

# Beyond the Endless Frontier

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## Introduction

Let me first compliment the planners of this conference in scheduling in the same session representatives from the University of Michigan and Johns Hopkins University. These two universities illustrate well the view of the contemporary university as a rather fragile enterprise, delicately balanced between two great and usually opposing forces on the modern university campus: the Department of Athletics and the University Medical Center.

Many was the night during my Michigan presidency when I woke up worrying about one of these activities: the University Medical Center. And my colleague, Bill Brody, probably also wakes up worrying about athletics–lacrosse!

Actually, there may be another purpose to this pairing. Year in, year out, Johns Hopkins and Michigan rank #1 and #2 on the National Science Foundation rankings of universities by research expenditure. Both are representative of one of the most remarkable institutions of 20th Century America, the research university.

Each generation has established a social contract between our leading universities and the society they serve. The particular form of this contract for the latter half of the 20th Century was framed by the seminar report, *Science, the Endless Frontier*, drafted by Vannevar Bush following World War II. It established a strong partnership between the nation and its universities in which the federal government would support the conduct of basic and applied research on the campuses. This partnership resulted in one of the 20th Century's more important societal institutions, the American research university.

It has made America the world's leading source of fundamental scientific knowledge. It has produced the well-trained scientists and engineers capable of applying this new knowledge. The academic research enterprise has played a critical role in addressing many of the nation's most important challenges, including national defense, health care, agriculture, and economic competitiveness.

## Stresses on the Academy

Largely, as a result of this partnership, America's research universities have become the strongest in the world at a time when the benefits from R&D investment have never been higher. A few years ago, a *New York Times* editorial referred to our nation's research universities as the "jewel in the crown" of our national economy. It went on to assert that university research "is the best investment taxpayers can ever make in America's future."

Yet, there are also great concerns about the future of the research university. In an international forum for world leaders in higher education held in Hong Kong this past summer, Peter Drucker challenged the group by stating: "I consider the

American research university of the past 40 years to be a failure. The great educational needs of tomorrow are not on the research side but on the learning side."

While most educators would disagree with his characterization of the research university as a failure, there are many within the academy that have equally serious concerns. Earlier this year, I had the privilege of co-chairing with Governor Richard Celeste a national meeting hosted by the National Academy of Sciences and the National Science Board, concerned with the nature of the stresses on research and education in American higher education.

This effort was stimulated several years earlier by the observation of Roland Schmitt, then chair of the National Science Board, that despite the relatively generous federal funding of academic research during the 1980s, faculty morale on our campuses appeared to be at an all-time low. A series of informal workshops hosted by the NSB revealed the usual litany of concerns:

- Fears about the future funding of research
- The stresses of grantsmanship
- The loss of a sense of scholarly community with increasing specialization
- The imbalance between the rewards for research vs. teaching
- And a host of technical issues, such as indirect costs, facilities support, government reporting and accountability requirements, and so on

To explore this in more detail, we asked the NAS Government-University-Industry Research Roundtable to sponsor dozens of townhall meetings for faculty and academic administrators on university campuses across the nation. Representatives of each of these universities then were invited to our meeting last week in Washington to discuss their findings with representatives of the federal government, including the White House science advisor, the heads of a number of key federal agencies, and the leaders of the national academies.

From these meetings, it has become clear that the stresses were driven by an array of more fundamental forces, all of which could be captured in a single word: *change*. Rapid and profound change is occurring in our world, our society, and consequently in our social institutions. And our universities are feeling the stresses of these forces of change.

There are many ways to group the challenges of change in higher education. For our purposes today, let me suggest the following framework:

A political-economic crisis: All universities are suffering the consequences of the structural flaws of national and state economies, the growing imbalance between revenues and expenditures, that are undermining support for essential social institutions as governments struggle to meet short-term demands at the expense of long-term investment. Beyond

this, there is a growing sense that the traditional public principle—that education is a public good that benefits all of society and hence should be supported by society-at-large—is shifting to a view of education as a private good that should be paid for by those benefiting most directly—the students.

Cost shifting among stakeholders: Each of the many stakeholders of the contemporary university—students and parents, state and federal government, business and industry, the public-at-large—wants to maximize the services it receives while minimizing the resources it provides to our institutions. Today few seem to be able to see the university and its diverse missions as a whole. More specifically, each constituency seems to want much more out than it is willing to put in, thereby leveraging other contributors.

A shift in national priorities—from guns to butter: For almost half a century, the driving force behind many of the major investments in our national infrastructure has been the concern for national security in the era of the Cold War. As concerns about national security have ebbed in the wake of the geopolitical restructuring of recent years, the nation is drifting in search of new driving imperatives. While there are numerous societal concerns, such as economic competitiveness, national health care, crime, and K-12 education, none of these has yet assumed an urgency sufficient to set new priorities for public investments.

A change from partnership to procurement: In recent years the basic principles of the extraordinarily productive partnership between the federal government and America's universities in support of research and advanced training has begun to unravel, so much so that today this relationship is rapidly changing from a partnership to a procurement process. Scientists and universities are questioning whether they can depend on the stable and solid relationship they had come to trust and that has paid such enormous dividends in the scientific and technological strength of our nation.

A shift in attitudes toward teaching and research: In recent years, there has been a decided shift in public attitudes toward the purpose of a university, away from research and toward undergraduate education. A several decade-long public consensus that universities were expected to create as well as transmit knowledge, a consensus that supported strong investment in the scientific—technological, and scholarly preeminence of this nation—has begun to erode.

## The Forces of Change

Behind these changes are powerful forces, driven by the changing needs, expectations, and priorities of our society:

### Financial Imperatives

Since the late 1970s, higher education in America has been caught in a financial vise. On the one hand is the magnitude of the services demanded of our colleges and universities have increased considerably. Enrollments have grown steadily; the growing educational needs of adult learners have compensated for the temporary dip in the number of high school graduates associated with the post-war baby boom/bust cycle. University research, graduate education, and professional education have all grown in response to societal demand. Professional services provided by colleges and universities also continue to grow in areas such as health care, technology transfer, and extension—all in response to growing needs.

The costs of providing education, research, and service have also grown and at an even faster rate, since these university activities are dependent upon a highly skilled, professional workforce (faculty and staff); they require expensive new facilities and equipment; and they are driven by an ever-expanding knowledge base. To be sure, higher education has yet to take the bold steps to constrain cost increases that have been required in other sectors of our society such as business and industry. This is in part because of the manner in which our colleges and universities are organized, managed, and governed. But, even if our universities should acquire both the capacity and the determination to radically restructure costs, it is debatable whether those industrial sector actions designed to contain cost and enhance productivity could have the same impact in education. The current paradigm of higher education is simply too people- and knowledge-intensive.

As the demand for educational services has grown and the operating costs to provide these services have risen, public support for higher education has flattened and then declined over the past two decades. The growth in state support of public higher education peaked in the 1980s and now has fallen in many states, in the face of limited tax resources and the competition of other priorities such as entitlement programs and corrections. While the federal government has sustained its support of research, growth has been modest in recent years and is likely to decline as discretionary domestic spending comes under increasing pressure from federal budget-balancing efforts. There has been a significant decline in federal financial aid programs over the past two decades, with a corresponding shift from grants to loans as the predominant form of aid. While the new federal budget agreement is good news to middle-class parents, it is unlikely to bring new resources to higher education.

To meet growing societal demand for higher education, at a time when costs are increasing and public support is declining, most institutions have been forced to sharply increase tuition and fees—substantially faster than the CPI. While this provided short-term relief, it has also triggered a strong public concern about the costs and availability of a college education, along with growing forces to

constrain or reduce tuition levels at both public and private universities. As a result, most colleges and universities are now looking for ways to control costs and increase productivity, but most are also finding that their current organization and governance makes this very difficult.

It seems increasingly clear that the higher education enterprise in America must change dramatically if it is to restore a balance between the costs and availability of educational services needed by our society and the resources available to support these services. The current paradigms for conducting, distributing, and financing higher education simply cannot adapt to the demands and realities of our times. An enterprise the size of higher education in America, with over fifteen million students enrolled, three million faculty and staff, and annual expenditures in excess of \$180 billion, simply cannot escape the dramatic restructuring that has occurred in other industries, such as health care, transportation, and telecommunications.

### Societal Needs

Yet the needs of our society for the services provided by our colleges and universities will continue to grow. Significant expansion will be necessary just to respond to the needs of a growing population that will create a 30 percent growth in the number of college-age students over the next two decades. Beyond this traditional role, we should recognize the impact of the changing nature of the educational services sought by our society.

Today's undergraduate student body is no longer dominated by eighteen to twenty-two year-old high school graduates from affluent backgrounds. It is comprised also of increasing numbers of adults from diverse socio-economic backgrounds, already in the workplace, perhaps with families, seeking the education and skills necessary for their careers. When it is recognized that the magnitude of this need for higher education may be significantly larger than that for traditional undergraduate education, it is clear that either existing institutions will have to change significantly or new types of institutions will have to be formed. The transition from student to learner, from faculty-centered to learner-centered institutions, from teaching to the design and management of learning experiences, and from student to a lifelong member of a learning community—all suggest great changes are ahead for our institutions.

The students entering college today require a different form of education in which interactive and collaborative learning will increasingly replace the passive lecture and classroom experience. The student has become a more demanding consumer of educational services, although frequently this is directed at obtaining the skills directed toward more immediate career goals.

We are beginning to see a shift in demand from the current style of "just-in-case" education in which we expect students to complete degree programs at the undergraduate or professional level long before they actually need the

knowledge, to “just-in-time” education in which education is sought when a person needs it through non-degree programs, to “just-for-you” education in which educational programs are carefully tailored to meet the specific lifelong learning requirements of particular students. So too the shift from synchronous, classroom-based instruction to asynchronous computer network-based learning, to the provision of ubiquitous/pervasive learning opportunities throughout our society will demand major change.

The nature of the needs for other higher education services also is changing dramatically. The relationship between the federal government and the research university is shifting from a partnership in which the government is primarily a patron of discovery-oriented research to a process of procurement of research aimed at addressing specific national priorities. The academic medical center has come under great financial pressure as it has been forced to deal with a highly competitive health-care marketplace and the entry of new paradigms such as managed care. While the public appetite for the entertainment provided by intercollegiate athletics continues to grow, our colleges also feel increasing pressures to better align these activities with academic priorities and national imperatives (such as the Title IX requirements for gender equity).

Even as the nature of traditional activities in education, research, and service change, society is seeking new services from higher education, e.g., revitalizing K-12 education, securing economic competitiveness, providing models for multicultural societies, rebuilding our cities and national infrastructure. All of this is occurring at a time when public criticism of higher education is high, and trust and confidence in the university is relatively low.

### Technology Drivers

As knowledge-driven organizations, it is not surprising that colleges and universities should be greatly affected by the rapid advances in information technology—computers, telecommunications, networks. This technology has already had dramatic impact on campus research activities, including the creation an entirely new form of research: computer simulation of complex phenomena. Many of the administrative processes have become heavily dependent upon information technology—as the current concern with the approaching date reset of Year 2000 has made all too apparent. There is an increasing sense that it will have an even more profound impact on the educational activities of the university and how we deliver our services. To be sure, there have been earlier technology changes such as television, but never before has there been such a rapid and sustained period of change with such broad social applications.

Most significant here is the way in which emerging information technology has removed the constraints of space and time. We can now use powerful computers and networks to deliver educational services to anyone at anyplace and anytime, no longer confined to the campus or the academic schedule. The market for

university services is expanding rapidly, but so is competition, as new organizations such as virtual universities and "learning-ware" providers enter this marketplace to compete with traditional institutions.

## The Changing Nature of the Higher Education Enterprise

Universities have long enjoyed a monopoly over advanced education because of geographical location and their monopoly on certification through the awarding of degrees. However, today all of these market constraints are being challenged, as information technology eliminates the barriers of space and time and as new competitive forces enter the marketplace to challenge credentialing.

In the current paradigm, our colleges and universities are faculty-centered. The faculty has long been accustomed to dictating what it wishes to teach, how it will teach it, and where and when the learning will occur. Students must travel to the campus to learn. They must work their way through the bureaucracy of university admissions, counseling, scheduling, and residential living. And they must pay for the privilege. If they complete the gauntlet of requirements, they are finally awarded a certificate to recognize their learning—a college degree. This process is sustained by accrediting associations, professional societies, and state and federal governments.

Yet this carefully regulated and controlled enterprise could be blown apart by several factors. First, the great demand for advanced education and training simply cannot be met by such a carefully rationed and controlled enterprise. Second, the current cost structures of higher education do not seem sustainable. Third, the expanding marketplace will attract new competitors, exploiting new learning paradigms, and increasingly threatening traditional providers. Perhaps most important of all will be the impact of information technology, which will not only eliminate the constraints of space and time but will create open learning environments in which the learner has choice in the marketplace.

More specifically, tomorrow's student will have access to a vast array of learning opportunities, far beyond the faculty-centered institutions characterizing higher education today. Some will provide formal credentials, others will provide simply knowledge, still others will be available whenever the student—more precisely, the learner—needs the knowledge. The evolution toward such a learner-centered educational environment is both evident and irresistible.

As a result, higher education is likely to evolve from a loosely federated system of colleges and universities serving traditional students from local communities into, in effect, a knowledge and learning industry. Since nations throughout the world recognize the importance of advanced education, this industry is global in extent. With the emergence of new competitive forces and the weakening influence of traditional regulations, higher education is evolving like other "deregulated" industries, e.g., health care or communications or energy. In contrast to these other industries, which have been restructured as government



regulation has disappeared, the global knowledge industry will be unleashed by emerging information technology that releases education from the constraints of space, time, and credentialing monopoly. As our society becomes ever more dependent upon new knowledge and educated people, upon knowledge workers, this global knowledge business must be viewed clearly as one of the most active growth industries of our times.

While many in the academy would undoubtedly view with derision or alarm the depiction of the higher education enterprise as an “industry” or “business,” operating in a highly competitive, increasingly deregulated, global marketplace, this is nevertheless an important perspective that will require a new paradigm for how we think about postsecondary education. Furthermore, it is clear that no one, no government, is in control of the higher-education industry. Instead it responds to forces of the marketplace.

Will this restructuring of the higher education enterprise really happen? If you doubt it, just consider the health care industry. While Washington debated federal programs to control health care costs and procrastinated taking action, the marketplace took over with new paradigms such as managed care and for-profit health centers. In less than a decade the health care industry was totally changed. Today, higher education is a \$180 billion a year enterprise. It will almost certainly be “corporatized” similarly to health care. By whom? By state or federal government? Not likely. By traditional institutions such as colleges and universities working through statewide systems or national alliances such as AAU or ACE? Also unlikely. Or by the marketplace itself, as it did in health care, spawning new players such as virtual universities and for-profit educational organizations? Perhaps. Just note a brief passage from a recent venture capital prospectus analyzing possible investments in education:

“As a result, we believe education represents the most fertile new market for investors in many years. It has a combination of large size (approximately the same size as health care), disgruntled users, lower utilization of technology, and the highest strategic importance of any activity in which this country engages . . . . Finally, existing managements are sleepy after years of monopoly.”

## Reacting to a Changing World

Such challenges suggest that the status quo is no longer an option for the research university. But, of course, change is no stranger to the university. American higher education has always been characterized by a strong bond with society, a social contract. As society has changed, so too have our institutions changed to continue to serve.

The American university has responded quite effectively to the perceived needs—or opportunities—of American society. A century ago our universities developed professional schools, rapidly transformed themselves to stress applied fields,

such as engineering, agriculture, and medicine, favored by the federal land-grant acts. In the post-World War II years, they responded again, expanding to absorb the returning veterans and later the postwar baby boom, and then to develop an extraordinary capability in basic research and advanced training in response to the evolving government-university research partnership.

Our GUIRR-NSB workshops reveal that this process of evolution continues on our campuses today. There is strong evidence that our universities are positioning themselves to respond to a new array of national needs:

- Sustaining the economic competitiveness of industry
- Providing affordable, high quality health care
- Becoming more involved with K-12 education and lifelong learning
- Addressing needs for greater equity and access
- Developing new partnerships and alliances, both among themselves and with government and industry, and they reach out to better serve society

The workshops also revealed the great level of activity within our colleges and universities to better position themselves for a time of constrained resources:

- Restructuring, reengineering, and streamlining of organizations, processes, and procedures
- Cost-containment and total quality management
- Focusing resources on our core competency: learning

The powerful nature of the forces swirling about the research university are already driving significant change in many of the components of our institutions, whether we realize it or not. This is not at all surprising, considering the individualistic, entrepreneurial nature of the faculty and the loosely coupled, dynamic organizational structure of universities. We can argue that these institutions have taken on far too many missions as a result, but we cannot deny that they do respond to the opportunities and challenges presented by society. Today, universities are evolving rapidly, responding once again to their faculties' perception of the marketplace. And the faculty are hearing loud and clear the message that America no longer values the importance of basic research and questions even the relevance of the research university.

While they may not like it, the faculty is remarkably sensitive to the criticisms voiced about the academy . . . too much emphasis on research over teaching . . . too many Ph.D.s and not enough jobs . . . the need for a shift toward more applied activities. And they are responding, quite rapidly, to adapt to this brave, new world. Just survey any group of junior faculty.

So, too, the broader elements of the higher education enterprise are also changing rapidly, in response to changing social needs. Community colleges and regional universities are responding to the needs of their local communities.

New forms of institutions are emerging such as virtual universities and open universities. Even for-profit institutions have been formed to serve particular markets such as adult education.

To some degree, research universities may be buffered from these early waves of change by their relative prosperity and prestige. But, while this may allow them to protect their traditional missions, quality, and character, it could also isolate them from the major restructuring and transformation that will likely occur in the broader higher education enterprise, as new learning paradigms evolve to serve a radically different future. The highly specialized PhDs produced by leading research universities are having an increasingly difficult time in competing for faculty positions in nonresearch colleges and universities. The textbooks and pedagogy used in these latter institutions no longer are created by faculty in research university. It is possible that a strategy of preserving the status quo of the research universities could lead to the decoupling and increasing irrelevance of these universities to the rest of higher education in America and throughout the world, thereby making their leadership roles somewhat meaningless.

## Beyond the Endless Frontier

History suggests that the university must change and adapt in part to preserve these traditional roles. Some, both within and outside the academy, believe that significant change must occur not simply in the higher education enterprise but in each and every one of our institutions. Yet, even most of these people see change as an evolutionary, incremental, long-term process, compatible with the values, cultures, and structure of the contemporary university.

There are a few voices, however, primarily outside the academy, who believe that both the dramatic nature and compressed time scales characterizing the changes of our times will drive not evolution but revolution. They have serious doubts about whether the challenges of our times will allow such gradual change and adaptation. They point out that there are really no precedents to follow. Some, like Peter Drucker, even suggest that long before reform of the educational system comes to any conclusion, the system itself will collapse.

It is my belief that the forces driving change in higher education, both from within and without, are far more powerful than most people realize. It seems likely that both the pace and nature of change characterizing the higher education enterprise both in America and worldwide will be considerably beyond that which can be accommodated by business-as-usual evolution. As one of my colleagues put it, while there is certainly a good deal of exaggeration and hype about the changes in higher education for the short term—meaning five years or less—it is difficult to overstress the profound nature of the changes likely to occur in most of our institutions and in our enterprise over the longer term—a decade and beyond.

While some colleges and universities may be able to maintain their current form and market niche, others will change beyond recognition. Still others will disappear entirely. New types of institutions—perhaps even entirely new social learning structures—will evolve to meet educational needs. In contrast to the last several decades, when colleges and universities have attempted to become more similar, the years ahead will demand greater differentiation. There will be many different paths to the future.

Certainly, as a primary source of basic research and the next generation of scholars, the research university remains an asset of great value that must be protected. To be sure, the world and the structure of academic research have changed greatly since Vannevar Bush wrote his report. However, the major principles he advanced merit reaffirmation. Now more than ever before, the national interest calls for an investment in human and intellectual capital. As Bush so clearly stated it, the government-university partnership is not simply about the procurement of research results. It is also about nurturing and maintaining the human strengths of a great technological nation and sowing the seeds that will ultimately bear fruit in new products and processes to fuel our economy and improve our quality of life.

As Erich Bloch, former Director of the National Science Foundation, stated it in Congressional testimony:

“The solution of virtually all the problems with which government is concerned: health, education, environment, energy, urban development, international relationships, space, economic competitiveness, and defense and national security, all depend on creating new knowledge—and hence upon the health of America’s research universities.”

The American public, its government, and its universities should not surrender the long-term advantage of this research partnership because of a short-term loss of direction or confidence. At a time when many of society’s other institutions do not seem to be working well, the public research university is a true success story. We simply must get that message across to the American public. We must re-articulate and revitalize the remarkably successful partnership that has existed between our government, our society, and our research universities over the past five decades.

But at the same time we must recognize that the years ahead will represent a period of significant change on the part of our universities if we are to respond to the challenges, opportunities, and responsibilities before us. A key element will be efforts to provide universities with the capacity to transform themselves into entirely new paradigms that are better able to serve a rapidly changing society and a profoundly changed world.

### A Possible Role for the Whitaker Foundation

It is indeed time that we considered a new social contract between the university and our society, a contract that both recognizes and sustains all that is valuable in the research and graduate education mission of our research universities. But we should do so in full recognition of the changing needs of our society, the changing environment for education and scholarship, and the necessary changes that must occur in our institutions if we are to continue to serve.

Last night we heard the remarkable story of the Whitaker Foundation and its impact on the important field of biomedical engineering. Many of us have had direct experience with the Foundation's programs on our campus.

Through a carefully-designed, strategic focus on a critical area, biomedical engineering, the Whitaker Foundation has

- Built new programs.
- Supported outstanding scholars
- And sustained research and graduate education.

It has linked together our engineering and medical schools. It has provided our biomedical engineering programs and our faculty with the visibility to attract support both within our institutions and from external sponsors.

It has been this careful strategy of focus, linkage, and leveraging that has been the key to the effectiveness of the Whitaker Foundation. And it could be this same approach that could help to shape the future evolution of the research university.

The changes of our times pose great challenges to our universities. But they also represent an unusual moment in history, a time of great opportunity for the Whitaker Foundation.