The Financial Mythology of Information Technology:
The New Economics

by John L. Oberlin

One of the most misunderstood aspects of managing information technology is the attendant economics. The rate of technical advancement is accelerating, demand is intensifying, standards and architectures are changing daily, prices are falling, but total costs are growing. Yet the legacy-based fiscal thinking of both technologists and financial officers has changed little in the face of these new realities. Understanding the attendant economics of information technology is a necessary first step toward developing sound financial strategies to accommodate technological advancement.

The financial truths surrounding information technology at educational institutions have never been particularly clear. The economics of these investments are often steeped in an intellectual haze that can be described as the financial mythology of information technology (IT). This mythology is nourished by an unusual set of economic and technical factors that often place the financial analysis of IT outside the comfort zone of not only technologists, but financial officers and senior administrators as well.

This article argues that the principal forces driving the new economics of information technology are: (1) it is steadily increasing in value, (2) academic demand for information technology and computing power is virtually unlimited; (3) the per unit price of information technology is declining rapidly; and (4) the total cost of owning and maintaining these systems is steadily rising. In other words, the potential benefits are truly revolutionary and the demand is insatiable—but the falling prices mislead many to expect cost savings that will never materialize.

These forces, combined with the breathtaking rate of change inherent in IT, produce a unique economic environment that seems to breed financial paradoxes. The new economics are formidable. Shortening life cycles will force fundamental changes in how institutions manage these assets; the increasing value of IT and the pressure to spend more on it will make the financial crisis facing many institutions worse; and the ability of new technologies to transcend time and distance will intensify competition among institutions. Information technology will represent the single biggest opportunity to either enhance or damage an institution’s competitive standing. Academic, technology, and financial leaders will have to come together as never before to address these issues.

The Institutional Context

The potential for information technology to do good is unarguable and contributes to a pervasive mythos that captures the imagination of individuals from every walk of life. In this infor-
"What was optional only a decade ago is now so valuable it is a necessity."

The Value of Information Technology

The issue of valuing IT investments carries a mystique. The question of how to value technology is being asked at campuses everywhere and is often viewed as a question that is impossible to answer correctly. I propose a new question: Can we value information technology without knowing its value? I believe we can. While we may not be able to assess the value of information technology in some absolute sense, we can clearly observe that its value to our institutions is increasing over time. This is the most critical aspect of value and the one most worth understanding.

The value of IT is increasing

Information technology has tremendous potential. Computers can already talk; they process visual images; and they will even have the capability to sense smells in a few short years. It would not be unreasonable within the decade to have our personal computers wake us up in the morning, read us the newspaper, report on the weather, and download the traffic report to our car before we leave for work. Scholarly scenarios have computers assessing prospective students’ knowledge base for course placement; managing curricula, interactions, data, and visualizations; and building lifelong connections to scholarship through distance learning technologies. The potential value of information technology is limited only by our imagination and our willingness to invest in change.

What was optional only a decade ago is now so valuable it is a necessity. Neither campus libraries, nor laboratories, nor research facilities would be viable today without computers. Over the last decade we’ve witnessed revolutionary changes in the level of computing and networking power that resides on the faculty desktop. The technology does so much more than it did a few years ago—the computer is already indispensable.

The problem is that many people don’t realize its increasing value because they have incorporated the expectation for constant improvements into the very nature of information technology. For example, the Commerce Department estimates that 70 percent of America’s top 500 companies use artificial intelligence (AI) in their computing. The quandary is that this innovation doesn’t get the credit it’s due. Whenever artificial intelligence works, it ceases to be called AI; instead, it becomes an integral part of the system and is then taken for granted. This phenomenon appears to be common whenever an explicit valuation of information technology is called for. Nevertheless, the implicit evaluation is changing. Just as we would be very reluctant to give up our heating, air-conditioning, or phone, we are quickly becoming equally loath to give up our computers.

This article was written on a computer that corrects my spelling as I type, monitors my e-mail communications in the background, reminds me of important appointments, travels easily in my briefcase, and scans the Wall Street Journal daily.
for articles relating to information technology—and it cost less to buy than my first computer purchased ten years ago. More to the point, that original computer wasn’t able to do any of these things. This computer is not just more valuable to me than my previous ones, it has become critical to what I do.

Each successive generation of information technology brings new levels of performance and functionality that weren’t there previously. There is very little information technology on campuses today that couldn’t be replaced with something that is both less expensive and superior in performance and function. It seems clear that the value of information technology is increasing from year to year, as well as its respective value to our institutions. IT supports teaching, learning, communications, and collaboration in ways that simply weren’t available only a few years ago.

The aggregate value of IT

The total value of information technology is greater than the sum of its parts. To the extent that enterprise-wide systems function in aggregate-like ecosystems, much of IT’s value grows exponentially as its supporting infrastructure and interconnections grow richer. For example, the value of a departmental e-mail system is enhanced if the entire campus community is also on the network, and is greater still if the campus is connected to the Internet. Similarly, connecting faculty to a campus network would be valuable, but the value of connecting the entire campus community of faculty, staff, and students would be much greater still.

In these cases there is a multiplying effect on the value accrued to the institution that goes beyond the sheer number of users. There is a synergistic aspect to this aggregation of users and resources. It appears that the cost/benefit curve for technology investments is a step function, where particular levels of investment can produce superior value. The challenge for financial planners is to target the specific level of functionality desired and identify the minimum investments needed to move from one plateau to the next.

The Demand for Information Technology

Years ago Pablo Picasso quipped that “computers are worthless, they only give answers.” While his assertion may have had great validity at the time and may still have in philosophical circles, it appears today that his conclusion is completely wrong even though the original reason he gave is still true. The problem for educational institutions is that there’s no end in sight to the questions. Thus, there is no end in sight for the demand for the computers and information technology that help provide the answers.

The demand for information technology is driven by more than just the need to answer questions. Successful implementation almost always creates new demand and expectations that grow exponentially. Computationally intense researchers can bring any quantity of CPU power to its knees simply by relaxing a few restrictions in their models. The challenge is to accept this exponential growth in demand and work to develop financial and management strategies to accommodate it. The academic value of IT systems is growing—it is only natural to expect individuals, departments, schools, and institutions to desire more of it. The fact that they do is an affirmation that our scholarly values are strong and that our campuses are vigorous.

The demand for large systems

Researchers across a range of disciplines will continue to propose questions that can only be answered using the largest systems available, and once these questions are answered, new and more demanding questions will follow.\(^3\) The need for large machines to help solve large problems will persist and grow. Furthermore, the demand for enterprise-wide solutions for data warehousing, e-mail, and administrative functions will drive demand for ever larger central administrative systems. Electronic libraries with digital archives and advanced search and retrieval engines will require large systems currently unavailable on campuses.

Twenty years ago the entire campus computing capacity was centralized in the academic computing center. Today, personal computers, local area networks, and distributed computing environments have changed that. While it is true that the trend is for central computing to represent a smaller percentage of the total computing resources available on campus, it is equally true that this key central resource has been growing in absolute size, and will need to continue growing.

Computing power will continue to be deployed throughout campuses at a level that is appropriate to meet aggregate demand. Desktop systems will deliver some minimum level of power suitable for personal use, departmental servers will be larger to meet the demands of multiple users and larger databases, schools will require even more powerful computers and storage systems to meet their demand, and institutions will deploy central academic resources to meet the remaining level of aggregate need. The NSF Blue Ribbon Panel on High Performance

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 CPUs Price Trends

![CPU Price Trends](image)

**Figure 1:**

**The demand for distributed systems**

Today’s conventional wisdom is heavily in favor of distributed computing systems and client/server architectures. Individuals on campus want the greater personal power and freedom of choice that is inherent in these systems. PCs and departmental LANs are increasingly expected to support multimedia, visualization, virtual reality simulations, and disintermediated teaching and learning opportunities. Larger networks are facing similar demands; consider ARPANET, the first large-scale computer network used by faculty. It was originally designed to link computer scientists at universities to distant computers, thereby permitting efficient access to computational resources unavailable at their respective institutions. A minor feature called electronic mail was included only as a sidebar to the host computing function. Yet electronic mail rapidly became one of the system’s most popular features. Today, traffic on the Internet is growing at 10 percent per month, a million and a half new servers were connected in 1994, and the advent of the World Wide Web is driving even more growth.

**Increases in demand**

The demand for information technology is not simply a “change in quantity demanded” as prices fall. In this case there is an actual “increase in demand.” The subtle difference in this economic jargon is an important distinction with significant ramifications. A change in quantity demanded describes how individuals tend to desire more of almost anything when the price is lower or when their income increases; for example, entertainment, travel, or vacations. Conversely, an actual change in demand describes a shift in the demand curve for that product—a situation where more is demanded at all price points. This is the case with information technology. This demand characteristic is a major driver of the economics of the entire technology industry. It is what allows technology providers to lower prices continuously. It means that technology manufacturers can expect their revenue, and profits, to grow even as they drop their prices radically. Without this shifting demand function, the economic viability of information technology would be much different than it is today.

**The Cost of Information Technology**

It is commonly reported today that buying computing systems has never been cheaper. By some accounts, the price of buying computers has been halved at least every three years. However, this encouraging news comes with at least two caveats. First, lower per-unit prices for individual components of a computer system do not always translate into a lower acquisition price for today’s average system. For example, no one would argue that the per-unit price of memory, processors, and most peripherals for personal computers hasn’t fallen dramatically. On the other hand, as mentioned earlier, today’s average user demands more memory, more powerful processors and more peripherals than the average user did three years ago. The end result is that we get a lot more for what we paid three years ago, but in many cases the actual acquisition price may not be falling significantly. Worse yet, demand for even more powerful systems that are now financially viable could actually drive the average acquisition price up.

The second caveat is that the total cost of owning technology is rising. More sophisticated and distributed systems require more technical support, more training, more peripherals, and more time. The price of technology is what you pay to purchase it. The cost includes the price as well as all the other expenses associated with owning, operating, and maintaining it. Every new generation of technology introduces its own unique set of incompatibilities and obsolescence of peripherals. The net effect is a host of new costs that include training, user support, and time to reconfigure networks. As long as total costs are increasing as demand increases, it appears that the best result that institutions can hope for are...
solutions that support future cost avoidance rather than actual cost reduction.

The cost of distributed systems

The growth of distributed computing environments, with their inherent complexity, significantly contributes to the increase in total costs that campuses face. According to the Gartner Group, the total cost of distributed systems may be ten times or more the purchase price. These costs, including the opportunity cost of having research faculty administer local computing centers, may very well exceed that of central systems. Moreover, studies have shown that the cost of owning and maintaining a PC in a distributed environment has grown steadily over the last five years.9

The cost of success

One of the paradoxes of managing information technology is the high cost of success. Successful technology implementations almost always lead to greater expense. A marginally effective e-mail system or networking environment on campus will result in only a limited utilization of the services. However, history shows that once a system becomes functionally viable there is typically an explosion in the number of users as well as in the level of usage. The result is an increase in demand and an increase in total cost as more equipment is needed and better support and training become an imperative.

Emerging technologies will almost certainly repeat this pattern, whether they be distance learning, multimedia, or some other innovation. The shift from traditional paper-based libraries to electronic libraries is a case in point. As libraries move to put more and more electronic information online, few if any of their historical services are being displaced.10 Even though the expectation is that full text retrieval will alleviate the need for books, it may instead create new requirements for printing on demand. The effect is that these electronic services are adding new costs in terms of equipment, training, and operations, with little in the way of cost savings from discontinued activities. There is no evidence that information technology has lowered the total cost of operating academic libraries.

The sociological cost

The largest costs of IT will come from the social changes it produces. Fundamental changes in the positions of individual stakeholders are taking place. Technology is changing the role of libraries and supporting the privatization of information. The advent of distance learning will affect the nature of faculty-student relation-ships. Changes of this nature will certainly spawn new costs. Strategies that support continuous or incremental change of social norms, not revolution, should dominate in this environment. As Kotter makes clear, planning for transformations is the wrong goal.11 Planning for constant incremental change not only produces better results, but can help avoid the most expensive disruptions in organizational effectiveness.

The Economics of Information Technology

As described above, the value of information technology is increasing over time, the demand is intensifying, and the price is falling, while total cost is growing. How do these observations affect the fundamental economic equations that determine the wisdom of investing in and managing these systems?

Life cycles

The first step toward understanding the new economics of information technology is to realize that each new generation has an economic life cycle that is independent of its functional life cycle. Computers rarely wear out. Instead, they become economically obsolete and are replaced. The record of academic institutions is littered with examples of technology at every level—desktop PCs, departmental servers, campus networks, and shared regional supercomputers—that have become functionally obsolete long before their hardware stopped working.


End of life
Recognizing the end of life for information technology equipment is not always obvious, nor is it easy. The problem with determining end of life on most campuses is the decision rule they use. The test on most campuses is, “if it’s still running, it must be good for something.” The paradox is that a five-year-old computer still looks and runs as well as it did when it was new, even though it may be obsolete. It does everything it did then and more, and whatever was prone to break has already been fixed. Nevertheless, it may be well past its economic life.

An economic life cycle is defined as the useful financial life of an item. In other words, the life cycle is the number of years one should plan to keep a piece of hardware or software. For example, a life cycle of three years for a computer implies that at the end of three years, the computer is either: (1) no longer suited for its intended purpose (e.g., Intel 80286-based servers won’t run Netware 3.11), or (2) maintenance and support have grown to the extent that it is cheaper to replace the computer than keep it, or (3) new requirements or performance standards (such as portability, ease of use, user interfaces, visualization, networking, processing power) have necessitated its replacement to meet user needs.12 Keeping information technology longer than its economic life cycle is a mistake. Not only does it waste current money, but it forfeits the advantages inherent in new technology.

Replacing old technology
When compared to other capital assets, the replacement of information technology systems is unique. The difference with technology is you don’t just replace what you had, you upgrade it significantly. Replacing traditional assets, like cars and office furniture, results in something basically the same as what you started with, only newer. On the other hand, a five-year-old desktop computer (e.g., a 16 MHz Intel 80386-based machine) could be replaced with a 100 MHz Pentium-based, multimedia, portable computer for less money. These two computers are fundamentally different. The new one not only does the old things better, it does important new things that the original didn’t. The economic equation has changed.

Determining life cycles
There are several ways of determining technology life cycles that draw on quantitative assessment methods. One is to take into account technology generations. In the simplest example of this method, consider a single faculty member who uses a personal computer to support his or her computationally intense research. If the area of research is competitive, which is almost always the case, the researcher will need to maintain a competitive level of computing. It could be argued, all other things being equal, that this researcher could afford to be no more than one generation of processing power behind his or her peers—otherwise the research would suffer from time delays or poor analytical depth. If new CPUs are introduced every three years, the maximum competitive life cycle for this researcher would be six years—three years for the current generation, and three more for the next. After that, he or she would have to upgrade to stay no more than one generation behind.

Changing life cycles
In the 1980s Intel produced a major new generation of microprocessors approximately every three and a half years.13 Currently, the time between generations is shorter, perhaps two years or less. The implications for life cycles are obvious—they’re getting shorter. As a result, it’s more expensive for institutions to stay on the leading edge and be competitive in the 1990s because of shorter technology life cycles, and it’s likely to be even more difficult in the next decade. All indications point to an accelerating rate of technological change which will continue to shorten life cycles.

Even if institutions were to ignore the competitive aspects upon which this generation approach draws, they would still be in for trouble when managing the changes their students will bring to campus. Today, $1,800 buys a 75 MHz Pentium computer with 8 MB of RAM and 500 MB of disk. In five years or less, $1,800 will buy

Figure 3:
What $1,800 Will Buy

<table>
<thead>
<tr>
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<th>1995</th>
<th>2000</th>
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<tbody>
<tr>
<td>Processor</td>
<td>Pentium</td>
<td>Pentium</td>
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<tr>
<td></td>
<td>fifth-generation</td>
<td>eighth-generation</td>
</tr>
<tr>
<td>Speed</td>
<td>60 MHz</td>
<td>600 MHz</td>
</tr>
<tr>
<td>Memory</td>
<td>8 Megabytes</td>
<td>64 Megabytes</td>
</tr>
<tr>
<td>Storage</td>
<td>420 Megabytes</td>
<td>8,320 Megabytes</td>
</tr>
<tr>
<td>CD-ROM</td>
<td>Double-speed</td>
<td>Six-speed</td>
</tr>
<tr>
<td>Monitor</td>
<td>VGA</td>
<td>SVGA+</td>
</tr>
<tr>
<td>Outside link</td>
<td>14.4K bps f/m</td>
<td>100 M bps net</td>
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Source: Dataquest Inc.

A 600 MHz fifth-generation Pentium computer with 64 MB of RAM, over 6 GB of disk, and an ultra fast network connection (see Figure 3). Students will be bringing these machines to campus in large numbers whether they are required to or not, and this alone will drive increased expectations, expensive additions to campus networks, and a need for additional support services.

It won’t be easy having faculty and seniors using old systems while incoming freshmen enjoy new technological advantages. Expectations are going to rise. Life cycles can’t be ignored, nor can they be avoided. Understanding them, accepting them, managing them, and planning for them goes to the heart of the new economics of information technology.

**Asset management**

The principles of asset management that apply to buying a computer are fundamentally unlike those of buying a truck. If the physical plant purchased a half-ton pickup truck for $25,000, with an expected life of five years, it would have a capital cost of $5,000 per year. At the end of five years, the truck could be replaced with another truck that would cost more but still be more or less functionally identical. (A half-ton pickup truck will still only carry half a ton five years from now.) One way to help make this investment pay better would be to invest more in maintenance and amortize the cost over more years. The rule of thumb to optimize this type of investment is to amortize it for as many years as possible.

Computers, on the other hand, are quite different. If the physics department purchased a $25,000 computer and amortized the expense over five years it would also cost $5,000 per year. The difference comes when considering what happens when the machine is replaced. In this case, the physics department will be able to spend significantly less on the replacement and still receive a new computer that is superior to the one it is replacing. This fundamentally changes the asset management paradigm for this equipment.

Given the superior performance of the replacement machine, the lower price, and the growing demand, the whole premise of evaluating information technology investments by the same methods used to evaluate the truck seems silly. Yet most campuses do just that. A strong argument can be made to turn the model on its ear. Increasing the amortization period for technology investments may actually be a less desirable investment decision. Instead of buying the biggest computer necessary to do the job for five years, it seems compelling to consider the case of buying the smallest computer that would do the job, say, for three years. The question is, would the physics department be better off buying a $25,000 computer for five years, or a $15,000 computer for three years, and then replacing it sooner? It seems obvious that the second case is superior. It has the same annual cost and the department gets the benefit of replacing it with a superior machine for less money after only three years instead of five. In cases where this is true, the rule of thumb for making computer purchases is to adopt a life-cycle model where you buy as little as possible and keep it for as short a time as possible. The challenge for planners is to balance the constant academic demand for more power today against a financial strategy that will provide for superior power over time.

**Saving versus gaining**

In the above example, the physics department actually has a strategic choice of how to manage the replacement of technology. At the end of three years the department can choose to either: (1) keep its computing power at a constant level and lower its annual expenditure by buying something with the same power for less money; (2) grow its computing power by holding IT spending constant and taking advantage of new economies; or (3) expand its real investment in IT by growing its level of spending. Case one can be rejected as a strategy of stagnation—regardless of the life cycle length, it assumes no growth in power or capabilities. The strategic choice is actually between holding the capital budget constant or growing it.

Current evidence shows that private industry has adopted the strategy of growing its capital budget for IT hardware. Trends showing increased spending on IT among educational institutions suggest that a similar, albeit tacit, conclusion within the higher education community may be brewing. If higher education doesn’t keep pace, the benefits of information technology may accrue disproportionately to the private sector.

**Financial pressures**

As long as institutions can expect a continual improvement in their return on investments in information technology, they will be compelled to spend an increased percentage of their budget on IT. It is a simple economic reality. Any organization in a competitive environment will be forced over time to invest more of its money where the return is greatest. In the case of information technology, where it pays to invest today, it will pay even greater dividends to invest even more tomorrow. Regrettably, these forces may...
not always be well understood or recognized explicitly. Nevertheless, they are quite real, and are already affecting most institutions. Many institutions feel the pressure growing to invest more in technology, yet struggle to accept IT's relentless nature. They scrutinize investments on a case-by-case and school-by-school basis but often fail to see the big economic picture inherent to IT investments.

Colleges and universities will have to spend more money on information technology simply because it benefits them to do so—it's a better alternative than whatever is second best. There is no other asset among their resources that improves its cost/benefit ratio every year. The only other possibility is their human resources. If the return on personnel is increasing, it is almost certainly linked to increased productivity derived from new technology.

The business case
Who is responsible for developing a business case for information technology? Developing a business case for information technology in higher education is difficult. Colleges and universities have their own unique brand of conventional wisdom and peer review that manages most critical decisions well. Information technology seems to be an exception. It doesn't fit well with the existing political system and decision-making structure. For example, deans are often out of the loop when it comes to technology issues. They typically don't know much about IT, and faculty tend to bypass them when dealing with computing issues. This is because there's usually an administrative or academic computing organization operating outside of the deans' normal sphere of influence that fields these calls. Exacerbating the problem is the fact that institutional financial officers are also out of the IT decision-making loop. That leaves technologists holding the bag for developing the business case.

This shift in authority for decision-making contributes to the mythology surrounding the economics of information technology. All three parties—deans, financial officers, technologists—see a different set of facts. As a result the business case is frequently poorly understood, under developed, crudely articulated and disseminated, and often misses the key elements of what the analysis should be all about.

The business question
Traditional wisdom governing technology investment decisions views the investment decision primarily as an expense issue. In reality it's a cost/benefit issue, where it's an investment in both the goals of the institution as well as the individuals charged with advancing them. No dean or department head would fill a faculty vacancy based solely on the fact that one applicant might be less expensive than another. It should be equally ridiculous to make investment decisions for technology based solely on cost. Moreover, many faculty might actually argue that the "best" possible candidate should always be hired, regardless of cost—a position few would advocate for technology. The financial decision to purchase and manage information technology cannot be based on minimizing cost, but instead needs to be based on maximizing the net return of the investment.

Teaching and learning
As mentioned earlier, part of the promise of information technology is its tremendous potential to improve teaching and learning. What will be the business case for technologies that support teaching and learning? Are distance learning, multimedia applications, and online information services going to be a financial cash cow for colleges and universities? Not likely. Justifying investments in technology for teaching and learning will have to come from either greater benefits (e.g., better student learning), or lower costs (e.g., fewer faculty), or higher revenues (e.g., more students).

It seems unlikely that technology investments will truly be able to disintermediate students from teachers enough to allow for either significant reductions in faculty or increases in students. If information technology should significantly disintermediate student learning from teachers, it would imply that technological solutions to providing education are equally viable to traditional campus experiences. This would create new and alluring opportunities for private concerns that could threaten the traditional notion of campus experience being central to the educational process. If the promised disintermediation doesn't prove effective, and teachers are needed in similar numbers and ratios to what is needed today, then the business case for investing in information technology for teaching and learning will rest primarily on a scenario that relies on valuing greater learning. If this is the case, which appears most likely, then institutions will have to grow their technology budgets without significantly reducing their faculty. They will be faced with the hard decision of either raising the price of an education or reallocating current budgets to eliminate inefficient and redundant programs.16 This prospect is further complicated by the fact that higher education has few mechanisms available for measuring and demonstrating higher value for its primary product.
Fee versus free services

Central computing facilities and libraries face the question of whether to charge for some or all of their services or to provide some or all of them for free. This is often referred to as the “fee versus free” problem. The dilemma faced by these organizations is how to provide the best possible level of service to all possible users while also being efficient and equitable. The history of the debate is best documented in the library literature, where equity arguments generally have prevailed over any scheme to pervasively charge for service.

From a fiscal perspective it is an error to structure the argument in this manner. The issue has never really been a question of fee versus free; instead it is a question of fee versus subsidy—a much different issue with different implications. In this context, the issue becomes one of assessing the costs and benefits of the entire user community under each of the two possible cases. What is important is that under either of the two schemes there will be a different allocation of costs and benefits to the user community—although there is no clear answer yet as to who might benefit the most or by how much. However, where services are to be subsidized, the planning task is to determine the appropriate size of the subsidy as well as the primary audience the subsidy is intended to serve. Given the growing demand, subsidizing all services to all groups will never be economically viable.

Competitive economics

The biggest institutional downside of new information technologies is their potential impact on inter-institution competition. For example, if distance learning, enabled by IT, becomes viable, it could drastically change the competitive landscape. One result would be to break down the regional barriers to competition. If it were financially viable for State College to deliver education at a distance, what is to stop Out-of-State University from delivering competing offerings? A second consideration is that the cost of teaching “personalities” could go through the roof. Like the market for TV personalities, the market for teaching personalities in a distance learning environment could lead to some unpleasant dilemmas for colleges that desire star performers. Assuming that distance learning becomes viable, it implies by definition that new competition will be inevitable. Similarly, if there is new competition, the one thing we can predict with certainty is that there will be winners and losers.

As another example, should the notion of electronic libraries become viable, the potential impacts could be equally dramatic. Consider the case where major Research-I university libraries have, for the bulk of their holdings, online searching and full-text retrieval available over the Internet. Library holdings have been, and still are, an important factor in accreditation and institutional ranking decisions. In this electronic library scenario, smaller colleges with more limited financial resources would have an incentive to leverage these online libraries and downsize their own facilities, effectively free-riding on the investments of other institutions. If the accreditation process ever recognizes the significant value of “access” to information that the new information highway paradigm emphasizes, wealthier schools with large electronic holdings would have an incentive to either withhold services from the Internet to preserve their status or attach fees to prevent freeloading. In other words, if online access to searching and retrieval becomes truly valuable as technology visionaries suggest, large holders will have financial and competitive reasons to withhold access or charge for it.

In either event, the vision of ubiquitous access to free information would be in jeopardy. Moreover, as online services in general become more financially viable, the trend of increased privatization of information and education will accelerate—again threatening the vision as well as changing the economic equations that colleges face.

Conclusion

In summation, the legacy-based thinking of both technologists and financial officers has changed little in the face of new realities: the accelerating rate of technical advancement, continually changing standards and architectures, and falling per-unit prices. Rationalizing financial strategies to accommodate technological change is an imperative for effective IT investing. Financial officers will need to accept a new set of economic realities that will in turn change how institutions manage their investments in technology; CIOs will need to abandon as their dominant financial strategy positioning IT as a tool for cost reduction; and institutions will need to accept the verdict that they will be spending a greater percentage of their budgets on information technology.