This paper was presented at CUMREC 98, The College and University Computer Users Association Conference. It is the intellectual property of the author(s). Permission to print out or disseminate all or part of this material is granted provided that the copies are not made or distributed for commercial advantage and that the title and authors of the paper appear. To copy or disseminate otherwise, or to republish in any form, requires written permission from the authors.
Arizona State University
“Hey! Where’s My Application?”
A Transformation in Graduate Admissions Processing

Dr. Bianca L. Bernstein
Dean
Graduate College
iacbxb@asuvm.inre.asu.edu

Kent Blaylock
Senior Manager, Administrative Services and Information Systems
Graduate College
kent.blaylock@asu.edu

Roger Lurie
Application Systems Analyst, Principal
Information Technology
roger.lurie@asu.edu

Arizona State University
Box 871003
Tempe, Arizona 85287-1003

In the spring of 1997, the Graduate College and Information Technology started a major reengineering initiative at Arizona State University. This project required the active participation and cooperation of several administrative units and virtually all academic units at this state institution with more than 49,000 students, including 12,000 graduate students.

With many facets to the project, including staff development and significant reengineering of the work flow process, a large focus is towards implementing new technology. These technological advances are wide spread and involve Web applications, imaging technology and interaction between client/server databases and the legacy mainframe applications.

This presentation will explore the results of a year long initiative and the impact on processing graduate admissions. Information will be shared about the changes that have impacted students and staffing within the Graduate College and academic units. Furthermore, this presentation will describe and demonstrate technological implementations, which include an electronic application, intelligent character recognition (ICR) system and internal Web applications that provide workflow management.
Arizona State University

“Hey! Where’s My Application?”

A Transformation In Graduate Admissions Processing

Introduction

Arizona State University (ASU) is a leading national and international research and teaching institution. It is located in the Phoenix metropolitan area, with a total population of nearly 2.7 million persons. ASU is a rapidly growing multi-campus institution with a current enrollment of approximately 49,000 full-time and part-time undergraduate and graduate students. ASU offers a full range of degree programs from baccalaureate through doctorate.

ASU is part of a three-university system governed by the Arizona Board of Regents (ABOR), a body corporate and politic with perpetual succession under the constitution and laws of Arizona. The regents select and appoint the president of the university, who is the liaison between the ABOR and the institution.

The Applications and Consulting Information Technology (ACIT) department within Information Technology (IT) provides information resources for the administrative operating departments of the ASU campuses. The existing portfolio of ACIT managed applications are written primarily in COBOL, using the IDMS database environment. ASU also has applications in the DB2/CICS environment. These mainframe applications operate on an IBM 390 platform running MVS/ESA. An aggressive project is currently in progress to provide millennium changes necessary to keep these systems operational.

While the central ACIT organization concentrates on maintaining existing legacy systems, conversion of programs to support millennium requirements and support for new enterprise development, departmental needs are being addressed in a distributed, departmental paradigm. Several academic and administrative units including the Graduate College have hired programmer/analysts and graduate assistants to develop and maintain in-house applications. These departmental applications have focused primarily on the use of PowerBuilder, Microsoft Access, Sybase System 11 and Web development environments for technical implementation. S-Designor has also been used for data and process modeling in a number of applications.

The Graduate College promotes and supports the integrity, quality, and vitality of graduate programs at ASU. It offers 46 doctoral and 92 master’s degree programs supported by 1,500 faculty members and employs 42 permanent staff and a number of graduate assistants, student workers and temporary employees. Its primary business functions include recruiting, processing and facilitating admissions applications and student financial aid for graduate students, providing student support services, developing publications related to graduate studies and overseeing accreditation and academic unit program reviews for the university.

In the spring of 1997 the Graduate College embarked on an initiative to reengineer the graduate admissions process. This project has involved staff and faculty from virtually all academic units at the university. Additionally, a cooperative initiative with the central Information Technology department has enabled the Graduate College to proceed with shared staff and technical resources. This Graduate Admissions Reengineering Project (fondly known as GARP) and the resulting information systems will be explored in detail in this paper.

Background

In the fall of 1996, the Dean of the Graduate College requested assistance from Information Technology (IT) in developing an Information Strategy Plan to review its business processes and the technology supporting those processes. IT assigned two application systems analysts to work with the Graduate College in developing this plan. The completed document included an analysis of the current business processes and information systems, summary of future goals, and recommendations on resources needed to reach those goals. This plan resulted in a decision to reengineer the Graduate
College’s business processes and apply new technologies. Due to resource constraints, it was determined that this would be a long-term plan and that priorities would need to be established.

One of the first steps in this effort was to determine best practices by reviewing other graduate schools’ efforts. This was accomplished by reviewing Web pages, sending messages to Internet user groups, and contacting staff at other universities. As a result of this effort three graduate schools were identified that were implementing innovative business processes and applying new technologies: UCLA, Indiana University at Bloomington, and the University of Delaware. Site visits were made to each of these schools to determine what elements of their processes and technologies might be applied or adapted to the situation at ASU’s Graduate College.

During the spring of 1997 staff developed goals and objectives and identified technologies and electronic processes required to meet these goals and objectives. The processing of graduate admissions applications was targeted as the area needing the most improvement and was set as the highest priority. The following goals were established: 1) provide an application submission process that is user-friendly to prospective students and 2) process admissions materials in an efficient, timely manner.

**Getting the Project Started**

**Acquiring Support**

It was determined that this project would involve faculty and staff from over sixty academic units on campus plus staff from administrative units and IT. In order for this project to succeed, the support of the university community, particularly that of upper administration was needed.

The Graduate College had made a commitment to hire a permanent application systems analyst for its staff plus two graduate assistants to develop and maintain its applications and information systems. However, it was clear that this endeavor would require the support and collaboration of IT. The Dean of the Graduate College met with the Vice President of Information Technology who agreed to provide additional staffing from his area to support the project. The Dean also met with the President, Senior Vice President and Provost, and Vice Provost responsible for university continuous improvement to gain their support. In addition, meetings were held with the Dean’s Council from each of the academic colleges affected by this project.

**Forming Teams**

Because of the far-reaching effects of this project an extensive list of teams was put together which included the participation of staff from several areas. These included Graduate Admissions, other areas of the Graduate College, Information Technology, faculty and staff from Academic Affairs, University Continuous Improvement, Human Resources and Student Affairs. Each team was set up to have two co-leaders, one internal to the Graduate College and one external. The project officially started in May of 1997.
Three teams were involved in design and implementation. The Admissions Process Coordination Team was assigned to 1) document the current business process for processing applications for admission and 2) design a new admissions process to distribute, receive, review, process, and maintain graduate student applications. The Technical Team was charged to plan, design, and develop technological solutions to benefit graduate student admissions, resulting in a more efficient and effective process. The Affiliates were not a formal team; individually, they identified those members of Graduate Admissions and other Graduate College staff who were involved in the admissions processes but not selected to participate in one of the GARP teams. It was critical to get the input and support of these staff as the teams documented the old business processes and developed new ones.

Two teams were involved in communication, strategy, and training. Communication with academic units would be essential to successful implementation of the new processes. The Academic Unit Coordination Team was assigned to disseminate information to academic units on a regular basis and solicit input from academic units on process design. Managing the human element of the change process was viewed as critical to the success of the overall project. The Staff Development Team’s mission was to coordinate change management and job development issues related to staff for the Graduate College and academic units. It was also responsible for the design and creation of jobs under the new business processes as well as training.

In addition to these teams, the Senior Manager for Administrative Services and Information Systems (Graduate College) and a representative from University Continuous Improvement were given the responsibility of co-leading the project. These two members chaired the Executive Team consisting of the co-leaders from each team plus two faculty members. The team was charged with promoting inter-team coordination, communication, and oversight and ensuring that the project moved forward in an expedient manner. The Sponsor Team consisted of the Deans of the Graduate College and Liberal Arts and Sciences and the Vice President for Information Technology. This team reviewed and provided feedback regarding team deliverables, provided executive level support to the executive team as needed, and resolved issues specific to meeting team objectives. Finally the Information Technology Advising Team, consisting of representatives from IT, Graduate College, and Continuous Improvement, was responsible for advising on issues and resources related to selection of technology and staffing resources.

**Communicating with Academic Units**

One of the biggest challenges to reengineering business processes is resistance and skepticism from those people whose jobs are affected by the changes. From the inception of this project staff and faculty were encouraged to communicate
their concerns about process changes and provide feedback on how processes could be improved. The Academic Unit Coordination Team conducted several meetings to discuss the goals and objectives of the project with representatives from academic units (staff and faculty) and to invite discussion and feedback. These meetings, each with 50 – 60 participants, would continue through the duration of the project. Other forms of communication included placing articles in the university’s faculty/staff newspaper, establishing a project Web page, and sending regular electronic mail messages to all deans, chairs, graduate directors and support staff regarding implementation of changes to the process.

Changing the Admissions Process

Analysis of the Existing Admissions Process

The graduate admissions process was paper-based, labor-intensive, and costly. Significant levels of work were required to process an application for admissions from the date of receipt until a decision was made and applicants notified. A study of the process found that at a high level, over 30 process steps were required. A number of these tasks involved duplication of files, distribution via campus mail and a distributed process that involved Graduate Admissions Office (GAO) staff, academic unit staff and faculty. Decisions on whether to admit or deny a student were often slow during peak processing.

A detailed analysis of the workflow was performed with eye-opening results. During slow times in the admissions cycle, the GAO needed the equivalent of 3 – 7 staff to process the daily work. During peak periods, 36 staff were required to keep up with the daily processing of admissions. The GAO had a permanent staff of 14 and during peak periods brought in 4 - 5 temporary employees. In addition, staff would be asked to work overtime. Even with the additional staffing and time, backlogs continued in the admissions process and there was concern that the delays were impeding the goal of recruiting and admitting top students.

There were also certain facts that would not change with the implementation of new processes. The first of these involved the cyclical nature of the receipt of applications. The GAO receives an average of 25 applications per day during slower times and 170 applications per day during peak periods. However, the office has been known to receive over 300 applications on some days during the peak period. Another fact was that the volume of applications has continued to increase over time. Figure 2 demonstrates the peaks and valleys in the process and the continuing increase in the volume.

![Figure 2. Number of Graduate Admissions Applications Received at ASU](image-url)
Designing the New Process

One of the first steps in moving this project forward was to schedule several facilitated sessions. For several weeks the Admissions Process Coordination Team, with the assistance of members from the Technical Team and the co-project leader from University Continuous Improvement, met to analyze the current business processes and begin mapping the new processes. Representatives from selected academic units were also invited to participate in these sessions. Members of the Affiliates group were asked to provide input on the old and new business processes. The Admissions Process Coordination Team identified significant process improvements that greatly impact the way in which staff in the GAO and academic units do their work. While the process improvements were initiated October 1, 1997, significant work is still under way to provide technological support for these changes. Figure 3 graphically depicts the new business process.

Figure 3. Graduate Admissions Reengineered Process Diagram

The principal business reengineering changes that were incorporated into this effort are described below.

Communication

Past: Applicants requested information via phone, written, or e-mail communications. Disseminating information was a drain on staff resources.

Present: Applicants are encouraged to seek information through the Graduate College Web site.
Consolidation of Admissions Materials

Past: Admissions application and other admissions information were included in separate brochures.

Present: Admissions application and other admissions information are consolidated in an application booklet.

Distribution of Booklet

Past: GAO mailed application materials directly to the prospective student. A report would be generated and forwarded to each academic unit with information on pertinent prospects. The academic unit would then type a label and send a separate mailing to the prospect.

Present: GAO distributes booklets to the academic units who have responsibility for mailings to prospects. To make this desirable, the Graduate College is reimbursing the academic units for added postage costs. The impact of this change is a more streamlined process with minimal duplication of effort.

Coding the Application

Past: GAO staff spent approximately 1.5 minutes per application assigning system codes for countries, graduate programs, institutions and degrees.

Present: Applicant is required to look up codes for countries, graduate programs, institutions and degrees. Codes are provided in the application booklet. While there are over 4,000 institution codes that define universities and colleges, only the 400 most attended by ASU graduate applicants are included in the application booklet.

Transcript evaluation and computation of GPA’s

Past: The Graduate Admissions Office staff in the Graduate College performed transcript evaluations and GPA calculations on all files received.

Present: Applicant self-reports GPA and test scores on the application form. The Graduate Admissions Office forwards file to academic unit. Academic units individually determine extent of transcript evaluation required on applicant files. The Graduate College reviews the academic units recommendation and, for units that request this service, verifies the GPA.

Time to department

Past: Applicant files were held at the Graduate College until all transcripts and test scores were received. Files were copied and often sent to academic units in campus mail. In some instances, there was a delay of several weeks between the university’s receipt of the application and knowledge by the academic unit that it existed.

Present: All applicant files are forwarded to the appropriate academic unit within 24 hours of receipt. Transcripts, test scores and other documents received by the Graduate College are forwarded to the academic unit when received. “Runners” are used to deliver files to academic units.

Department recommendation/Returning file to Graduate College

Past: Department made recommendation and returned files to the Graduate College, including all admits and denies. Files were often returned via campus mail.

Present: Department makes a recommendation and only returns admit files to the Graduate College. Admitted files are returned through a runner, instead of campus mail. Denial files are retained in the academic unit for a duration of no less than one (1) year.
**Future**

The future will include technological enhancements to support this reengineering effort. These changes will improve the expedient flow of work and processing of applications. The basic architecture provides for an Intranet based system that will be used by Graduate Admissions staff, academic unit staff and faculty.

The Admissions Process Coordination Team has identified at a high level the major components and features required for this system. Based on the specifications and intent, a prototype of the major core functionality was built. Academic unit staff are now involved in Joint Application Design (JAD) sessions to prepare the detailed specifications of this system.

The highlights of this system are identified as follows:

**Academic Unit Screens**

The academic unit screens provide tabular listings of applicant files in progress. These HTML pages are updated on a real-time, interactive basis as processing occurs. New applications are available to an academic unit to begin review as of the date entered. These tabular reports include lists identifying new paid applicants, unpaid applicants and applications in progress. Drill down capabilities enable staff and faculty to view detailed information on the applicant without requiring a separate lookup on the mainframe Student Information System (SIS). Furthermore, a download screen enables an academic unit to select data elements to be extracted for inclusion in a separate departmental database system. Academic unit staff and faculty will only be privileged to update applicant files within their specific areas.

**Recommendation Screen**

Academic unit staff will have the capability to enter a recommendation for admit or deny, thereby eliminating the need to send a piece of paper to the Graduate College with this information. In addition to specifying an admit or deny, the recommendation screen enables an academic unit to specify deficiencies that must be fulfilled by the applicant. In the instance of discrepancies from standard parameters, a justification must be filled in prior to submission, and is subsequently reviewed by the Graduate College staff.

**Graduate College Screens**

The Graduate College Admissions Staff screens will enable review of the recommendations from the academic units. Furthermore, a batch upload process will provide a means for the academic unit recommendations to be reviewed and transferred in mass to the mainframe system.

**Intelligent Character Recognition**

**OMR versus ICR**

Technological advances are an integral part of a major reengineering effort. Optical mark recognition (OMR) was initially a consideration for reducing the dependency on manual data entry tasks in the Graduate College, specifically related to admissions processing. While anticipating a significant shift towards use of an interactive Web based application for admissions, there was a consensus that paper based forms will exist and even dominate processing for some years. In the June 1997 issue of Business Systems Magazine, Hugh Green is quoted as stating “For the concept of Internet-based forms to be acceptable, there is a need for the existence of a critical mass. Today, it does not appear to exist.”

OMR is a technology that uses a specialized scanner to detect the absence or presence of a mark. Software interprets the output from the scanner, and translates it into an ASCII file output. The forms contain small circles, referred to as bubbles that are filled in by the respondent. This is a technology that has historically been used with a high rate of success for processing examinations in universities, with accuracy rates that approach 99 % - 100 %. A prototype of an
OMR form was developed for graduate admissions at Arizona State University. However, the form was 12 single-sided pages, and the staff agreed this would be a method of saving manual data-entry time, but create an unfavorable impression with prospective students.

Intelligent Character Recognition (ICR) is the ability to turn images of handprint characters into machine-readable characters. Images of the handprint characters are extracted from a bitmap of the scanned image. Forms can be scanned or faxed, with a bitmap image being generated. Accuracy rates vary considerably with ICR, but are often stated in the range of 75% - 85%. The prototype ICR form for graduate admissions resulted in a 3 single sided sheet application.

While the initial plan involved an implementation of OMR technology, the ICR system had significant advantages from a customer service standpoint. Furthermore, the ICR technology is one that enables the university to plan ahead towards an eventual goal of imaging and indexing all forms and documents received. The investment in an imaging server with RAID disk and two duplex scanners with a speed of 40 pages per minute (ppm) is a clear investment towards our future direction in an imaging system. After significant investigation, a committee was formed to draft a Request For Proposal (RFP) which was distributed to several vendors offering ICR solutions. The result was an acquisition of a turnkey system that included installation, training and professional development of the ICR form.

**Designing the Form**

In order to design a comprehensive application form, a thorough analysis was conducted to ensure that all elements were included and questions were appropriately phrased. To accomplish this, the Admissions Process Coordination Team conducted facilitated sessions to review and analyze the existing form. Behind the scenes, extensive research was conducted to map the application form to the legacy Student Information System (SIS).

Furthermore, all academic units were contacted to provide copies of their specific application packets. Out of 60 academic units, approximately 25% include a supplemental application requesting additional information about the candidate’s background and academic interests. These packets were reviewed in order to assess commonality and the feasibility of including additional information on the application form.

Also, it was concluded that the application forms for domestic and international applicants would be combined, thereby creating one application form. This would result in one packet that could be mailed to all prospective students.

The outcome of this process was a comprehensive list of data required to fulfill application requirements, regardless of program of interest or citizenship status.

**ICR Form**

Development of the Intelligent Character Recognition (ICR) form presented a number of options for consideration. Major considerations in the development of this form included the following:

**Drop out colors**

Drop out colors are often used for the borders of constrained fields; the scanner is then programmed to ignore the specified color. The use of drop out color reduces the size of the transmission between the scanner and computer with an imaging scanner, while raising the cost of printing. It was also suggested by a vendor that drop out colors would enhance the accuracy of the results. After extensive testing, ASU concluded that no direct benefit would be achieved through the use of drop out colors. Also, monochrome forms would enable reprint at any time without requiring the services of a professional printer.

**Comb style versus fully constrained fields**

Comb style and fully constrained fields are two choices available to the designer of an ICR form, as depicted in Figure 4. The comb style field is perceived by many to lead to a more aesthetically designed form, while risking the possibility that the person filling in the field will not be constrained by the blocks. On the other hand, fully constrained fields create
a more rigid form in which applicants are more likely to write their letters, numbers or special characters within the space allocated by the boxes. Fully constrained fields were utilized for the Graduate Application for Admissions.

![Comb Style Field](image1.png)  
Comb Style Field

![Fully Constrained Field](image2.png)  
Fully Constrained Field

**Figure 4. Comb Style and Fully Constrained ICR Fields**

**Radio buttons and check boxes**

Radio buttons and check boxes may also be included on ICR forms and are treated in much the same way as OCR fields. The recognition software detects the presence of light and dark spots in the radio buttons or check boxes. This is an accurate way of collecting information where the choices are limited. Radio buttons are often associated with a single selection choice, such as a gender. Check Boxes are typically associated with a multiple selection, such as identifying multiple ethnic categories.

**Simplex versus duplex printing**

Most often, printing forms in duplex (double sided) will be preferable to printing single sided forms, thereby minimizing costs. However, a frequently used capability with ICR forms is a feature enabling respondents to fax in their completed form. The fax process simply outputs a TIFF image into the input stream that appears as a scanned image to the verifier. The fax process, if desired, may lead to a decision to print the forms in simplex (single sided).

**Field types**

The ICR recognition software generally allows for a number of choices in defining fields on the form. For example, fields may be defined as alphabetic only, numeric only or alphanumeric. Alphanumeric fields pose the most significant number of issues with recognition and should be avoided wherever possible. With alphanumeric fields, it is often challenging for the recognition software to distinguish between an O and an 0, or an I and a 1.

**Overall design and readability**

The ICR form must be eye appealing and readable. Constrained fields should be adequate enough in size for a variety of personal handwriting styles. Generally speaking, four constrained fields per inch allows an adequate amount of space, so that respondents are not printing their characters on the lines. Furthermore, it is important to include clear instructions on how the respondent should print characters and numbers. These instructions need to be placed in a visible location on the form so that they are not ignored.

**Web Form**

Having successfully designed the ICR form for an application for admission, the generation of a Web form was a natural migratory step in the process. Specifications and a sample of the ICR form were handed to the university’s “GUI Master”. This individual worked on developing the graphical, eye appealing design of a Web page for input of application information.

The result of the GUI Master’s work was 5 HTML pages. These pages were written in native HTML without a graphical tool such as Microsoft FrontPage being used to facilitate the design. The GUI Master handed over the HTML pages, which were refined to accommodate for additional business rules and text editing. As a next step, a programmer added elements of Netscape’s Server Side JavaScript (LiveWire) between the various pages so that the complete application
process could be demonstrated as a prototype from beginning to end. Furthermore, a log-in page was added, thereby enabling a prospective student to start work on an application and return at a later date to complete the process.

The prototype of the Web application was advertised to all Graduate Admissions Reengineering Project (GARP) team members. Feedback was obtained over a three week time period. As with the ICR form, there were a number of factors that needed to be considered in the design and development of a Web based application for admissions. In designing any Web based product, it is important to evaluate who the target audience will be. In the case of an application for admission to a university, it is likely that applicants will originate from a variety of Web browsers, computing platforms and countries. Therefore, it is important to create an application that will work in as many instances as technically feasible.

**Inclusion of graphic images**

Minimizing the amount of graphics in the application will result in a more efficient process. Customers of the application will be pleased when remote access can be achieved in a few brief seconds, as opposed to a sophisticated Web site that requires a significant amount of time to load. The Arizona State University application for admission includes a standard graphical header and footer that are used consistently throughout the university’s main Web pages. These graphic files are relatively compact in size, visually appealing and provide a consistent look and feel throughout the site. Furthermore, these graphic files do not significantly impact load time for the prospective student.

**References to code lookup tables**

A number of code lookup tables are an integral part of the Web based application for admissions. In order to properly code an application for upload to the mainframe system, values must be selected for state, country, ethnicity, previously attended institutions and program of interest. Codes that are unlikely to change are acceptable to place directly into static HTML pages as radio buttons, check boxes or drop down lists. Codes that are subject to change or involve several hundred or thousands of values require more complex programming. Each code lookup table should be evaluated based on the number of entries, frequency of change and relevance to the Web page being developed.

**Legality of electronic signature**

The Registrar’s Office and General Counsel participated in the decision to accept electronic signatures. The result was to create a Web page requiring the applicant to read a disclaimer statement and then check a box stating that his/her application is complete and correct. Checking this box updates a database field noting that this is a complete application and ready to be transferred to the mainframe system. Furthermore, the application flow is designed in such a way that this is the last step in the process.

**Validation and editing of data**

There are a variety of techniques that are being used in validating and editing of data in Web based applications. An approach that increasingly appears on more Web pages is the use of client side scripting using JavaScript or Visual Basic (VBScript). These client side-scripting techniques provide more interactive capabilities and immediate feedback to the customer. However, client side scripting techniques will result in some incompatibility issues between Web browsers. JavaScript, originated by Netscape, has been implemented as JScript in Microsoft’s Internet Explorer. There are subtle differences between JavaScript and Jscript, with no apparent direction towards a standard. Furthermore, older versions of the Web browsers such as Netscape Navigator 2, do not support use of JavaScript.

As a result of these issues, the Arizona State University application for admissions will be an HTML form that can be used consistently on all Web browsers supporting the HTML 3.2 standard. Validation and editing of data is done using server side code, written in C++.

**Security Considerations**

The Web based application for admissions is deployed to a Netscape Enterprise Server, running under the Sun Solaris operating system. 128-bit encryption ensures that data is secured as it passes through the Internet. Cookies, which provide a method of saving data to the client workstation are not being used, since in some instances, applicants will be
using a common, shared workstation. Data from the application is interactively loaded into a Sybase database that is secured. Updates to the database are performed exclusively through the execution of stored procedures, providing even further protection.

**Selection of a Web development environment**

Selection of a stable, high performance integrated development environment for the Web has been a challenge. A number of products were evaluated and considered for their strengths and weaknesses. Microsoft VisualStudio, Allaire ColdFusion, Netscape LiveWire, NetDynamics and Bluestone Sapphire/Web were all considerations in selecting a development environment. Sapphire/Web was selected for this development effort, largely based on prior development experience and proven success with Bluestone’s product at the university.

**Nuts and Bolts of the Technical Component**

In designing the technical components, an effort was made to develop a system that was flexible and would enable re-use of components. Development of components would enable distinct programming tasks to be accomplished disparately and lends itself to re-use of code. Figure 4 presents a pictorial overview of the technical design.

To initiate the technical design, a Sybase relational database was modeled using PowerDesignor 6.0, (previously known as S-Designor). This is an upper CASE tool that enables the designer to capture the tables and elements in a logical and physical data model. The tables were designed to capture all elements that would be required for processing applications for admissions, with distinct tables identified for those components that would upload to the mainframe. There were also components of the data model identified for the capture of elements that are supplemental and cannot be sent to the mainframe, including electronic mail address, fax number, faculty contacted and a scholarship request flag. Additional fields were added to the table structure for identifying system information, such as the date information was entered and uploaded to the mainframe.

The Sybase database was designed to accommodate processing of Web and ICR based admissions. A Visual Basic batch program was designed to take the ASCII file output from the Intelligent Character Recognition System and load that data into the Sybase database.

Furthermore, the Web application for admissions was designed to interactively update the Sybase database. As portions of the Web application for admissions are completed, data is inserted directly into the database. Once a Web application form is completely filled out, a flag is set indicating that the data is ready for upload to the mainframe system. Sybase stored procedures are used in all cases to ensure that transactions impacting data are done in a secure and systematic manner.

In designing the component that would upload data to the mainframe Student Information System (SIS), a detailed analysis was done of the business rules to assess the feasibility of creating an FTP process that uploads data directly into the IDMS database underlying this mainframe legacy system. The findings were that several thousand lines of COBOL code were involved and duplication of these rules inside a batch program would be a laborious task that would result in redundancy and maintenance issues. As a result, an investigation of screen scraping technology lead to the acquisition of Wall Data’s Rumba/ObjectX. This is a library of ActiveX objects that may be invoked from Visual Basic to perform screen scraping. Using these objects enabled design of a system allowing screen emulation which places data on the mainframe screen, gets data from the mainframe, checks for errors and submits the data. A Visual Basic program was created that requires staff to interact with the process in order to perform secure login to the mainframe. Once this is done, the program emulates the mainframe session and updates the Sybase database indicating that the load has been successful.

Reports are available to the Graduate Admissions Office staff, which enable them to identify errors that have occurred in transferring data from the ICR system to Sybase or from Sybase to the mainframe system. Furthermore, staff are permitted to make corrections and updates directly to the Sybase database through a Web based interface that is similar in functionality to the interface used by prospective students.
Another component involved is the creation of a report that identifies applicants that have the same name as an existing record on the Student Information System (SIS), but have provided a different social security number. This ensures that most, if not all records are caught prior to establishing duplicate records on SIS.

Facilitated sessions are currently being conducted for the design of an Intranet application that enables academic units and Graduate Admissions Office staff to more effectively manage work in a paperless environment. This business system will require the design of components that can merge IDMS data from the mainframe with Sybase data in an integrated, seamless manner.

![Schematic of Technical Design](image)

**Figure 4. Schematic of Technical Design**

### Conclusions/Summary

There is always excitement associated with a project that is making a significant contribution to the university and general community. The Graduate Admissions Reengineering Project is one that has generated pride, enthusiasm and support throughout the university.

To achieve the goals of improving the admissions process and providing value added services to prospective students and the academic units, open lines of communication were essential. Open communication was effectively established at the beginning of the project with a commitment to form an Academic Unit Coordination Team and conduct regular forums. Regular electronic mail notes and a project Web page have also contributed significantly to the project communications and success.

This project has provided direct benefit to staff and faculty from a variety of offices. Academic units now have considerably more control over the application process. Each academic unit can autonomously decide the degree to which a full transcript evaluation is required. Furthermore, by placing the files in their hands within 24 hours of receipt, they are able to make decisions towards actively recruiting highly sought students. Value added services are provided to applicants and prospects by providing a more comprehensive Web page, including the ability to apply on-line.
Applicants who provide an electronic mail address also receive immediate feedback from having entered their application on-line. In many instances, the admit or deny letter is received by the applicant several weeks or months sooner.

The Graduate Admissions Office can be proud of the way in which they have responded and adapted to a new process. The requirement for overtime and Saturday work will significantly diminish during peak processing. Furthermore, the Graduate Admissions Office staff is excited about learning new technology and working with the scanning and Web based processes. During non-peak periods, approximately 560 hours was required of staff time per week to perform all functions within the Graduate Admissions Office. The forecast is that this will drop significantly to approximately 350 hours per week, with a higher percentage of time spent performing customer service functions.

A project of this magnitude is not without issues. There has been some turnover in staff positions within the Graduate College, including technical resources that are key to the project. Furthermore, issues have arisen with the selection of Web development tools that are stable and capable of withstanding use for mission critical applications, such as the Web based application for admissions. Both of these factors have resulted in revisions to the project plan and shifts in the dates at which technological deliverables will be available.

Further issues have arisen in working with the academic units. While the admissions process impacting the academic units has changed significantly, few departments have responded with corresponding reengineering to their own internal processes. Therefore, it is conceivable that the process of sending and receiving application materials is expedited, while the internal academic unit work is a bottleneck. The Office of Continuous Improvement will be providing resources to assist academic units with an assessment of their own internal processes related to admissions processing. Additional issues have arisen with the reluctance of some academic unit staffs to participate in Joint Application Design (JAD) sessions. Responsibilities of staff in the academic units are often broad; thereby, creating challenges in providing dedicated active participants to facilitated sessions.

As previously mentioned, there has been some skepticism about whether these reengineering changes would occur in the time frame identified. Now that the changes to the business process have occurred, many of the doubters are recognizing the significant power of change. It is also evident from the improved productivity and processes that the Graduate Admissions Reengineering Project is a success.
References