Ann Arbor Leadership Conference

We are living in the most remarkable of times. Who would have predicted a few years ago:

- the collapse of communism and the end of the Cold War
- the redefinition of the world economic order
- the direct manipulation of the human gene to cure disease
- the Internet phenomena, liking 25 million people worldwide
- digital convergence, in which communications and computer companies merge with the entertainment industry.

Yet all of these events have happened, and the pace of change continues to accelerate.

Indeed, many believe that we are going through a period of change in our civilization just as profound as that which occurred in earlier times such as the Renaissance and the Industrial Revolution--except that while these earlier transformations took centuries to occur, the transformations characterizing our times will occur in a decade or less!

I used to portray the 1990s as the countdown toward a new millennium, as we found ourselves swept toward a new century by these incredible forces of change. But the events of the past several years suggest that the twenty-first century is already upon us, a decade early. We live in a time of breathtaking change, at a pace that continues to accelerate even as I speak.

This last point is very important, for today we are seeing a dramatic shift in the fundamental structure, nature, and perspective of our society. We are evolving rapidly into a society in which the key strategic resource necessary for prosperity and social well-being has become knowledge itself. In this world knowledge will play the same role that in the past was played by natural resources or geographic location or labor pools. Put another way, while forces such as land, guns, and money drove the past, ideas will be the driving force of the twenty-first century.

The "age of knowledge" in which we now find ourselves is accompanied by a fundamental transformation that is reshaping every product, every service, and every job throughout our nation and the world.

A Communications-Driven Society

In Michigan we have a unique vantage point from which to view the a particularly important feature of these changes. If there was one sector that most strongly determined the progress of the twentieth century, it was *transportation* and its related industries--cars, planes, trains, oil, space. Transportation determined prosperity, national security, even our culture--with the growth of the suburbs, international commerce, and so on. During this period Michigan's automobile industry had no equal, and the state rapidly became one of the most prosperous and powerful industrial regions on earth.

Today things are very different. We have entered a new era in which the engine of progress is not transportation but rather *communication*, enabled by the profound advances we are now seeing in computers, networks, satellites, fiber optics, and related technologies. We now face a world in which hundreds of millions of computers easily can plug into a global information infrastructure. Jacques Attali in his profound essay, *Millennium*,[1] suggested that the impact of information technology will be even more radical than that of the harnessing of steam and electricity in the nineteenth century. Rather it will be more akin to the discovery of fire by early ancestors, since it will prepare the way for a revolutionary leap into a new age that will profoundly transform human culture.

It is clear that information technology on which our knowledge-intensive society is increasingly dependent continues to evolve very rapidly. In the next several years we will see yet another 1,000-fold increase in the power of computers and networks. In the same time frame, massively parallel computation servers will offer tera-operations per second, while the price performance ratio of workstations will continue to improve. Within several years, widely available international networks capable of point-to-point multi-media (including video) will be available. Wide-area networks in the gigabit-per-second range will be in routine use, although still well short of the 25,000 gigabit potential of third generation fiber optic technology. Wireless communication will support remote computing and communication.

These rapidly evolving technologies are dramatically changing the way we collect, manipulate, and transmit information. Needless to say, the implications for our universities are profound. Let me illustrate with three themes:

---

[1]Jacques Attali, Millennium

Theme 1: The University as a Knowledge Server

One frequently hears the primary missions of the university referred to in terms of teaching, research, and service. But these roles can also be regarded as simply the twentieth century manifestations of the more fundamental roles of creating, preserving, transmitting, and applying knowledge. If we were to adopt the more contemporary language of computer networks, the university might be regarded as a knowledge server, providing knowledge services (i.e., creating, preserving, transmitting, or applying knowledge) in whatever form needed by contemporary society.

From this more abstract viewpoint, it is clear that while the fundamental *knowledge server* role of the university does not change over time, the particular realization of these roles do change--and change quite dramatically, in fact. Consider, for example, the role of "teaching"--that is, transmitting knowledge. While we generally think of this role in terms of a professor teaching a class of students, who, in turn, respond by reading assigned texts, writing papers, solving problems or performing experiments, and taking examinations, we should also recognize that classroom instruction is a relatively recent form of pedagogy. Throughout the last millennium, the more common form of learning was through apprenticeship. Both the neophyte scholar and craftsman learned by working as apprentices to a master. While this type of one-on-one learning still occurs today, in skilled professions such as medicine, and in advanced education programs such as the Ph.D. dissertation, it is simply too labor-intensive for the mass educational needs of modern society.

The classroom itself may soon be replaced by more appropriate and efficient learning experiences. Indeed, such a paradigm shift may be forced upon the faculty by the students themselves. Today's students are members of the "multimedia" generation. They have spent their early lives surrounded by robust, visual, electronic media--Sesame Street, MTV, home computers, video games, cyberspace networks, and virtual reality. They approach learning as a "plug-and-play" experience, unaccustomed and unwilling to learn sequentially--to read the manual--and rather inclined to plunge in and learn through participation and experimentation. While this type of learning is far different from the sequential, pyramid approach of the traditional university curriculum, it may be far more effective for this generation, particularly when provided through a media-rich environment.

Hence, it could well be that faculty members of the "knowledge-server" university will be asked to set aside their roles as teachers and instead be asked

to become "designers" of learning experiences, processes, and environments. Further, tomorrow's faculty may have to discard the present style of solitary learning experiences, in which students tend to learn primarily on their own through reading, writing, and problem solving. Instead they may be asked to develop collective learning experiences in which students work together and learn together with the faculty member becoming more of a consultant or a coach than a teacher.

One can easily identify other similarly profound changes occurring in the other roles of the university. The process of creating new knowledge--of research and scholarship--is also evolving rapidly away from the solitary scholar to teams of scholars, perhaps spread over a number of disciplines. Indeed, is the concept of the disciplinary specialist really necessary--or even relevant--in a future in which the most interesting and significant problems will require "big think" rather than "small think"? Who needs such specialists when intelligent software agents will be available to roam far and wide through robust networks containing the knowledge of the world, instantly and effortlessly extracting whatever a person wishes to know?

So, too, there is increasing pressure to draw research topics more directly from worldly experience rather than predominantly from the curiosity of scholars. Even the nature of knowledge creation is shifting somewhat away from the analysis of what has been to the creation of what has never been--drawing more on the experience of the artist than upon analytical skills of the scientist-- but more on this in a moment.

The preservation of knowledge is one of the most rapidly changing functions of the university. The computer--or more precisely, the "digital convergence" of various media from print to graphics to sound to sensory experiences through virtual reality--has already moved beyond the printing press in its impact on knowledge. Throughout the centuries the intellectual focal point of the university has been its library, its collection of written works preserving the knowledge of civilization. Yet today, such knowledge exists in many forms--as text, graphics, sound, algorithms, virtual reality simulations-- and it exists almost literally in the ether, distributed in digital representations over worldwide networks, accessible by anyone, and certainly not the prerogative of the privileged few in academe.

Finally, it is also clear that societal needs will continue to dictate great changes in the applications of knowledge it excepts from universities. Over the past several decades, universities have been asked to play the lead in applying

knowledge across a wide array of activities, from providing health care, to protecting the environment, from rebuilding our cities to entertaining the public at large (although it is sometimes hard to understand how intercollegiate athletics represents knowledge application).

The knowledge server theme for the university is not merely a possible paradigm for the future. Rather it is a paradigm which has existed throughout the long history of the university and will certainly continue to exist as long as these remarkable social institutions survive. But the particular realization of the fundamental roles of knowledge creation, preservation, transmission, and application will continue to change in profound ways, as they have so often in the past.

Theme 2: A Shift from Analysis to Creation

The professions that have dominated the late twentieth century--and to some degree, the late twentieth century university--have been those which manipulate and rearrange knowledge and wealth rather than create it, professions such as law, business, accounting, and politics. Yet it is becoming increasing clear that the driving intellectual activity of the twenty-first century will be the act of creation itself.

> "The winners of this new era will be creators, and it is to them that power and wealth will flow. The need to shape, to invent, and to create will blur the border between production and consumption. Creation will not be a form of consumption anymore, but will become work itself, work that will be rewarded handsomely. The creator who turns dreams into reality will be considered as workers who deserve prestige and society's gratitude and remuneration."   Jacques Attali, *Millennium* [2]

Perhaps the determining characteristic of the University of the twenty-first century will be shift in intellectual focus from the preservation or transmission of knowledge to the process of creation itself. The tools of creation are expanding rapidly in both scope and power. Today we have the capacity to literally create objects atom-by-atom. We are developing the capacity to create new life-forms through the tools of molecular biology and genetic engineering. And we are now creating new intellectual "life forms" through artificial intelligence and virtual reality.

---

[2]ibid., Attali

Hence, perhaps the university should structure itself in a more strategic fashion to nurture and teach the art and skill of creation. Perhaps we should form strategic alliances with other groups, organizations, or institutions in our society whose activities are characterized by great creativity (e.g., ... the Disney Company? . . .)

Theme 3: The Need to "Re-invent" the University

A third theme lies in the implications for existing social structures of knowledge-based organizations such as universities. It is clear that although the digital age will provide a wealth of opportunities for the future, we must take great care not simply to extrapolate the past, but instead to examine the full range of possibilities for the future.

But here we face a particular dilemma. Both the pace and nature of the changes occurring in our world today have become so rapid and so profound that our present social institutions--in government, education, the private sector-- are having increasing difficulty in even sensing the changes (although they certainly feel the consequences), much less understanding them sufficiently to respond and adapt. It could well be that our present institutions, such as universities and government agencies, which have been the traditional structures for intellectual pursuits, may turn out to be as obsolete and irrelevant to our future as the American corporation in the 1950s. There is clearly a need to explore new social structures capable of sensing and understanding the change, as well as capable of engaging in the strategic processes necessary to adapt or control change.

Since the business of the university is knowledge, technology such as computers, networks, HDTV, ubiquitous computing, knowbots, and virtual reality may well invalidate most of the current assumptions and thinking about the future nature of the university. Some examples will illustrate this:

i)   Will a "university of the 21st century" be localized in space and time, or will it be a "metastructure", involving people throughout their lives wherever they may be, on this planet or beyond?

ii) Will lifestyles in the academy (and elsewhere) become increasingly nomadic, with people living and traveling where they wish, taking their work and their social relationships with them?

Each paradigm suggests the extraordinary nature of the transformations that would be required in our universities in the years ahead. Just as they have so many times in the past, it is clear that our institutions must continue to change and evolve if we are to continue to serve--and, indeed, remain relevant to--a rapidly changing world.

Personal Closing Remarks...

Since last fall when I announced my intent to return to the faculty after serving as president of the University for the past eight years, there have been many questions--and, indeed, much speculation--about just what "return to the faculty" means for the Duderstadts. Indeed, Anne and I wondered ourselves about life after the presidency, but the press of our continuing responsibilities for leading the University gave us little opportunity to make more definite plans for our transition this July.

Some aspects of our new role were apparent enough. With a title of *President Emeritus* and *University Professor of Science and Engineering,* I will have a University-wide faculty appointment that will allow me to teach and conduct research in any of our academic programs. Clearly, as well, Anne and I will continue to be involved in a variety of roles associated with institutional advancement such as fund-raising and government relations. However, during the course of the past several months, I have agreed to serve in several additional roles:

- ♦ Director of the Millennium Project
- ♦ Chief Scientist of the Media Union
- ♦ Collaborator and Facilitator for Academic Outreach

This letter is intended to share with you my excitement about these new roles.

The Millennium Project

This summer I will be launching a small research center in the new Media Union on the North Campus aimed at exploring the future of the American university. This center, known as **the Millennium Project**, will draw together scholars and students both from our campus and beyond to explore various possible paradigms of the American university for the 21st Century (...or, better yet, the Third Millennium...).

While the Millennium Project will explore a number of quite different visions of future universities, it will not be a simple thinktank. Rather it will be an experimental laboratory. It is our intent to use the center to develop working models or prototypes of future university paradigms. Like the famous Lockheed Skunkworks, every so often the hangar doors of the Millennium Project will open and something really weird will be wheeled out and flown away

The Millennium Project will be launched on seed funding from the University for an initial five-year period (...to the year 2001...) But we have already had strong interest in support from both the federal government and private foundations, and the Project could eventually evolve into a major national center or institute for the study of higher education.

The Media Union

As we have noted on many occasions, the Media Union itself is designed to explore many aspects of the impact of information technology on education. To quote the initial prospectus:

> "Our new Media Union merges the creative aspects of disciplines across the entire campus, ranging from art, psychology, and architecture, to engineering, philosophy and biology. Inventive scholars will come together with powerful resources, entering a free-wheeling space where extraordinary people can do exceptional things. Michigan's portal to the rest of the world, the Media Union will reach out to the huge storehouses of information growing daily on the Web, while drawing national and international scholars and students into our campus conversations. New information technology will create a "virtual" community of thinkers, allowing face-to-face dialogue and collaboration across thousands of miles."

Or, as put more succinctly by Dean Paul Boylan, "We are creating an environment where students and faculty can dream and then act on their dreams."

In response to a request by the executive officers and the North Campus deans, I have agreed to serve as well as "chief scientist"...or perhaps more appropriately "executive producer" of the Media Union. (Some have even suggested "The Wizard o
f MU" as a more apt title...) While others will provide the ongoing direction for the technical support and operation of the facility, it will be my role, joined by

my colleagues in the Millennium Project, to provide much of the intellectual momentum for this exciting new resource.

Academic Outreach

I have also agreed to work closely with Doug Van Houweling and his colleagues on a number of projects associated with our growing efforts in academic outreach. These include the development of so-called "virtual" or cyberspace universities at the state, national , and international level; exploring new methods for the delivery of educational services such as multimedia; and designing and launching a major new academy for the education of future academic leaders. My particular role in each of these projects will vary. For example, the Governor has asked me to head up the effort to build a statewide virtual university to serve the automobile industry. The AAU universities have asked me to explore a similar concept that would allow these research universities to provide educational services on a worldwide basis. And Farris Womack has expressed an interest in working with me to develop a national academy for academic leaders, similar to the very successful executive education program conducted by our School of Business Administration.

Relationships

The interrelationship among these various roles is best illustrated by the diagram in Figure 1. This characterizes the Millennium Project as providing the intellectual content for a sequence of activities ranging from fundamental research to development to prototyping to actual production and delivery.

More specifically, the Millennium Project will explore various paradigms for the future of higher education within the extraordinary environment provided by the Media Union and sustained through strong interactions with academic units--in particular, the School of Information and the North Campus schools and colleges; the Information Technology Division; and the University Libraries. There will be extensive interaction with other ongoing efforts such as academic outreach, K-14 education, UMTV, and new initiatives such as virtual universities. Finally, it seems likely that new organizations will be formed to take successful paradigms beyond the prototyping and testing stage, such as nonprofit corporations and alliances with for-profit companies.