Managing platform conversion in educational institutions

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This paper describes a re-engineering project undertaken by a comprehensive university's extended education department. The project involved a transition from a decentralized workplace dominated by Macintosh personal computers to an IBM PC/clone-based client/server environment. Lessons learned during the decision making and platform conversion stages of the project are emphasized. These lessons are applicable to other similar re-engineering projects.

Introduction

The process of re-engineering higher education is based on new assumptions concerning service and quality and involves redesigning work processes to take advantage of emerging technological capabilities (Penrod and Dolence, 1992). The motivation for re-engineering is a desire to compete in the new world of low costs, global reach, fast cycle times and customer satisfaction (King, 1997). At its foundation, the process of re-engineering depends on the development of a viable information technology (IT) infrastructure (Penrod and Dolence, 1992). This paper describes an IT conversion project that was undertaken at a large comprehensive university's extended education department. The project's objective was to provide a comprehensive computer system to support the department's continued growth, thereby improving service for its students. The project involved a transition from a decentralized workplace dominated by Macintosh personal computers to an IBM PC/clone-based client/server environment. While most conversion projects involve transitions from a more traditional mainframe environment, the lessons learned during the implementation of this project appear to be scalable and applicable to a wide variety of IT conversion efforts.

To date, numerous examples of transitioning technology in higher education have been documented in the literature (Allen and Wilson, 1996; Barry, 1994; Borel and Vincent, 1995; Eaton and Schuler, 1994; Mullig and Frey, 1994). A common theme that emerges from these examples is that key management concerns need to be addressed in the project planning phases. Foremost among these is the restructuring of the information systems (IS) organization to be more user-friendly. This implies, among other things, retraining existing technical staff, training clients, and finding new ways to do business with IS clients. A coordinated capital replacement plan for desktop hardware is also recommended.

The primary IT restructuring/re-engineering focus in the 1990s has been on the implementation of client/server strategies. The client/server paradigm has become the computing architecture of choice, and much attention has been given to client/server application development methodologies (Friend, 1994; Hager, 1996; Jeffery, 1996; Levis and van Schilling, 1994; Low and Looi, 1997; Miller, 1997; Rabin, 1996; Saelens and Nelson, 1994; Subramanian and Lacity, 1997). While the client/server paradigm is being touted as a radical change in IT, most of these articles find that classic project management techniques that have been applied in other IT contexts are still valid. These include such steps as obtaining top management support, redesigning business processes before automation, soliciting user participation, and developing phased implementation strategies.

Client/server applications are not without difficulties. The negative side of client/server and the management of risk have been addressed by many authors (see for example: Charette, 1996; Powell and Klein, 1996; Stephens, 1996; Solomon, 1994). The consensus appears to be that when effectively applied, risk management is a powerful tool for making an IT project proactive. However, poorly applied, risk management can lead an IT project into ruin. Solomon (1994) recommends caution. He notes that although expectations are great and enthusiasm high, most of the actual client/server applications that he reviewed were peripheral, non-core applications, and certainly not mission-critical. In addition to technological issues, a number of authors have stressed the human side, namely the advantages of participatory planning and user training (Amoako-Gyampah and White, 1997; Duffin, 1996; Muller, 1997; Rouse, 1996). Varied approaches are proposed for effective participation. They recommend the use of pilot systems and note the importance of training to assist in the smooth transition to advanced technologies.

The next section presents background information on California State University, Fullerton (CSUF) and its University Extended Education (UEE) department. Subsequently, the history of computing at UEE is reviewed and the evolution to a Macintosh-based environment is described. The motivation/strategy for the IT re-engineering project is presented with an emphasis on the lessons learned during the decision making and implementation stages of the project. The following summarizes the lessons learned, which should be applicable to other similar re-engineering projects.
IT re-engineering lessons learned
1. Study market trends carefully and assess longevity potential dispassionately.
2. Use interim solutions to assist the transitioning process.
3. Personnel are more likely to cooperate and assist others when they are convinced that technology changes will be beneficial to their own jobs.
4. Identify users who can easily adapt to change and use them as agents of change.
5. Do not force change to take place at an unrealistic pace.
6. Be prepared to deal with technophobic workers.
7. Utilize "excessed" hardware if possible.
8. Purchase the most powerful hardware available.

Background/environment
CSUF is one of 22 universities in the California State University System. Located approximately 30 miles southeast of Los Angeles (and about eight 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. In addition to semester-based credit programs, CSUF offers a variety of credit and non-credit courses through its UEE department. The extension program at CSUF operates as a "mini" or shadow version of the university with its own personnel responsible for academic programs and administrative functions. Table I shows some of the activities carried out by each of these functional groups in CSUF's UEE unit.

<table>
<thead>
<tr>
<th>Functional group</th>
<th>Responsibility</th>
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<tbody>
<tr>
<td>Academic programming</td>
<td>• Course/program definition&lt;br&gt;• Instructor selection and evaluation&lt;br&gt;• Fee determination&lt;br&gt;• Facilities management</td>
</tr>
<tr>
<td>Marketing</td>
<td>• Competitive analyses&lt;br&gt;• Publications</td>
</tr>
<tr>
<td>Registration</td>
<td>• Student registration&lt;br&gt;• Student services</td>
</tr>
<tr>
<td>Accounting</td>
<td>• Fees collection&lt;br&gt;• Instructor contract management</td>
</tr>
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Table I
University extended education functional groups/responsibilities

History of computing at UEE
When UEE first began its operations, it acquired CP/M-based personal computers and developed a few standalone database (file management) applications for some of the activities listed under "IT re-engineering lessons". Due to the relative inexperience of the novice computer staff at that time, the applications that were developed were neither integrated nor networked. Data sharing among applications was nonexistent.

Computer systems applications within the university itself, however, were developing along more traditional lines. The campus computer center evolved its mainframe administrative and academic support applications based first on CDC mainframes and DEC VAX minis, later migrating to IBM mainframes and Alpha-micro computers. On the instructional side, Apple Macintosh personal computers proliferated during the late 1980s due primarily to Apple Computer's well-documented efforts to penetrate the education market. This was accomplished through a combination of grants and exceptional pricing policies. The Macintosh penetration extended far beyond the boundaries of instruction so that by the end of the 1980s and even through the mid-1990s, Apple Macintoshes could be found on the desks of most university administrators and their support staff.

In the mid-1980s, an acting director of UEE was appointed who brought with him an unwavering dedication to Apple Computer products. The acting director began a major computerization of UEE's administrative functions, all based on the Apple Macintosh. Over the next few years, more than 75 new Macintosh computers were installed in UEE, keeping pace with the growth of the department. An AppleTalk network was
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Lesson No. 1: Study computer industry market trends carefully and assess longevity potential dispassionately

Hardware

Software application development within the department evolved in a disjointed fashion. Despite the increasing popularity of integrated client/server database systems in business, there was no strategic software application development plan within UEE. Instead, standalone applications continued to be developed on the computer of the person responsible for a particular task. There was no file sharing among or even within functions. Data from one machine was copied to a floppy disk and copied again to another machine. If the file formats were incompatible, for example between a database application and a spreadsheet, a hard copy of data was produced and rekeyed on a second machine. Even when computer applications on different machines were equivalent or similar, there was no online file sharing. To complicate the situation, Apple discontinued early Macintosh models and introduced new ones, resulting in a wide variety of somewhat incompatible Macintosh computers within UEE.

At the beginning of the 1990s, budget cutbacks at CSUF resulted in a need to generate additional revenue through entities such as UEE. A new dean was hired and one of his initial activities was to contract with a consultant to recommend a systems strategy for the department. The consultant recommended that UEE hire a director of information systems, modernize its systems environment, standardize its workstation hardware, and integrate its application software. From a strategic standpoint, the desirable computing environment for UEE was one in which all users could have access to an integrated database system. Furthermore, the application environment needed to be implemented on proven, reliable, cost-effective hardware, and developed with standard development methodologies and software tools. A two-phase strategic plan was proposed. Phase One required the conversion of UEE from an Apple to an IBM PC (or clone) workplace. Phase Two of the system conversion was planned as a parallel development of a client/server database application system. The remainder of this paper presents lessons learned from the development and implementation of the new IT infrastructure at UEE.

• For the foreseeable future, whether or not teams have access to a variety of shared Apple laser printers.
• Hardware peripherals and software for PC workplaces were a matter of major concern throughout the international business environment. Concerned about the potential impact on its own operation, UEE decided to change from an Apple to an IBM PC (or clone) workplace. Other supporting reasons included:
  - Apple Computer had captured less than 10 per cent of the total marketplace.
  - Apple’s market share was continuing to decrease.
  - There was a great deal of uncertainty about the future viability of Apple Computer.
  - There was a wide selection of IBM PC compatible platforms and peripherals.
  - Virtually all computer-based business systems were (and continue to be) implemented on IBM PC and not on Apple platforms.
  - There was an increasing proliferation of software development tools for PC compatibles.
  - There was a wide and increasing range of application software available for PCs.
  - Hardware peripherals and software for PC platforms were reasonably priced in comparison to equivalent products for Apple computers.
  - For the foreseeable future, whether or not their products were state-of-the-art, vendors such as Microsoft and Intel had appeared to replace “IBM” in the refrain of the 1960s and 1970s that “No one ever lost their job choosing IBM”.

Operating systems

Choices for the operating system for UEE included Unix, Novell, OS/2, and Windows NT. Since Intel-based PC workstations had been selected for the end-users, an Intel-based PC server platform was selected for consistency as well as to maximize the probability of compatibility. For all practical purposes this eliminated Unix as a candidate. IBM’s OS/2, despite appearing to have many of the functions desired for the planned client/server environment, simply did not appear to be a popular choice among businesses with needs similar to UEE’s. Novell at the time had a significant market share in similar client/server arenas but the company’s upper management seemed to be in disarray, ever since the company purchased and then sold off its WordPerfect productivity suite. Meanwhile, Microsoft’s stock values were skyrocketing. It was clear that Microsoft had significant marketing momentum and that the company was determined to compete against...
Novell, who seemed to be vulnerable to Microsoft’s plans for NT.

Microsoft’s NT 4.0 Server and the relatively low-priced bundled system software BackOffice were selected, although the first version did not have all the functions that would eventually be required for the UEE system. It was felt that it was likely that by the time the UEE client/server system was fully implemented, the required functions would be available from Microsoft or from another supporting software vendor.

**Application software**

An analysis of UEE’s Macintosh application software was performed and a plan was developed to provide end-users with equivalent software functionality on the IBM PC platform. Due to the success of Microsoft’s integrated suite of productivity software, Office, and its exceptionally low price, the decision was made to standardize on that product. Table II identifies the Macintosh applications that required conversion and the IBM PC platform solution for each.

**Table II**

IBM PC platform replacements for Macintosh products

<table>
<thead>
<tr>
<th>Macintosh product</th>
<th>IBM platform replacement</th>
<th>Primary UEE user</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word, Excel, PowerPoint</td>
<td>These products were available within Microsoft Office on IBM PC platforms, and at a higher version release than for Macintoshes</td>
<td>• Academic programmers</td>
</tr>
<tr>
<td>InForm Manager</td>
<td>Available for IBM PCs; the PC version reads Macintosh-created “forms”. With the eventual availability of the client/server system, InForm Manager forms and usage would eventually be made obsolete</td>
<td>• Accounting</td>
</tr>
<tr>
<td>OrgPlus – an organization chart builder</td>
<td>The functionality of this product was available within PowerPoint</td>
<td>• Administrative services</td>
</tr>
<tr>
<td>A generic personal schedule manager</td>
<td>Available in Microsoft Office</td>
<td>• Administrative services</td>
</tr>
<tr>
<td>Screen savers</td>
<td>The multiplicity of screen savers (some of which were of questionable origin) could be replaced with a Windows version. A side benefit was the ability to enforce a single, professional screen saver standard throughout UEE and eliminate many of the screen savers that were of questionable taste</td>
<td>• All UEE functions</td>
</tr>
<tr>
<td>3270 terminal emulators – for access to the campus mainframe student registration system</td>
<td>With only a few minor differences, IBM PC and Macintosh 3270 emulating software is almost identical</td>
<td>• Student registration</td>
</tr>
<tr>
<td>QuickMail – a campus-wide electronic mail system with Internet access</td>
<td>QuickMail for PCs could be made available on a PC/Macintosh hardware e-mail server combination</td>
<td>• All UEE functions</td>
</tr>
</tbody>
</table>
A decision was made to invest programming resources to rewrite the FileMaker application in Microsoft Access, the relational database manager within the Office suite of software. This was done despite the fact that the application would eventually be subsumed within the integrated client/server system. There were at least three benefits derived from this activity:

1. The project provided a training opportunity for the software engineer assigned to this task since she was, at the time, relatively unfamiliar with Microsoft's database products.

2. Because a redesigned version of the application was going to be developed as part of the Phase Two system implementation, the reprogramming activity would provide important input into the design of this module in the client/server system.

3. Data conversion/transfer would eventually be required between the old Macintosh accounting module and the new PC-based relational database. The interim application's Access data files would be completely compatible with the file structures of the Phase Two system (SQL-Server) and could easily be imported into the master database at the proper time.

When the interim Microsoft Access application was completed, the accounting department's Macintoshes were replaced with PCs without losing the purchase order capability. Although the Access application would be discarded with the completion of Phase Two, it would serve its purpose and provide added benefits to the entire project.

Lesson No. 3: Personnel are more likely to cooperate and assist others when convinced that technology changes will be beneficial to their own jobs.

The success or failure of a technological transformation may hinge on the manner in which the change process is managed. Proper preparation and communication with end-users are critical. In order to prepare UEE for Phase One of the project, group meetings were conducted to describe the plan for replacing the Macintoshes. Information regarding existing problems was collected from the end-users. The most visible of these problems included slow network printing (or sometimes no printing capability), and an inability to run the latest versions of Office. These problems were due to the variety of aged and unreliable Macintoshes, including some with insufficient resources to run upgraded software. Subsequent meetings presented explanations of how the new systems would address those problems. At those sessions an expectation was created that the new systems would eliminate many, if not most, of the computer problems that were being experienced. While many end-users remained skeptical, some of the personnel were enthused and were keen to volunteer for first use of the new machines. These workers became valuable instruments of change.

Lesson No. 4: Identify users who can easily adapt to change and use them as agents of change.

Following the group meetings, end-users were identified who were already familiar with the target platform and/or were most likely to adapt to the new system with the least difficulty. Two such individuals were selected (or volunteered) within each of the UEE functional groups and they were scheduled to become the first PC/NT users within their departments. The specific software application needs of each individual were identified, for the most part reflecting the eventual software that would be installed on the machines of the other members of their functional groups.

Machines were ordered for this first group of early adapters, and appropriate software was installed for each. By this time the required hardware/software infrastructure was in place. The physical facility was rewired with Ethernet cabling and with connectors at each workstation site. The NT workstation PCs were configured so that the NT desktop icons (applications and folders) would be as similar as possible to the Macintosh desktops with which users were familiar. NT per mission-setting functions were used to set up the workstations so that system functions and settings could not be altered by the user. For example, the Windows Registry, wallpaper, and screensaver settings were configured to be protected from end-user tampering.

Each person was provided with a brief, individualized familiarization session concerning the PC and the NT interface, and if requested, a summary textbook describing Windows NT functions. After about two weeks, the frequency of assistance calls to UEE's End-User Support regarding the new platform was negligible. The success of the first group was quickly becoming a topic of conversation among the staff, and the ease with which the first group adapted to the new machines encouraged people to volunteer for new PCs.

Lesson No. 5: Do not force change to take place at an unrealistic pace.

Based on the successes to date, it was determined that full workstation deployment could take place. About 20 more PCs were ordered.
and five more end-users within each functional group were selected to receive them. The new group was selected primarily because their offices were physically close to the first group of NT users. This was done so that if new users had problems or questions, there would be someone close by to help them. As a result, the next part of the rollout went almost as smoothly as the first. In addition, the early adapters soon became identified as a resource to draw upon for questions on use of the new PCs.

Lesson No. 6: Be prepared to deal with technophobic workers
In the final phase of the rollout involving approximately 50 more end-users, it was noted that there was a group of workers who were less comfortable with the proposed changes and computers in general. For these users a conversion from the desktop metaphor of the Macintosh to that of the IBM PCs was not easy. While Windows 95 and NT had come a long way, there were still enough differences to confuse end-users whose main purpose in using a computer was to just accomplish a work-related task. Even trivial differences such as single versus double clicking or the use of a one- or two-button mouse can be major headaches for ordinary computer end-users.

Recognizing the nature of the workforce, a less ambitious implementation schedule was adopted for this final group. More “hand holding”, and individualized attention was anticipated. One-on-one, personalized training programs were provided for key personnel who were viewed as being somewhat technophobic. This final rollout turned out to be easier than expected because of the availability of on-site “experts” within their own functions (see Lesson No. 4). Within approximately four months, all of UEE had been successfully and relatively uneventfully converted to Windows NT platforms.

Lesson No. 7: Utilize “excessed” hardware if possible
When announcements were made regarding the plan to convert, many staff members inquired about the fate of the Macintosh hardware. Most of the older systems were of no value, being inadequate to run contemporary software applications. However, newer and faster machines that could be upgraded with memory (taken from even older Macintoshes) were candidates for redeployment. Redeployment eases budgetary pressures since certain procurements may be deferred into the future. Two types of end-users were identified that could utilize upgraded Macintoshes: Student Registration and the UEE student assistants.

Student Registration’s primary use of personal computers (about ten machines) was as 3270 emulated terminals accessing campus mainframe administrative systems, and for campus e-mail. Rather than invest in new NT-machines for these people, it was decided that those functions could easily be carried out using the best old Macintoshes in the inventory.

UEE employs approximately 25 student assistants whose primary computing activities are e-mail with their supervisors, and word processing of their supervisors’ letters, reports, etc. It was felt that there was no need to quickly deploy NT machines for these users, so each student was provided with one of the “better” remaining Macintoshes. Eventually, student supervisors would require that their students be upgraded to NT-compatible machines, and the budget was adjusted accordingly.

Lesson No. 8: Purchase the most powerful hardware available
Utilizing the “excessed” hardware and deferring procurements permitted UEE to purchase fewer, more powerful PCs for the same budget. During the initial procurement phase the Intel family of Pentium processors underwent significant changes in availability, price and capability. In addition, the current trend for application software to grow larger and more memory hungry shows no sign of diminishing. It was felt that the fastest available processor would provide the longest potential utility and would delay the need for replacements. Consequently, UEE paid a premium to purchase the fastest available processor each time an order was placed. The first batch of machines used 133 MHz processors, and the final batch used 200 MHz Pentium Pro processors.

When, as anticipated, the first student Macintosh users’ need for compatible NT machines became apparent, 233 MHz Pentium processor-based PCs were available. Those new machines were acquired and substituted for the earlier-deployed 133 MHz PCs, thereby allowing professional staff to receive state-of-the-art PCs while the students received the older and slower 133 MHz machines. Each time new machines were ordered, either for new staff or to replace Macintoshes, a re-examination of all users’ computing needs was performed to determine which users could best utilize the increased power of a new machine.

Conclusions
Although the activities that took place at UEE were not undertaken as a pilot or test case, much of the experience that was gained
implied that the very same strategies could be used for a conversion/deployment of many more users and computers, i.e., the UEE strategy was scaleable. In fact, a few months after the completion of phase one, the university began planning a similar but more wide-scale personal computer standardization process across the entire organization. The UEE experience provided valuable input towards the planning of that project.

One final observation: Personal computer folklore reinforces a metaphor concerning “religion-like” differences between Macintosh and Windows users. Lewis (1997) describes this as a form of “tribalism”. Whether their passion is best described as tribalistic or religious-like, it is very, very difficult to convert Macintosh users to IBM PC platforms. However, disapproval of Microsoft’s business practices and/or admiration for Apple’s incontestable historic contribution to personal computing cannot be factors in making practical business decisions. When cost benefits and work efficiency must be guiding principles, sheer emotion cannot stand in the way of progress. In CSUF’s UEE, professional attitudes towards progress were a motivating factor in facilitating the movement of the unit forward from its entrenched computing culture towards a more contemporary, efficient work environment.

References