Chapter XII

Technology and the Music Unit

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Introduction

Among the many chapters of this book of management principles for music executives in higher education, it seems likely that this chapter will be the first to become hopelessly outdated. The reason, of course, is that the pace of development of new technological tools in general, as well as the evolution of those tools that are applicable to music settings, has been, is, and is likely to remain high. Little else in our management field seems likely to change nearly as rapidly. And indeed, any serious forecasting about the uses of technologies more than five years or so into the future seems ultimately to be proved naive. Thus, this chapter will focus on relevant principles as opposed to techniques or tools of technological applications, with the hope that they will prove useful far longer, through several successive generations of new techniques and/or applications.

Technologies based upon microprocessors—computers—have revolutionized almost every aspect of contemporary society, including much of what colleges and universities routinely do to manage their affairs and to be of good service to their students. Some of these developments have profound implications for the managers of the music units at these schools. The competent higher education music executive must at least be aware of how these devices are being deployed at his or her school, the management implications relating to their use, and the opportunities for enhancement in instruction or the provision of service that are available or are likely to become available in the near future.

General discussions of the rate of computing evolution over these last decades often include references to "Moore's Law," drawn from an oft-cited article in the April 1965 issue of *Electronics* magazine by Gordon Moore, one of the founders of the microchip manufacturer Intel. In this article, Moore speculated that the cost of computing would decline by roughly half and that the speed of computing would double approximately every 18 months for the foreseeable future. That extraordinary projection has proved remarkably accurate for more than 40 years, and we have witnessed enormous increases in computing power as well as steep declines in computing cost, together bringing nearly unimagined computing applications to almost every aspect of human activity, including university education. Many have wondered how long Moore's Law would continue to be descriptive of advances in computing. Moore answered in April 2005 with an admonition that the computing field was approaching an absolute limit of sorts, at least as it is now being realized, as transistor miniaturization approaches atomic levels. His projections, he contended, would not hold forever. Still, he maintained, development will continue exponentially as he had forecast for at least another ten or twenty years. We'll be able to do more, faster, and cheaper as the years go by.

Technological Applications in Higher Education

Music executives in higher education have an array of computer applications at their disposal, and others will no doubt appear in the months and years ahead. They support activities in areas such as instruction and instructional support; communications, including promotions and marketing; the storage and retrieval of information; budgeting; and research.

Computers have generally been connected one to another through cables and telephone lines. We have already moved into an age when all but the most sensitive sites can be connected wirelessly. Rooms, buildings, and now entire municipalities have been provisioned so that computer users with wireless interface equipment installed in their laptops can connect through the Internet to virtually any site. Only in very sensitive applications does it make sense to invest heavily in cable connections.

Instruction

At the very core of our instruction in higher education is a commitment to fostering student development through teaching. That topic, it seems, should be central in this discussion as well. Higher education as a field already employs computer technologies in support of a wide array of student development, but these applications are best understood by the type of instruction or instructional support they promise.

Wisely programmed, personal computers have long been shown to be capable of managing certain types of instruction and in those applications to essentially function in lieu of a live teacher. That has been the case for 25 years now. In these applications, the computer's greatest capability may be its consistency. Unlike live teachers, it never misspeaks, never makes an error of sequence, never becomes disappointed or bored or agitated, and is always immediately available to the student. When computers guide instruction, the classroom teacher is often freed to help in ways that the computer (at least as yet) cannot—diagnosing and treating emotional issues, creating new ways of presenting or explaining a concept to a "special needs" student, and working to keep students on task.

Typically these programs lead the student through the acquisition of a sequential series of skills, facts, or conceptual understandings, each building upon the last. The more sophisticated of these programs evaluate the student's progress through the material and control the student's pace through each component part, providing the student with remediation and/or additional relevant exercises if the skill or understanding has not been firmly established, and moving directly on the next component if it has. Most report the student's performance or progress back to the student and to the teacher/supervisor. Music units already widely use such programs in support of such skill sets as aural skills, rhythmic dictation, and note reading. Most often, it seems, activities such as these, in which the computer is guiding the instruction, are described as *computer-managed* instruction. In them, the computer is *central* to the instructional process.

In the field of composition education, an exciting pedagogical revolution seems to be under way. It long was the case that music students could develop their knowledge and understanding of musical systems—and indeed could *experience* music—by only two avenues: listening and performing. Indeed, those two avenues have represented the entire set of alternatives for becoming musically literate. Composition was something pursued by those with an interest who had developed at least a fairly sophisticated music understanding through one or both of these other activities. Computers and a few well-crafted programs now enable even completely untrained music students to construct musical compositions and to come to learn about music in the process. The computers can record any sound generated by the student, replicate it, alter it according to the student's directions—transpose it, change the timbre, enable other sounds to be layered on top of it—and play it all back at any time, while allowing the student to adjust it according to his or her own sensibility. Thanks to computer-based technology, composition has finally become a realistic avenue for *learning* about music.

More recently, teachers, and especially college professors, have realized that computer-based activities can enrich and extend what takes place in an otherwise traditional instructional setting (i.e., a classroom), with an array of available computer programs designed to supplement traditional instruction. These programs enable the teacher to post information important to the class, facilitate out-of-class communication between the students and the teacher and among the students, provide ready access to reading assignments and other resources, enable easy electronic submission of assignments, and much, much more. In music settings, the availability of digital audio playback allows each member of an orchestra to listen to a specific performance of a piece they are preparing before the next rehearsal. We might refer to such computer-supported augmentation of traditional instruction as *computer-assisted* instruction.

It is also possible, in certain fields, at least, for the entire course in a college or university curriculum to be delivered remotely by computer over the Internet, though the efficacy of such instruction has not yet been demonstrated to everyone's satisfaction. The term used to describe such educational activities is *distance education,* and it has become a regular part of the "pedagogical playbook" at a great many colleges and universities. Distance education's advantages are substantial. When studying in this manner, students are no longer limited by geography. They may participate in the instruction from wherever they happen to be, so long as they have access to the Internet.

Most distance education projects are *asynchronous*. That is to say, students may do their learning at any convenient time within a given period and not necessarily at the same time as their classmates, the way a traditional course might be scheduled. In asynchronous settings, students are not limited by time. This means that students who have been hospitalized, or who are employed during their period of study, or even those who might be serving in the military or as missionaries in an underdeveloped country can still take classes and pursue their educational goals. Data collected relating to distance education indicate that even students living on campus (and so proximate to classroom buildings) may prefer to have at least some of their instruction delivered by this technology.

Not all subjects seem equally amenable to distance education. Those with discrete and readily expressed conceptual underpinnings, such as accounting and computer science, seem most workable in distance education applications. Those that depend heavily on class discussions and/or collaborative work, such as literature and acting, do not. In the field of music, music history, music theory, and perhaps aural skills could conceivably be taught well at a distance. It's difficult to imagine, on the other hand, that ensembles or even applied instruction can be realized with high standards through distance education. At this writing, though, Boston University is offering a complete and pioneering graduate degree program in music education exclusively through distance education—a pioneering initiative—and NASM (National Association of Schools of Music) continues to accredit the program.

Though the extent of distant education in the future is a matter for bold speculation, many of the colleges and universities who have experimented with it in the hope of achieving a per-student cost reduction have become at least somewhat jaded. Many, it seems, have discovered that teaching courses through distance education is generally far more timeconsuming than teaching in traditional classroom settings. Distance education seems generally not to promise significant cost reduction on a per-student basis. Many have discovered that distance education is, on the whole, *more* expensive than traditional classroom-based instruction, though these quick calculations often overlook the cost of building and maintaining classrooms.

Speculation on the future of computer-managed, computer-assisted, and distance education in colleges and universities, and especially in their music units, suggests that each type will continue and that their applications will be refined and lead to greater student development far into the future.

One possible new application of computer-managed or assisted instruction seems potentially so powerful in helping our music students reach some of their goals as musicians that it deserves special mention. Just as commercial airline pilots routinely now complete the majority of their flight training in simulators, so too may musicians use simulators soon to foster their own growth. Instead of stepping into an acoustically severe and aesthetically barren practice room to work on, say, the principal clarinet excerpts from the Brahms First Symphony, our students may soon be able to step into a simulator and take the principal clarinet chair in the virtual Chicago Symphony Orchestra while Pierre Boulez conducts them in a *performance* of the Brahms First. The simulator would generate high-fidelity audio and visual information, evaluate the performance, and allow the student to return to any part of the piece as often as he or she would wish for further experience. Alternatively, the student could sing tenor with the King's Singers on an English madrigal, play viola with the Emerson Quartet on Beethoven's opus 131, conduct the St. Paul Chamber Orchestra in the Mozart Requiem, or lead an elementary school orchestra rehearsal. The possibilities for authentic and vital musical/educational experiences will be nearly endless, and those experiences seem likely to far transcend what we can now provide. That's a part of the future that the music executive will need to be prepared to face.

Communications

Communicating information internally with our students, our faculty and staff, and our central administration has been an important activity for music units since the days of carbon paper, mimeograph machines, and early photocopiers—earlier incarnations of technological advancement. Communicating externally with prospective students, the parents of current students, alumni, donors and donor prospects, and those we'd like to invite to our concerts has similarly been important since well before computing became widespread on campus. Microprocessor-based technologies have profoundly influenced our ability to share information with these various internal and external constituencies less expensively, more easily, and with higher quality productions than ever before.

Twenty years or more ago, businesses began to imagine using technology in pursuit of what was then described as "a paperless office." Colleges and universities weren't far behind them in contemplating paperless school offices and classes. What was imagined then is being widely realized today. E-mail and the electronic exchange of documents—created and viewed on computer screens—have, in many places, allowed all necessary work to proceed without paper documents. Virtually all of the communications that music units have long sustained can now be accomplished quickly, cheaply, and in a well-polished form via electronic means. We now use e-mail regularly to distribute electronic memos to our faculty and staff, advise students of new opportunities or changes in the schedule, invite our regular audience members to attend special events, report expenditures and plans to our central administrators, communicate with prospective students, respond to parental concerns, and share ideas with and respond to questions from the students we teach. We similarly use Web sites as repositories of information about our programs, our applications processes, our concerts, our policies, our faculty, and more.

We use computers to create and edit special electronic promotions, and generate the materials that we will use to print marketing and promotional pieces, and quickly update those pieces that are no longer current. Updating class schedules, course catalogues, syllabuses, and so on has become a quick operation—saving many hours over the time when these documents had to be generated anew each time and the typewriter and a bottle of correcting fluid represented our most advanced technologies. It's hard now to fathom the number of hours computer-based technology has saved music units simply in communications.

Not long ago, the printed catalogue and the handwritten or typed application—delivered to the college or university admissions office by the U.S. Postal Service—were the primary mechanisms of communication with and by prospective students. Sometime within the last ten years, the primary vehicle for engaging prospective student interest has become the college's or university's Web site, the primary mechanism for responding to student questions has become e-mail, and the majority of applications now arrive electronically. The ease with which a prospective student can submit an application now seems to have contributed to a dramatic increase in the number of schools to which most students apply. Where in an earlier time, a student might apply to no more than four or five schools, now they seem very likely to apply to ten or twelve. Some of the time saved in admissions offices by the ease of communication that technology has brought must now be devoted to responding to a significantly increased numbers of applicants.

The specific tools of communication we use continue to evolve. Voice-over-Internet service, for example, is reliable and far less expensive than telephone service and promises to become the dominant mechanism for distant conversations. Further, though e-mail was "cutting edge" among college and university students just fifteen years ago, students now rely much more heavily on text messaging through their cell phones while e-mail messages may go unread for many days.

Storing and Accessing Information

Computers, and the electronic files they create and to which they can provide access, have revolutionized one enormously important responsibility of every college and university—the need to carefully manage and protect data. These data range from applications to academic records, alumni donations to personnel files, financial records to inventories, and curricula to contact information of all constituencies. Thanks to computer-based technologies, these data are cheaply and compactly stored, easily backed up, protected, and almost immediately accessible even from very distant sites.

With the ease of storage and access comes a magnified responsibility to protect the data from theft or corruption. Data security and controlled access are important concerns and require additional programs that must be upgraded regularly to protect against new threats.

One fairly recent development in database management, integrated architecture, seems likely to become the widespread standard for both businesses and schools. In these systems, data from otherwise discrete databases are allowed to migrate into other regions without new data entry activity. In colleges and universities, for example, a prospective student may complete an application for admission containing a great deal of information; these data are enhanced with new data—test scores and an evaluation of the application essay—and a decision to offer admission may be made. If the student accepts the admission, he or she becomes a matriculated student, and his or her data moves to another data set—current students—and the "file" begins to accumulate data regarding registrations, grades, and application for and admission to a specialization. Ultimately, we hope, the student graduates, and those data are migrated to the alumni data set.

Under older systems, the same base data, including name, birth date, address, social security number, and the like, would have to be entered anew at each transition—from applicant to student and from student to alumnus. With an integrated architecture, those data are entered only once. The power and the promise of an integrated architecture is time saved in data entry and the ability to make inquiries across otherwise discrete data sets—to determine, for example, the ways in which our current students are and are not like our former students.

Budgeting and Financial Reporting

The critical aspects of both budgeting and financial reporting lie in the judgment of the financial managers and ultimately in the decisions they make. This is, in a sense, a special case area of the storage and retrieval of information discussed above. Current, accurate, and easily accessible financial information is a necessity for any financial managers who aspire to informed judgments. With this particular type of data, computer-based systems of storage and retrieval that provide immediate and automatic updating of account information are highly valued.

Research and the Internet

Information on almost any topic is easily available through the Internet. Some journals have begun publishing in electronic format as well as in print, and others are available *only* electronically. Further, initiatives continue that promise to make every important book available electronically as well. These dramatic and recent developments have profoundly affected three areas of long-standing concern to college and universities: scholarship, respect for intellectual property, and libraries. No doubt further changes will be a part of future technological development.

Scholarship is a bedrock activity for faculty and a focus of a great deal of student work as well. Indeed, it has long been the case that learning to value scholarship and pursue scholarly inquiry according to the conventions of the academy is a fundamental outcome of higher education. A significant part of this learning has focused on assessing the validity of each source encountered in any scholarly inquiry, and students learned to trust the content of refereed journals and books published by highly reputable firms. The Internet, though, has allowed almost anyone to publish, without referee or editor if they wish, resulting in a vast sea of readily available information of grossly variable credibility. The academies, and especially the students, have not yet learned to parse this information as to its credibility, and student scholarship could be in decline as a result.

A somewhat related issue and another core academic value is an absolute abhorrence of plagiarism. So much information is available so readily through the Internet, though, and so much of it unfamiliar, that students and even faculty members have too often copied large amounts of Internet text into their own "scholarly" work without attribution and submitted it as though it were their own. Clearly this academic value is no longer consistently established in the academy. However, computer programs already exist that make ferreting out plagiarism much easier than ever before. One may now submit suspect portions of a paper, or even the entire work, and rapidly learn if it came from an extant source and, if it did, precisely from which source it was drawn.

College and university libraries may be changing as well. The Internet and the electronic publishing phenomenon give students and faculty far less reason to visit the school library than before; now almost every source they might wish to consult can be accessed at any time of the day or night from their apartment, dorm room, or the coffee shop across the street. Libraries have fewer live "customers" and diminishing need to acquire and sustain large print collections, as well as no need to replace lost, stolen, or damaged materials. If this trend should continue to its logical conclusion, research libraries may someday exist in virtual space only.

Some holders of large digital audio file collections, and specifically a couple of recording companies, have developed subscription services that allow subscriber institutions to access and download any of their digital files. Schools employing this service can now bring any of tens of thousands of high-quality recordings into the classroom for study and analysis instantly, without handling a CD or tape. Professors can respond immediately to opportunities to teach a specific point by bringing the recording to life in the classroom. The digitization of audio has made the unlicensed copying of audio materials easy and cheap. It falls to everyone in the profession to resist the temptation to employ pirated audio files in any way; we must respect the rights of the performers and composers.

A consortium of more than 200 universities, 45 corporations, 70 government agencies, and more than 50 international partners has since sustained a very high speed Internet called Internet2, created in 1996 and with transfer rates several times faster than the Internet allows. Some of these schools and research centers have begun development of an even faster network which they call Internet3. Schools of music connected with those universities may be able to take advantage of those elevated transfer rates to "broadcast" high-quality live music at a distance.

Computing Costs

Though we have realized an increase in computational speed and the reduction in cost that Gerald Moore predicted in 1965, the cost of computing is not zero. Many of us have learned the hard way that projects with technological components must include some sort of budget for support. The Web site that we developed in 1995 was pioneering then and served our needs well, but the information it contained regarding faculty, curriculum, schedule, and especially policies quickly became outdated. In retrospect, we were foolish not to build into our base budgets the cost of maintaining and updating the site, just as we do for maintaining and tuning our pianos. Similarly, the new computers we purchased when we first created a computer lab for our students would not be serviceable forever. We needed to build into our budget and our expectations the need to periodically upgrade the lab with new and more powerful machines. The wise music executive should increase budgets realistically to maintain technological applications.

What remains undeniable is that computer-based technologies will continue to make our work in college and university music units easier, faster, and more powerful. Likewise, the technologies we employ today will inevitably be replaced by faster, less expensive, and more capable tools in the future.