing graduation rates of student athletes to the general student population.) The design and development of the front end of the Client/Server DBMS is just beginning. It is anticipated that extensive front-end modifications will be considered when the prototype is available for testing.

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