Information Technology in Higher Education: Evolving Learning Environments

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Information technology effectiveness has been, and will continue to be, an important factor for organizational success on a worldwide basis. For an educational institution, the ability to assimilate and distribute knowlege is crucial; however, universities suffer from a lack of vision where information technology is concerned. In order to establish an effective learning environment, the higher education IT organization must re-examine its strategic plan and its role within the institution as a whole.

Evolving Learning Environments

> By the year 2000, American colleges and universities will be lean and mean, service oriented and science minded, multicultural, and increasingly diverse -- if they intend to survive their fiscal agony.
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> *Time* , April 13, 1992

In a recent symposium, leaders in higher education were brought together to discuss the place of technology in colleges and universities. They addressed the following general questions: Why does education need technology? How will technology effect education as it is known today? What justifies technology's cost, and what is its value to higher education? To an intelligent person, it seems impossible that educators could possibly need to ask these questions in the last decade of the twentieth century. The fact that these questions were asked, however, suggests that there is a major problem. In a society where almost all cultures have embraced technology and are moving quickly to fill gaps in order to utilize technology, higher education as a whole lags behind. One wonders if, in the past, higher education was as slow to embrace running water in dorms or slide projectors in classrooms. In a recent issue of *The Monitor*, Tom Wason reaffirms the fact that no situation in which the world finds itself is truly new: "If you look far enough into the future . . . you can see the past. The development of new information technologies has placed the educational establishment at a juncture parallel to the fifteenth century academy shortly after the Gutenberg revolution. . . ."(Wason, 1996) It seems, therefore, that a twentieth century revolution parallels a fifteenth century revolution. How can this be? How is it possible that this mindset still exists? Perhaps it exists because higher education is not driven by the demands of a capitalistic society, as is private enterprise. Perhaps it is an arrogance that life will always be the same and that one does not have to change. Perhaps it is the academic mentality. Whatever the reason, it leaves society wondering if higher education in its current form can meet the demands of this modern information age. Twenty years ago industry learned that to survive it must embrace technology as an intregal part of the industrial world, and today if colleges and universities are to survive they must embrace technology as an integral component of higher education.

One of the first areas that requires change is higher education's perception of technology as it relates to the mission of higher education. For the past decade, most attempts to use technology in higher education have been very haphazard: systems have been designed only to automate existing processes, computers have been thought of as strictly computational devices, and desktop workstations have not accomplished much more than to replace the typewriter and the adding machine. Today, however, technology is creating a new educational platform and is reconfiguring the way a student learns. Network learning - accessing libraries, scholars, networks, and information worldwide - is evolving. In light of this, one important question needs to be considered - what is the mission of higher education? Since education is a discovery process, an exploratory process, its mission is to provide the widest repertoire of possibilities with which a student is faced when entering a learning situation. Technology can provide this learning expanse, and because of it a student's educational experience will be immeasurably richer. For example, anatomy students generally hear lectures and read textbooks on anatomy and maybe are lucky enough to have a human cadaver to dissect in a laboratory; using a computer, however, they can actually dissect a human body, do procedures over and over, and even practice surgical procedures. Instead of viewing cell slides once in a laboratory or looking at still photographs in a textbook, students can have around the clock access to live slides and can perform laboratory procedures using the computer. Medical residents can have access to heart and lung sounds that they probably would never have experienced in a residency in just one hospital. With distance learning, students can view medical procedures first hand to which they otherwise may have never been exposed and listen to Nobel Prize winners lecture while sitting in their classrooms. With many universities providing their scholarly lectures on the Internet, students can have many views of a topic and can also have electronic access to

more scholars faster than publications can provide. With automated history books, students can hear and see the Fireside chats and watch Apollo liftoffs instead of just reading about them. In their article "Using IT to Enhance Academic Productivity," William Massey and Robert Zensky state the conditions necessary to make such an experience possible: "IT offers a great potential, but in order to reap the benefits, institutions will have to transform themselves in fundamental ways. Our task is to understand these changes in terms that are both practical and operational." (Massy and Zensky, 1995) This statement emphasizes the basic change to which higher education must devote itself in order to accomplish its mission.

The most important potential of technology in education is in the use of the world's increasing amount of knowledge. In all disciplines there has been a tremendous implosion of data with no real way to disseminate it; this data requires technological resources to communicate it as usable information. This communication of usable information tends to be disseminated vertically; to be useful, it must also be disseminated horizontally, crossing discipline boundaries. Traditionally, higher education has organized itself along rigid boundaries of discipline which result in a ghettoization of thought; but technology forces people to cross boundaries, to think comprehensively, to find ways to solve problems. For instance, one learning experience which could be more comprehensive if these rigid boundaries were crossed exists between two very dissimilar disciplines, physics and medieval English. A very basic concept in the study of physics is the study of sound waves. In medieval literature Geoffrey Chaucer, in a poem written in 1379 entitled "House of Fame," gives a long, accurate description of the way sound waves travel through air. If one were researching the concept of sound waves in a traditional library setting, he would never find a reference to Chaucer's medieval poem among the scholarly treatises on physics; however, querying the Internet for references to sound waves, he would not only find the physicist's theories, but Chaucer's as well. The theories are not different, but while the physicist observes the scientific importance of the journey of sound waves through the air, Chaucer looks at this physical phenomenon through the eyes of a very practical man and a poet. By seeing this topic communicated in different ways and by crossing these distinct discipline boundaries, the student has broadened his perspective in a way that was almost impossible before technology reached this stage. In a recent Eductech report, William Graves insists that technology is the most viable tool for improving educational quality and information accessibility. (Graves, 1995) To encourage human potential by providing this wide variety of communications resources is, therefore, the vast potential of the information age in higher education.

If there is then great potential in using information technologies to benefit higher education, why is it not happening? What is the problem? What can be done to solve the problem? Massey and Zensky suggest that an overall sense of purpose is missing from higher education. A futuristic understanding at what all of these technological advances might mean or what these innovations might look like is missing. The fact that practicality and accountability for the consequences of decisions are also missing results in the haphazard approach to the use of IT resources. (Massy and Zensky, 1995) As a result of the traditional isolationist environment surrounding higher education, a vision of how to utilize technology is missing. Not only does this lack of vision exist in the mission of higher education as practical educational applications but is also prominent in the higher education system as evidenced by a severe lack of adequate administrative systems. The university leadership and infrastructure must support the endeavor to use technology to improve and evolve learning environments. Learning environments cannot evolve without the adaptation of practical educational applications strengthened by strong administrative systems. To achieve this, there should be a philosophy in higher education of delivering computing services as a public utility, such as electrical services or telephones. In order to accomplish this philosophy, in order to make decisions that will create a collaborative learning environment, the two sides of education must meet: the fiscal and managerial must meet with the academic and philosophical. The collaboration of these two entities requires the leadership and vision of the entire university organization.

The organization of IT in higher education must be improved, and the university as a whole should have an infrastructure in place to support the potential of this information age.

Metatonia

> It is a misfortune, inseparable from human affairs, that public measures are rarely investigated with a spirit of moderation which is essential to a just estimate of their real tendency to advance or obstruct the public good; and that this spirit is more apt to be diminished than promoted by those occasions which require an unusual exercise of it.
>
> James Madison
> Federalist

In supporting the potential of the information age in higher education, complexity in the use of information technology must evolve into simplicity. Information systems should be as simple to use as a light switch or a telephone. If technology is to be embraced and thus indispensable to higher education, it must be that simple. IT professionals must, therefore, understand the way the user thinks: technology is broken and discarded if the user can not perform necessary tasks. In a recent CAUSE professional paper, Jan Baltzer suggests that IT must think of itself as a supplier of information to the rest of the institution, must consider the entire institution as a customer base, and must realize that IT needs the customers as much as the customers need IT. (Baltzer, 1991) If IT professionals thought of themselves as suppliers of information and thought of the users at the institution as their customers, they would make the utilization of IT services simple. For instance, something as simple as dialing into the network from home to use email can require the integration of up to three processes: configuring modem software, installing network software, and installing email software. To the IT professional, this seems simple; to the user, who must spend one hour installing all the software and subsequent hours reading through pages of manuals and going through three steps to log on, the task is not only difficult but also frustrating. Simplicity then is necessary and simplicity requires integration. To achieve integration, Heterick maintains that everything should appear as one system to the user and that systems should be distributed with a single systems interface. He also proposes a "single system image" as the principle element whereby coherency in information technology (IT) is maintained. (Heterick, 1988) Integrating systems into a user view of a single systems image and thinking of users as a customer base will allow the IT organization to evolve complexity into simplicity.

Achieving this objective of simplicity requires a major change in the thought processes of leadership in higher education as it relates to strategic planning and the role and organizational arrangement of IT. The way the university thinks, feels and acts toward technology must be restructured, and the way to achieve this objective is to weave the IT organization throughout the university infrastructure.

This restructuring of the IT organization requires a metatonia - a shift of mind - because, while a change in infrastructure can facilitate the potential of the information age, only the people in the organization can transform potential into reality. It requires a shift in the minds of university leadership, of the IT leadership and staff, and of the IT customers which include faculty, staff, and students. This metatonia will require them to look at the organization in a new and different way as interdependent groups, departments and individuals rather than isolated areas of structure. Ernst suggests that to accomplish this change, institutions should place less importance on the organizational chart and more emphasis on crossing departmental boundaries, stimulating and rewarding collaboration, providing easy access to information, and having customer centered objectives. (Ernst et. al., 1994) Strategic planning should be highly visible. IT organizations should, moreover, be in a continuous strategic planning roll and should make decisions and policy in concert with administration. Heterick underscores this need for collaboration: "As the paradigm for campus information systems turns from a mainframe centered,

Ptolemaic model to a user centered Copernican model, it will be necessary to define responsibilities." (Heterick, 1988) This defining of responsibilities will need to address the relationships between the university's strategic planning, the goals, and the information infrastructure. Heterick further suggests that the most recent management crazes - reengineering, total quality management, best practices, and zero defects - have all failed basically because they have not adapted the idea of networking, which is about getting as much information out in the organization as possible to allow diverse units to function as one. (Heterick, 1996) This metatonia is the ultimate responsibility of the university as a whole, and without it, any IT approach will fail.

Simplifying the using of technology and accomplishing a mind shift are, however, not achievable without strong leadership. Although the importance of networking has already been established, networking has less to do with management and more to do with leadership. Chinese history involves a highly educated figure known as a mandarin, a high civil servant who exercised immense but undefined powers without publicity or political control and who gave of his knowledge willingly. A mandarin's power was not accomplished by authority but by influence. Respect and power come from willingly providing people with a wealth of information, not from withholding it. Historically, IT leaders have sought to make their position in the organization very influential by treating the institution's information as their own to disseminate or not to disseminate at will. A better approach would be to learn from the example of the mandarin. Thomas West theorizes that the role of IT will have less to do with its place in the organization and more with the strategic perspectives, leadership and management brought to the IT function. (West, 1996) Leadership, therefore, is the mandatory base on which the IT organization must be built.

Leadership must not only be present in the IT organization, but in the whole of higher education in order for this metatonia to take place. For example, Cornell University is one of the leading universities in the country in terms of accomplishing innovative technology strategies in higher education. Many IT professionals at Cornell insist that without a "champion" outside the IT organization to provide dynamic vision and support , IT projects will fail and it subsequently becomes irrelevant how good the IT organization is. It seems that this champion's leadership projects the message that the technological advances are for the good of the university and are not just being implemented for the sake of using the newest technology. Therefore, all leadership in the university must embrace technology, and the impetus must come from outside the IT organization.

Evolution

There comes a time in every man's education when he arrives at the conviction that envy is ignorance; that imitation is suicide.

Ralph Waldo Emerson

In addition to strong leadership, strategic planning is an essential ingredient for this evolution. Although good people and good leadership are very important, they do not substitute for good strategic planning and organizational design. Strategic planning is, therefore, an essential element in having and maintaining a good IT organization. Since establishing goals seems to be such a static approach - considering the speed at which technology is growing and improving - Heterick suggests instead that universities should take a more strategic view of the institution's computing and telecommunications future to allow for a philosophy of seizing opportunities when they exist. (Heterick, 1996) Traditional strategic planning methods work for building dormitories, but they do not work for building information technology. IT strategic planning must be adaptive to change and must be able to change continuously as new developments in technology arise. Borel explains: "We have come to understand that as we plan for the future we can no longer apply the words long term to our computing solutions, that our plans must

remain flexible." (Borel and Vincent 1995) Historically, unadaptive strategic planning has resulted in throwing dollars at IT when funds were available or more often when funds were in surplus; these expenditures were expected to be one time costs, like bricks in a building. This haphazard approach to the use of IT resources was like feeding yeast to bread dough occasionally; the result was an unmanageable, continuously growing problem. The strategic focus should be to very thoughtfully define the purpose of learners, educators, and their support staff and to have a cost based knowledge of technology that would enable a learning infrastructure with a focus on outcomes. This learning infrastructure does not necessarily require more money, but it does require genuine strategic thinking. The current planning strategies are not outcome based. Productivity must be measured, and the strategic planning process for technology must allow self correction and adaptation to new directions in technology. A recent CAUSE/EFFECT article suggests that strategic planning must take into account the resources and the goals. It must find a fit somewhere in between these two, and if the planning is done appropriately, it will "stretch" the organization forward because "What holds many organizations back is not a surfeit of resources, but a scarcity of ambition." (Bleed and McClure, 1995) This debate regarding strategic planning for technology is not innovation versus tradition, but adaptation versus stagnation.

Typically, university organizational structures do not lend themselves to advancing this information age. Universities often enjoy the luxury of focusing internally and managing with departmental autonomy. Thus, the organizational structure that frequently exists in higher education is that of several fiefdoms, not a unified and sometimes not even a federal approach to organization. These fiefdoms are funded; goals are not. Heterick emphasizes how this approach to the organization of higher education must change: "The information age demands, and will enforce, a transition to empowered employees throughout the organization. The organization will be successful to the extent those employees are informed and are free to exercise leadership, and are capable of doing so. The organizations faced with the most difficult transition to the information age are likely to be those that never really bought into the industrial age paradigm - parts of the public sector with higher education and health care being the two most obvious examples." (Heterick, 1996) The new organizational structure should enable departments to be a part of the team that solves problems and allocates resources. Teams from departments should develop resources based on the goals of the strategic planning process; incentives and rewards should be based on productivity. This structure would change the traditional approach of prorating technology dollars to each department to spend at will. The planning process should still be coordinated at a central level and priorities established, but each functional entity should define its approach to achieving these goals, with IT being a intregal part of the process. To change the current organizational structure requires an adjustment of attitudes, and the restructuring of the technological infrastructure of the institution must occur with a restructured IT organization being woven throughout the new infrastructure.

This new infrastructure will have at its core a distributed organization. Historically, the IT department has been one of the fiefdoms that existed in higher education; to alleviate this, IT should move from a more historically centralized organization to a distributed organization. Distributed by definition is very different from decentralized. For instance, the decentralized approach suggests that the customer for a personnel system is personnel; the distributed approach suggests that the customer for a personnel package is the entire university. Baltzer suggests that by moving to this type of organization a more trusting relationship between IT and the institution is fostered, but she also warns that this move should be done with caution in order to maintain a central planning base. (Baltzer, 1991) To avoid the chaos of undirected choices of systems in a distributed organization, computing requirements should be dictated centrally, in conjunction with the outcome objectives of the planning process. Central computing organizations, however, have difficulty addressing the diverse needs of faculty, staff, students, administration, and research. In her article "Strategies for Restructuring IT Organizations," Suzy Chan describes how DePaul University integrated four diverse divisions of information technology into one centralized group while distributing functions across campus by creating cross-functional teams to

approach problem solving. (Chan, 1995) It is essential to combine all technical processes such as strategic planning, institutional research, library, network, telecommunications, academic and curriculum support, systems, operations, hardware and software support, computer labs, and development under one roof while distributing the professionals into content areas to support user needs as servers are currently distributed throughout the network to increase productivity and speed. There should also be knowledgeable users in the various departments who can serve as the point person for vertical projects and front line support. A balance must be maintained between centralization and distribution in the planning process: while involvement from functional entities is key, so is central coordination.

Culture

Wherever we are, it is but a stage on the way to somewhere else, and whatever we do, however well we do it, it is only but a preparation to do something else that shall be different.

Robert Louis Stevenson

Additional barriers that must be dealt with are the diverse cultural boundaries in any educational environment that must be crossed in order for any IT organization to be successful. The complexity of issues surrounding IT demands distribution and collaboration. These require trust; trust, in turn, requires common beliefs and values. Baltzer, however, suggests that communication is the key to bring about trust and to ensure that there are no misunderstandings, misinformation, or misconceptions regarding the use of technology within an organization, the type of technological services that can be provided, the dollars spent, the way decisions are made, or the distribution of technology. (Baltzer, 1991) The different occupational cultures must be successfully integrated to create this necessary trust and communication. Since engineers tend to focus on the technology - not the people - and thus are poor communicators, customer service is easily taken for granted. Historically, IT has been reactive to change, rather than proactive for change. In a recent Sloan Management Review article, Edgar Shein asks how an organization can promote teamwork and cooperation when the structure rewards individual or departmental competition. Shein suggests that the solution to productivity problems is not reengineering, participatory management, empowerment, or other forms of management programs but that "The deeper issue is that in most organizations, there are three different major occupational cultures that do not really understand each other very well and often work at cross purposes." (Shein, 1996) These three cultures are executives, who are more interested in the bottom line; engineers, who are more interested in designing people into the equation that out of it; and operators, who are the knowledge workers characteristic of any organization and who, in higher education's case, are faculty and students who thrive on human interaction. Peter Senge reacts to Shein's article with the following statement: "Can the discipline of a community building potentially be employed to reverse the growing fragmentation between the executive, operating and engineering cultures to build larger communities of common purpose truly concerned with the enterprise as a whole?"(Senge, 1996) Historically, users of IT systems have had little or no trust in IT professionals and have desired to strike out on their own in the face of a huge centralized IT conglomerate. There are several general reasons for this desire. First, IT professionals over promise and under deliver, not realizing that technology is a means to an end for the user. Second, the IT professional does not realize that his job is not to demonstrate intelligence but to increase productivity. For instance, an obvious business decision - outsourcing and buying systems instead of building them - is difficult for the IT designer, who always feels he can design something better, regardless of cost or time. Third, the executives faced with the increased spending in IT resent the cost and time waste and lose perspective of the needs of the operators and the engineers. Training and movement toward a learning organization model in which the employees visualize a potential and feel empowered to effect outcomes will help cross the cultural boundaries in the organization.

Techniques

If anything goes bad, I did it
If anything goes semi-good, then we did it
If anything goes real good, then you did it
That's all it takes to get people to win football games for you.

-Paul "Bear" Bryant

To transcend these inherent issues within higher education and build a successful approach, certain techniques must be practiced. In order for systems development techniques to be successful, developers must utilize a team approach to development using a leadership style similar to the one Bryant describes. In developing systems, one should have the freedom to innovate instead of the freedom to fail. The freedom to fail is safer; it requires no change, no risk. Creating systems that allow user independence is difficult for IT professionals, but the days of glass houses and ivory tower computing are over. IT professionals, by building systems with the direction of a mandarin-like leader, will see that, just as success is gained economically by allowing citizens self sufficiency, success is gained in IT by allowing users self sufficiency. This success requires training and planning as well as new ideas in terms of systems development. Ernst maintains that through training and communication independence must be made easier than dependence. He feels that, although engineers have a tendency to build systems themselves, IT should be reeingineering the university's business processes instead of automating manual processes and that IT should be building information infrastructure instead of building new systems. The old methodology resulted in disparate systems with no integration. (Ernst et. al., 1994) The history of dependency has developed because of IT's tendency to develop closed systems, systems that ignore the environment. These closed systems tend toward entropy. While this is a classic problem in centralized IT organizations, it could also, if not planned properly, be a problem in distributed organizations. The idea is that development should be to a business goal; therefore, it should involve development for business areas, not simply functional areas. For instance, a position control system in a university would involve the functional areas of business and finance, personnel, administration, and facilities. If in a distributed organization an analyst assigned to business and finance designed the position control system, it would fail with a tendency toward entropy, just as if a centralized IT team had developed it. The idea is a distributed organization with a synergistic approach to design. This approach assumes that the whole exceeds the sum of the parts and uses a diversified, distributed team to design while using a centralized method to insure integration. By maintaining a synergistic design approach and fostering user independency, systems development within an organization innovates and succeeds.

In building systems in higher education, users must be a part of the distributed team that creates the system. Planning is crucial, and teams should cross organizational boundaries. Borel and Vincent suggest that having application managers who are responsible for a specific suite of applications is an archaic approach to systems development although the client advantage to this approach is that the clients have one point of contact. The new approach is a flexible structure that insures that legacy systems are maintained and updated only when needed and that incoming programming requests are handled from one point. This approach allows staff trainability and no huge loss if a staff person is terminated. (Borel and Vincent, 1995) In order for this approach to work, however, this distributed systems approach should appear centralized to the user. IT must also change relationships with clients. People in distributed positions must have computing expertise, which is effective because they are in clients' offices every day with a home base in IT. This distribution allows close client contact with central goals, mission, and crosstraining. Markus and Keil further this idea by suggesting that users must want systems and that the user actually defines whether or not a system is successful because success is determined by user friendliness and implementation and requires IT professionals to also have good business sense: "Systems

do not improve organizational performance or create business value, users do." (Markus, 1994) Changing systems development to a cross-functional, user centered activity, in which the user is actually involved in the development of the system, creates successful systems.

As shown in this article, information technology has been and continues to be underutilized in higher education, because higher education is steeped in tradition and is slow to move to innovation. Several changes are necessary for higher education to develop a successful IT organization. The perception of technology as it relates to the mission and vision of higher education must be embraced with a futuristic understanding of the potential of technology in higher education. The mindset of IT professionals must be that of supporting the potential of the information age in higher education by evolving complexity in the use of information technology into simplicity. A flexible process must be developed to combine leadership and the involvement of IT in a good strategic planning process that sets priorities in accordance with mission and allocates resources to accomplish objectives. Traditional cultural boundaries between the fiscal, managerial leadership and the academic and philosophical faculty must be crossed to create a collaborative learning environment. These challenges should be accomplished by using a team approach with leadership that is willing to be accountable for failures and to give credit to others for successes.

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