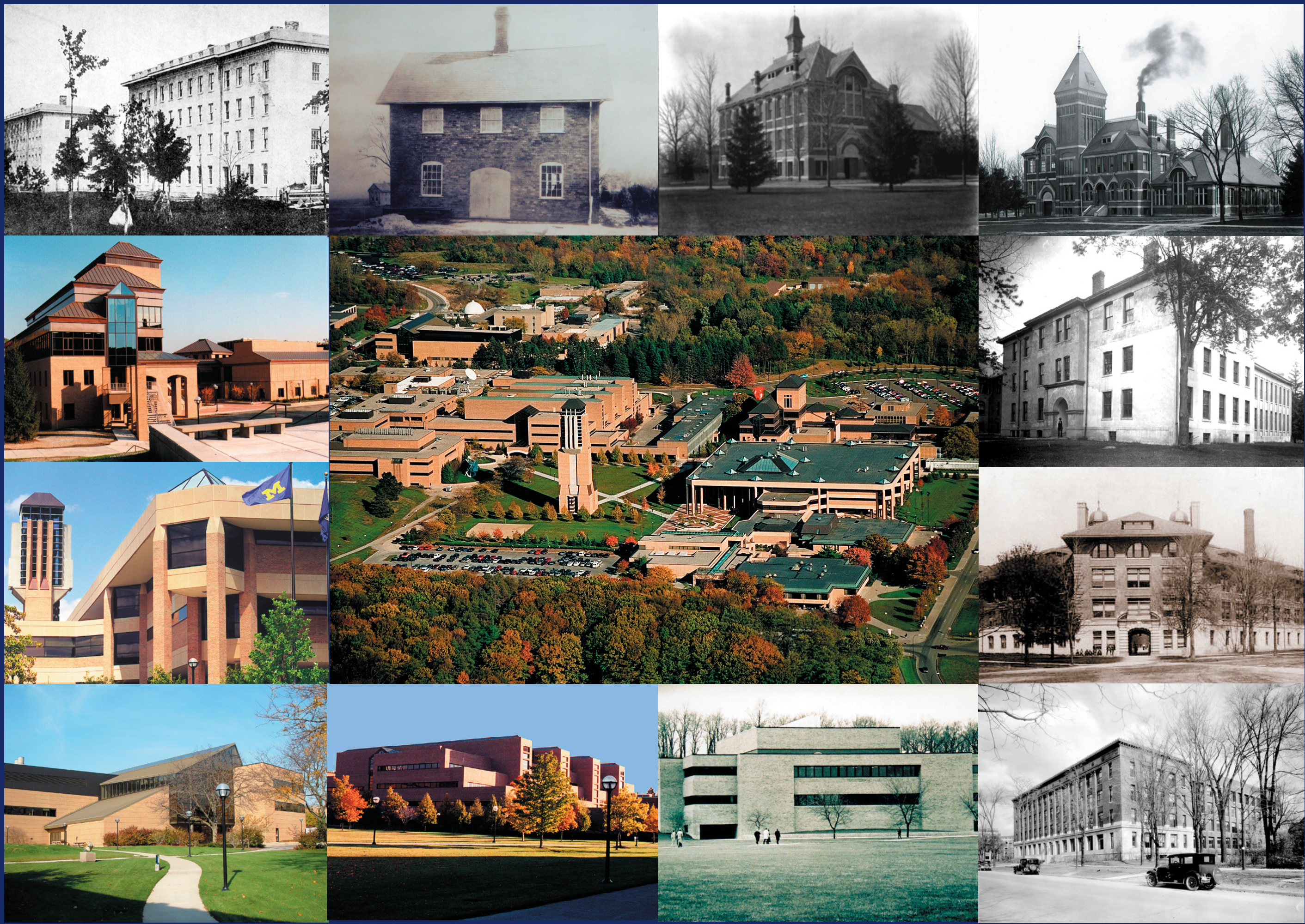
ON THE MOVE

A Personal History of Michigan's College of Engineering in Modern Times



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A Personal History of The University of Michigan's College of Engineering in Modern Times

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Preface

The 2003-2004 academic year will mark the 150th anniversary of engineering education at the University of Michigan. More precisely, the first classes in engineering met on January 20, 1854, and the first degree in engineering was given to a Michigan student in 1856. Throughout the ensuing years, the UM College of Engineering has provided leadership for engineering education, research, and practice for the nation and the world while contributing greatly to the progress of the University of Michigan.

When the College celebrated its first centennial in 1954, under the leadership of Dean George Granger Brown, a brief history of the College was developed along with a film and convocation to celebrate its achievements. Hence it seems appropriate to look to the 150 year milestone as an opportunity to update this history by adding an analysis of the events of the past half-century. Yet here we have an unusual challenge, since many of the records of the College were apparently lost during its move from the Central Campus to its current North Campus site.

Of course this should not be too surprising, since the neglect of history has been an all too frequent shortcoming of public universities. A visit to the campuses of one of our distinguished private universities, places such as Harvard, Yale, or Princeton, conveys an impression of history and tradition. The ancient ivy-covered buildings; the statues, plaques, and monuments attesting to important people and events of the past—all suggest that these institutions have evolved slowly, over the centuries, in careful and methodical ways, to achieve their present forms.

In contrast, a visit to the campus of one of our great state universities conveys more of a sense of dynamism and impermanence. Most of the buildings look new, even hastily constructed, in order to accommodate rapid growth. The icons of the public university tend to be their football stadiums or the smokestacks of their central power plants rather than their ivy-covered buildings or monuments. In talking with campus leaders at public universities, one gets little sense that the history of these institutions is valued or recognized. Perhaps this is due to their egalitarian nature, or conversely, to the political (and politicized) process that structures their governance and all too frequently informs their choice of leadership. The consequence is that the public university evolves through geological layers, each generation paving over or obliterating the artifacts and achievements of earlier students and faculty with a new layer of structures, programs, and practices.

Yet the history of public higher education in America is just as rich and significant as that of our elite private colleges and universities. One might even suggest that the complex and frequently ignored history of the public university, tightly coupled as it is to the changing needs of our society, may be more relevant to understanding the future of higher education in America than the gradual, evolutionary changes experienced by private institutions. Such is certainly the case with the UM College of Engineering, long regarded as one of the world's leading colleges of engineering education and research, and yet all too often unaware of its own remarkable history.

In considering what contribution we might make to the sesquicentennial celebration of the College, my wife Anne and I decided that an effort to fill in this historical record might be both appropriate and valued. After all, we have not only served (together) in my roles as Dean of Engineering (1981-1986), Provost and Vice President for Academic Affairs (1986-1988), and President of the University (1988-1996), but our tenure as a member of the faculty and leader of the broader campus community spans the majority of the past 50 years (1968 to present). Furthermore, we have long shared an interest in the evolution of the University campus and have worked with both library and administrative staff to build substantial collections of materials on this subject. Finally, from my earliest days as a scientist at the Los Alamos Scientific Laboratory, I have been trained to keep careful records of all of my experiences, events, meetings, observations, and plans in bound notebooks. Hence even though much of the formal historical documentation of the recent history of the College may have been lost, I have accumulated several bookcases filled with carefully documented notebooks on the evolution of the College of Engineering from my own perspective as I progressed through my various roles, from new faculty member to my current position as University Professor of Science and Engineering.

Our particular contribution to the history of the College will take two forms. First, Anne has created a pictorial narrative of the evolution of the College of Engineering on the Central and then the North Campus of the University, animated by a series of vignettes illustrating the remarkable people and events that shaped the life of the College.

Second, I have written a more personal narrative of the history of the College of Engineering as I have seen it, experienced it, and digested it from the multiple perspectives of a faculty member (from the trenches) to dean (at ground zero) to provost and president (as an angel on high) to my current appointment as a university-wide professor (as a ghost from the past). Here it is important to add the caveat that this narrative is not intended as a rigorous history of the College in modern times, but rather a fusion of personal memoirs, observation, and conjecture. Furthermore, I should confess that I have succumbed to the temptation of all former academic leaders by not only analyzing the past but also attempting to address the future, speculating a bit about the future of engineering education, and being so bold as to offer some advice to both the College of Engineering and the University of Michigan concerning how to sustain Michigan's 150 year tradition of leadership in engineering education.

There is yet another purpose to this effort: that of providing through personal example an introduction to the archaic academic profession of *deaning*. Among the menagerie of academic leadership positions, the role of dean is both one of the most important and most challenging, particularly in large, complex, and highly decentralized universities such as the University of Michigan. Although university presidents and provosts can influence the quality of the institution-wide environment for teaching and research, it is usually the dean who most directly impacts the quality and reputation of an academic school or college. Deans are responsible not only for recruiting, developing, and evaluating the faculties of their schools, but beyond that, they must attract the resources and build the environments necessary for quality teaching and research.

In sharp contrast to the challenge of leading the diverse array of disciplines characterizing the contemporary multiversity, the disciplinary span of most schools is sufficiently narrow to allow deans to exert intellectual leadership as well. Furthermore, the size of the faculty is usually sufficiently small (several hundred, at most) to enable the development of personal relationships in contrast to university-wide appointments that can involve responsibility for thousands of faculty members, students, and staff. Hence, in contrast to a university president whose role is more akin to that of the mayor of a large city, a dean plays a more pastoral role as the head of a family (albeit a large and occasionally cantankerous one).

My own experience as dean of Michigan's College of Engineering was rather short-lived, since I had the privilege of serving for only five years before being drafted into the roles of university provost and president. However, my longer tenure as a faculty member in the College (now in my fourth decade) and my experience in recruiting, serving with, and leading deans from other disciplines provides a 360-degree perspective of this important university role. I hope these experiences will be of interest and possibly even of use to others considering assignments (or even careers) in academic administration.

Ann Arbor, Michigan
Spring, 2003

Chapter 1

The First Century: 1850 to 1950

Good, Gray Michigan

In March of 1968 I visited the University of Michigan for the first time to be interviewed for the position of assistant professor of nuclear engineering. Actually, at the time I was more interested in staying in California, in a faculty position at either Caltech or UC-Berkeley. But my Caltech faculty advisor asked me to interview at Michigan as a personal favor, since he had promised his colleagues on the Michigan faculty that he would send along one of his recent Ph.D. graduates as a potential faculty candidate.

As I was to learn later, March is far from an ideal time to attempt to recruit faculty members to Michigan. The weather is usually terrible—cold, overcast, and wet. The streets and lawns have yet to recover from the beating they take from winter storms. It is a time that gives rise to one of the University's less desirable names, "Good, Gray Michigan."

Yet on my visit, I found a very vibrant Department of Nuclear Engineering, generally ranked along with MIT as the leading program in the nation, with lots of energetic young faculty, and even more energetic and enthusiastic graduate students. As I was to learn later, the Department had scored a coup in graduate student recruiting that year, since one of its faculty members had served on the selection committee for the Atomic Energy Commission graduate fellowships and managed to obtain an advance list of all the award winners. The Department took the bold step of calling every winner on the list and inviting them to visit the University, wining and dining them, and eventually landing over two dozen AEC Fellows. A faculty position in my area, neutron transport theory, had become available when one of the Department's most prominent faculty members had left in a huff for another university after his colleagues had called his annual bluff of threatening to quit if he didn't get his way. Hence, it was clear that if I came to Michigan, I would have my pick of the very best graduate students in the nation.

The facilities of the Department were also impressive, all located on the North Campus of the University, and clustered about the Phoenix Laboratory and its nuclear reactor, which provided superb experimental facilities. During my brief visit that spring I saw only the evergreen expanse of the North Campus, the high quality faculty, students, and facilities of the Department, and the home of the department chairman, before being hustled to the airport for my flight back to California. The Michigan faculty members assured me that the rest of the College of Engineering would join the Department of Nuclear Engineering on the North Campus in a few years, and if I decided to come to Michigan, I should definitely plan on finding a house in north Ann Arbor.

It would be many years later, long after I (rather, Anne) had accepted the offer of a faculty position at Michigan, toiled in the vineyards of teaching and research, and become involved in faculty service activities with the College of Engineering, that I became aware of just how atypical was my experience in nuclear engineering. During these latter years, my increasingly frequent visits to the Central Campus to serve on various faculty committees of the College of Engineering revealed the deplorable state of affairs faced by its other departments and programs. As I trudged up the stairs to meetings in West Engineering and East Engineering, I could see the ruts worn deep into the stone steps of these ancient buildings by generations of students and faculty. The classrooms were dark and musty, with broken blinds, cracked blackboards, and a total absence of amenities such as chalk (a terribly important tool for a theoretician such as myself). The laboratories, such as they were, looked old, dilapidated, and makeshift. The faculty looked even more ancient, dispirited, and apathetic. They had been promised time and time again by engineering deans and university presidents that their move into new facilities on the North Campus was just around the corner, only to find each time that the University simply had higher priorities for facilities, funding, and attention.

Looking at the North Campus complex of the College of Engineering today, it is hard to imagine that these times ever existed. Stunning new buildings such as the Electrical Engineering and Computer Science Laboratory, the François-Xavier Bagnoud Building, the Lurie Engineering Center and Carillon Tower, and the Media Union not only make important architectural statements, but they provide truly outstanding facilities for teaching and research. Even the older buildings of the College have been completely renovated (including the Institute of Science and Technology complex, finally assigned to the College in the 1990s). Together with state-of-the-art laboratories, a world-class computer system (the Computer Aided Engineering Network), and a library of the 21st Century in the Media Union, the College of Engineering today enjoys one of the finest environments for engineering education and research in the world.

Moreover, the College enjoys a level of financial support unprecedented in its history, provided through a combination of strong support from the University, research grants and contracts, and private giving. The quality of the faculty, students, and programs of the College reflects these investments, and the College is

The College of Engineering, circa 2001 generally ranked today among the top five engineering schools in the nation.

This remarkable transformation is really the focus of this book: how it happened; the people, the events, the sacrifices and the commitments that made it possible. But to tell this story, and particularly, to set the stage for the renaissance of the College in the 1980s, it is necessary to travel back in time to the last century, during the earliest years of the University and its College of Engineering.

For almost a century and a half, the College of Engineering at the University of Michigan has provided leadership in engineering education for the nation and the world through the quality and innovation of its programs; the teaching, research, and service of its faculty; and the remarkable achievements of its graduates. Excellence and leadership in higher education over the decades can be traced to many factors: to outstanding faculty and students, to strong support and leadership, and, in the College's case, to its presence within a great university.

The history of the College is a story of people and events, programs and places, and commitment and achievement. Although the focus of this book is on the more recent past, a time of personal experience, it is useful to provide a broader perspective by first summarizing the early history of engineering education at Michigan.

The Early Years

The College of Engineering at the University of Michigan usually identifies its formation in January, 1854, when the first classes in engineering were taught. However, to understand better the history of the College and the important role it has played for the nation and its university, it is useful to step back for a moment to consider both the evolution of engineering education in the United States as well as the evolution of the University of Michigan.

The story of the evolution of engineering, from a military craft associated with the technology of war to broader civilian applications such as bridge construction, industrial technology, and transportation, can be found many places and need not be repeated here.[1] Suffice it to note that the United States lagged behind Europe in the introduction of science and technology into the curriculum of its colleges and universities. The first American school to offer scientific instruction in engineering was West Point in 1802, followed by the Rensselear Polytechnic Institute (1824), Annapolis (1845), Harvard (1847) (later spun off as MIT), Dartmouth (1851), and Yale (1852), with Michigan's first courses in 1854.

Actually, engineering education might be dated even earlier at Michigan, since the legislative charter for the University of Michigan adopted in 1837 provided for a professorship in "civil engineering and drawing."[2] However, the state legislature provided little funding for the early University, and instruction in science and engineering lay dormant until the arrival of Henry Philip Tappan as its president in 1852. Tappan was a well-known philosopher, committed to building scholarly activity in the University and providing for instruction in both science and technology. In his inaugural address he proposed "a scientific course parallel to the classical course containing...civil engineering, astronomy with the use of an observatory, and the application of chemistry and other sciences to agriculture and the industrial arts generally."

Upon the recommendation of a faculty member, Erastus O. Haven (later to become Tappan's successor as president of the University), the regents appointed Alexander Winchell as professor of physics and civil engineering. However, when Winchell arrived in January, 1854 to begin teaching, it soon became apparent that he was a misfit. His own training had been classical, and his first "engineering course" at Michigan was, in reality, simply an introduction to English composition for engineering students. Furthermore, he had an abrasive personality and was soon involved in disputes both with the chair of Natural Sciences, Silas Douglas, and with Tappan.[3] After a year, Tappan concluded that Haven had led him astray and that Winchell was not qualified to teach civil engineering. Although several

University of Michigan (1850) (painting by Cropsey)

of the Regents wanted to fire him, Tappan finally found a position for Winchell in Natural History (zoology, geology, and botany). Winchell continued to be a thorn in Tappan's side, and he eventually played a role in conspiring with Haven and the Regents to undermine Tappan's presidency.[4] Winchell was succeeded first by William Peck, a lieutenant in the Topographical Engineers, and then in 1857 by DeVolson Wood, who is regarded by many as the true founder of engineering education at Michigan. Wood proposed, designed, and essentially taught single-handedly a four-year curriculum in civil engineering offered through a department of engineering that was established in 1858 within the Literary College. Following Wood's departure in 1872, the Department of Engineering was led by three faculty members who would guide its destiny for over three decades: Charles Greene, Joseph Davis, and Charles Denison. Greene was a professor of civil engineering, educated at Harvard and MIT, who would become the first dean of the College of Engineering in 1895. Davis was also a leading civil engineer who established the University camp in surveying, named Camp Davis in his honor, and located first in northern Michigan and

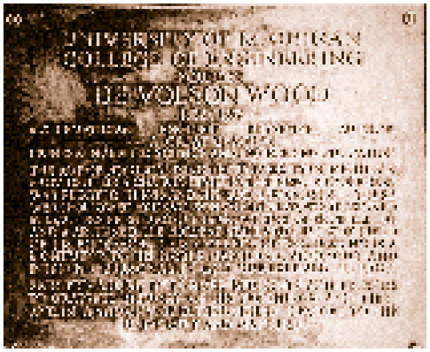
Alexander Winchell

later moved to Jackson Hole, Wyoming, where it continues to exist today as the University's geology camp.

Camp Davis surveying camp
(Pellston, Michigan)

Denison was an instructor in engineering drawing and taught for over forty years at the University, becoming one of the engineering faculty members most revered by the students. A lifelong bachelor, his fashionable clothing earned him the nickname, "Little Lord Chesterfield."[5]

Engineering classes were first taught in several rooms of the South College building previously used as student dormitories. Growth in the program finally persuaded then acting president Henry Frieze to recommend to the Regents that $2,555 be used for a modest engineering building to house laboratory facilities for mechanical engineering—or more accurately, a machine shop. A new faculty member, Mortimer Cooley,[6] was put in change of the project, and the first engineering building was completed in 1882.



Plaques in the Engineering Archway honoring Wood and Denison

Within a few years, additional laboratory space was necessary, and in 1885 a permanent brick Engineering Shop was built on the east side of the little building.[7] This was quickly enlarged in 1886, requiring the removal of Cooley's "scientific blacksmith shop." It should be noted that most instruction in the few science and engineering programs taught in American universities occurred primarily through lectures, supplemented only rarely by experiments performed entirely by the

A Surveying Class - 1863

instructor. Michigan became the first university in the United States to offer real laboratory facilities and to require laboratory courses for its students. In fact, when the Chemical Laboratory was opened in 1856, it was the only such instructional facility in the nation.

Key in the rapid growth of engineering education at Michigan during the last decades of the 19th Century was the interest and support of James Burrill Angell, who assumed the

The first engineering shop
(Cooley's "scientific blacksmith shop") – 1882

The Engineering Shops (1886)

Michigan presidency in 1871. Angell had once worked as a civil engineer in Boston and had even been offered a chair in civil engineering at Brown University, before becoming a professor of modern languages and literature. President Angell was keenly interested in the growth and development of the professional departments, recognizing their worth to the state and to society and providing them all the assistance within his power.

It was during Angell's tenure that the Department of Engineering was set off from the Literary College in 1895. More specifically, in 1895 the Regents resolved "that a school of Technology be organized, comprising the departments of Civil Engineering, Mechanical Engineering, and Electrical Engineering, and that Professor Charles E. Greene be appointed Dean."[8] The new College of Engineering and Architecture continued to grow during Angell's tenure, adding departments of chemical engineering, naval architecture and marine engineering, and architectural engineering.

Ironically, both Greene and Cooley were reluctant to separate the Department of Engineering from LS&A, since they believed that an engineer's education should be as broad as possible and that in a professional unit the tendency would be to narrow it. This was an issue that would return from time to time throughout the history of engineering at Michigan, including my own tenure as dean.

Despite Angell's strong support, it is also the case that engineering at Michigan frequently had to struggle with facilities inadequate to accommodate either its enrollment or the rapidly evolving nature of technology. Like the Literary College, it frequently had to make do with cast-off buildings such as that vacated by the Dental College (one of the original professors' houses on the campus) in 1891, the old powerplant (including its coalbunker) in 1897 to house highway and automotive engineering, segments of the old University Hospital Pavilion for the surveying department and even a discarded elementary school (the Tappan School adjacent to East Engineering) in 1923. Yet this pragmatic willingness to accept and utilize second-hand space could also be an asset, as the eventual move of the College of Engineering to the University's North Campus was to demonstrate in the 1980s.

The late 19th century was a particularly active time for engineering education across the nation. The Morrill Act of 1863, sometimes known as the Land-Grant Act because of its provision of federal lands to the states for the establishment of public universities, called for the encouragement of instructional programs in "agriculture and the mechanic arts." By 1880, there were 85 engineering schools in the United States, and by 1918 this number had grown to 126, 46 of which were in land grant colleges.[9]

The Engineering Building built on the old Dental School – 1891

East Hall (the old Tappan Elementary School)

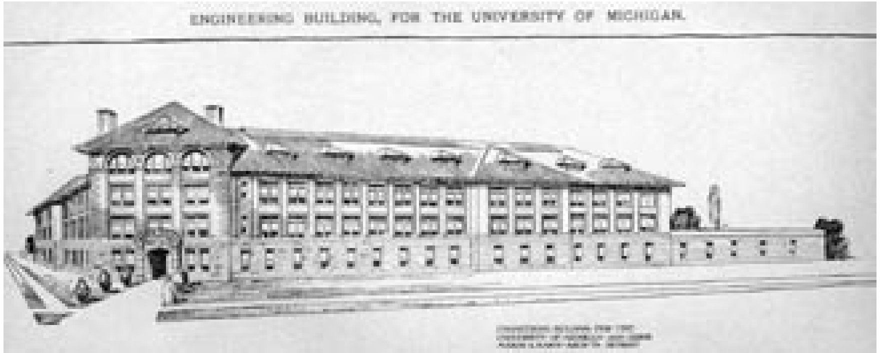
A New Century

The key player in the rapid progress of the College of Engineering during the early decades of the 20th Century was Mortimer Cooley, named as Greene's successor as dean in 1903.

Dean Mortimer Cooley

During Cooley's tenure at Michigan both as faculty member and then dean, enrollments in the College grew from less than 30 to more than 1,800; the faculty grew from two instructors teaching several courses to more than 160 professors and staff teaching hundreds of courses, and from a temporary shop of 1,720 square feet to over 500,000 square feet of well equipped buildings.

Cooley was an academic leader of remarkable energy and vision. During his 24 years as dean, the College grew considerably in strength and reputation and its campus presence assumed the form that would characterize it until its move to the North Campus in the 1980s. The West Engineering Building was completed in 1904.



Schematic of West Engineering

This building would also be added to many times, first to accommodate the naval towing tank in 1910 and then later to accommodate various other programs.

Throughout most of the history of the University, the arch through West Engineering (named after Denison but commonly called "the Engineering Arch") would become the symbol of the College of Engineering.

Under Cooley, the College continued to expand with the construction of East Engineering in 1923, built to accommodate the departments of Chemical Engineering, Metallurgy, and Aeronautical Engineering. This building was later expanded to accommodate the rapidly growing Department of Electrical Engineering.

West Engineering and the Engineering Arch (1904)

East Engineering (1923)

Cooley's remarkable energy extended far beyond the University campus. Since he served as mayor of Ann Arbor and in 1924 was the Democratic candidate for the United States Senate, he was a well-known presence throughout the community and the state. Cooley also had strong views about the nature of engineering education. It was noted earlier that he had initially opposed the separation of engineering from the Literary College, believing in the importance of a well-rounded education. He also believed that engineering should become a six-year curriculum, with the first two years devoted to cultural subjects, and the later years focused on professional education similar to Medicine or Law. (Perhaps it is not surprising that my own views of engineering education are very similar to those of Cooley!)

After finally stepping down as dean at the age of 73, Cooley was succeeded by the chairman of naval architecture, Charles Sadler, who served for the next decade. After the two-year tenure of Henry Anderson (of whom Cooley observed that "his health was such that he never should have taken the heavy responsibilities which he shouldered for so brief a time, and which without doubt greatly hastened his death"), the University recruited its first dean[10] from outside, Ivan Crawford, who had served in similar roles at the Universities of Idaho and Kansas.

Although the College enrollments continued to expand during the decades of Sadler, Anderson, and Crawford, there was relatively little new activity in either programmatic development or building. To some degree this is not surprising, since the Great Depression and World War II had a major impact on both the University and engineering education more generally. But it is also the case that Mortimer Cooley was simply a hard act to follow, and it was unlikely that the extraordinary growth of the College during his tenure would soon repeat itself.

The College of Engineering's Central Campus buildings (1940)

The teaching, research, and service activities of the College were conducted through a growing constellation of academic departments and programs, each with a distinguished and in many cases fascinating history. Fortunately, most of these departments have chronicled their own history, available through both written reports and websites, so it is not necessary to go into great detail here. But a few comments are necessary.

It has already been noted that Civil Engineering and Mechanical Engineering played essentially the role of founders of the College, contributing the first two deans (Greene and Cooley) and enrolling its early students. They were joined by Electrical Engineering in 1888 and Chemical Engineering in 1889. Although the University had introduced a chemistry curriculum in LS&A in 1884, it was discontinued in 1896, and from then until 1916 when the chemistry degree was reinstated, all chemistry activity was in the Department of Chemical Engineering. In fact, throughout most of the University's history, the enrollment in chemical engineering generally outnumbered that in chemistry. Ironic indeed, therefore, that when both programs were finally provided with new facilities in the 1980s, Chemical Engineering shared space with Materials and Metallurgical Engineering in a modest $12 million building on the North Campus while Chemistry received a new chemical sciences complex that was several times larger and worth $50 million. (This provides yet another demonstration that the closer the proximity of an academic unit to the president's office, the more generously it is supported...)

Electrical Engineering grew rapidly with the electrification of the nation and soon outgrew its space in the Physics Laboratory and later West Engineering. It also moved rapidly into newly emerging areas such as telecommunications. In fact, the first campus radio station was operated by Electrical Engineering (and, at one point, had future MIT president Jerome Weisner as its engineer and future CBS news reporter Mike Wallace as its on-air talent!).[11] In 1947, a major wing was added to East Engineering to accommodate the department. Yet with the growth of the electronics industry and then computers, this department was to continue its growth to the point where today it comprises over 30% of the enrollment of the College and spills out beyond the massive Electrical Engineering and Computer Science Building into several adjacent laboratories on the North Campus.

Although Dean Cooley first arrived at Michigan as professor of "iron shipbuilding," the Department of Naval Architecture and Marine Engineering was not formed until 1901. Cooley did have the foresight to provide for a 300-foot-long tank in the basement of the new West Engineering building where ship models could be towed and studied. The importance of shipping in the Great Lakes stimulated the rapid growth and prominence of the department.

Michigan launched the first program in aeronautical engineering in the nation in 1911, created by a European engineer, Felix Pawlowski. Although the courses were first taught in naval architecture, a separate department was formed in 1930. Throughout its history, the Department of Aeronautical Engineering (and later Aerospace Engineering) has ranked among the top programs in the nation, graduating leaders of the aerospace industry such as Kelly Johnson (founder of the Lockheed Skunkworks and perhaps the most famous designer in American aviation), Willis Hawkins and Robert Fuhrman (both CEOs of Lockheed), and George Skurla (CEO of Grumman).

A program in industrial engineering was first introduced in 1926, and later, following the introduction of operations research methods in World War II, expanded to become the Department of Industrial and Operations Engineering. The College continued to be an innovator throughout the 20th Century, introducing the first programs in the nation in nuclear engineering (1957), computer engineering (1959), and integrated manufacturing (1986).

The College also had a number of more specialized programs reflecting both the nature of engineering education and the needs and opportunities of the moment. For example, since mechanical drawing played such a major role in engineering practice, the College had a separate Department of Engineering Drawing, complete with blueprinting equipment and numerous drawing rooms in West Engineering. With the introduction of computer aided design, the department was gradually phased out in the 1970s.

During the years of WWI, the College formed a Department of Military Science and Tactics. It also mobilized its resources in support of officer training during WWII. Since that time it has played a major role in supporting ROTC efforts on campus.

Michigan training soldiers for World War I

Finally, during the 1920s, the College organized a Department of Engineering Research under the leadership of Albert E. White, a faculty member in metallurgical engineering. This activity evolved into a major research organization, the Engineering Research Institute, conducting research for both industry and the federal government in the years after WWII. However, eventually the increasing bureaucracy associated with federally sponsored research stimulated the University to launch its own Division of Research Development and Administration, reporting to the vice president for research, that took over all responsibilities for research administration campus-wide in the 1950s.

The Significance of the College

To Engineering Education

The University of Michigan's College of Engineering has long provided leadership for engineering education. It was not only among the first engineering programs in the United States, but throughout its century and a half of existence, has also been one of the largest (currently second in size only to Purdue's), most comprehensive, and most innovative. The lists of "firsts" is much too long to document here, but several examples illustrate.

As we have noted, the College was a leader in the introduction of new engineering programs, including the earliest programs in naval architecture

(1881), electrical engineering (1890), chemical engineering (1898), aeronautical engineering (1914), nuclear engineering (1953), and computer engineering (1965). The College has also pioneered the development of unique facilities for engineering education and research, such as the first naval architecture towing tank (1904), the Willow Run Research Laboratories (1946) (later the Environmental Research Institute of Michigan), the Phoenix Laboratory and Ford Nuclear Reactor (1951), the Michigan Terminal System (MTS) time-sharing system (1963), the College's Instructional Television System and Chrysler Center for Continuing Engineering Education, and the Computer Aided Engineering Network (1983).

The contributions of faculty members to engineering education and research have been considerable. The College has long been known as the source of many of the major textbooks used for engineering education with prominent authors such as Stephan Timoshenko (applied mechanics), George Granger Brown (unit operations), Richard Sonntag and Gordon Van Wylen (thermodynamics), Joseph Shigley (design), Arnold Kuethe (aerodynamics), Lawrence Van Vlack (materials), Brice Carnihan and James Wilkes (computers), Vic Streeter (fluid dynamics), and Glenn Knoll (nuclear instrumentation), to mention only a few.

Faculty members and graduates of the College have also made important contributions through their research. For example, Felix Pawloski offered the world's first course in aeronautical engineering in 1916. Stephan Timoshenko essentially created the mathematical discipline of applied mechanics in the 1930s by applying rigorous mathematical methods to engineering mechanics. William Dow was a leader in electronics and an early pioneer in plasma devices. Homer Martin invented fluid catalytic cracking, an indispensable step in providing the aviation fuel essential to Allied victory in WWII. Claude Shannon developed the science of information theory, laying the foundation for digital communication. Donald Katz invented the methods used today for storing natural gas in underground storage fields. Ed Lesher built and piloted planes that held the world's distance records.

Professor Edward Lesher and his experimental aircraft

Chihiro Kikuchi invented the ruby maser, laying the foundation for today's laser technology. Emmett Leith and Juris Upatnieks adapted radar technology to develop the first working holograms.

Professor Emmett Leigh and his holography apparatus

And, of course, no history of the College would be complete without mentioning the contributions of Professor A. D. Moore, one of the pioneers of electrostatics, who served as a faculty member for almost half-a-century (continuing into his 90s to ride his bike to his laboratory in the early morning hours).

A.D. Moore

To the Nation, the State, and the Community

Faculty members of the College also have made important contributions to their nation, the State of Michigan, and the City of Ann Arbor. Federal agencies, commissions, and advisory bodies such as the National Science Board, the Space Sciences Board, and the National Science Foundation have benefited from the many faculty members who have served in various roles.

Two members of the faculty have actually served as mayor of Ann Arbor: Mortimer Cooley and A. D. Moore. Many others have served as city council members, county commissioners, and school board members.

To the University

The College of Engineering has played a particularly important role in the history of the University. From its earliest days as the third degree program offered by the University (after LS&A and Medicine), it has enrolled roughly one-quarter of the University's students. It has also had a major impact on the evolution of the academic programs of the University. For example, both the programs in architecture and art first were developed within the College (1906) and did not become independent schools until 1931 and 1972, respectively. Similarly the College of Engineering played a major role in the development of programs in mathematics, finally merging its mathematics curriculum with that of LS&A in 1928. The University's modern languages programs also trace their beginning to instruction in the College in German and French, later joining with the LS&A counterparts in 1929. Public health can be traced to early instruction offered by Engineering and Medicine in public health engineering and later a program leading to the degree of doctor of public health in 1911. The College even participated directly with the School of Forestry and Conservation in developing joint programs in wood technology.

The College of Engineering provided leadership for the University in many other ways. It was the first academic unit to establish a mentor system for first year students. Furthermore, it adopted an honor code system, based on the principle that "it is dishonorable for any student to receive credit for work which is not the result of his or her own effort." This system derived its authority directly from the students, who both investigated possible violations and prescribed sanctions. It continues to operate today as a model for student responsibility and integrity.

The engineering faculty also served the University in many other ways. During the early years, they operated and maintained the University power plant (as well as the water treatment facilities of the City of Ann Arbor). For most of the history of the University, engineering faculty members have

Dean Mortimer Cooley as Commencement Marshall

served as the marshals for University commencement exercises, beginning with Dean Cooley himself.

And while engineering faculty members were never tapped for executive positions in the University (at least until I was selected as provost and then later elected as president of the University), they did serve in key positions of faculty governance such as the chair of the faculty Senate Assembly (Brymer Williams, Arch Naylor, and Harris McClamroch) and the Board in Control of Intercollegiate Athletics (George Springer, Dale Grimes, and Bruce Karnopp).

The Deans of the College of Engineering

Charles Greene (1895-1903)

Charles Greene was a civil engineer and a member of the faculty for 31 years. He became the first dean of the Department of Engineering in 1895. During his tenure the College added the departments of marine engineering and naval architecture and chemical engineering and the construction of the West Engineering was begun.

Table 1:
The Deans of the College of Engineering

1895-1903	Charles Ezra Greene
1903-1928	Mortimer Elwin Cooley
1927-1928	George Washington Patterson, Acting Dean
1928-1937	Herbert Charles Sadler
1937-1939	Henry Clay Anderson
1940-1951	Ivan Charles Crawford
1951-1957	George Granger Brown
1957-1965	Stephen S. Attwood
1965-1972	Gordon Van Wylen
1972-1980	David V. Ragone
1980-1981	Hansford W. Farris, Acting Dean
1981-1986	James J. Duderstadt
1986-1989	Charles M. Vest
1989-1990	Daniel E. Atkins, III, Interim Dean
1990-1995	Peter M. Banks
1995-1996	Glen Knoll, Interim Dean
1996 -	Stephen W. Director

Mortimer Cooley (Dean, 1903-1928)

Mortimer Cooley was a member of the faculty for 47 years, a mechanical engineer trained at Annapolis. Under his leadership East Engineering was built, East Hall was acquired, the departments of Aeronautical Engineering and Engineering Research were started, and the Mentor System and the Honor Code were instituted. The policy of selecting outstanding professional engineers for department heads was adopted. Cooley worked closely with Presidents Angell, Hutchins, and Burton to build the College during a time of dramatic enrollment growth and laid the foundation for the success of the College during the early half of the 20th Century.

Charles Sadler (Dean, 1928-1937)

Charles Sadler was a naval architect and member of the faculty for 37 years, playing a major role in the design and construction of the towing tank. He was dean during the Great Depression. Despite continued enrollment growth during this period, the College budget declined and further development of its campus stalled.

Henry Clay Anderson (Dean, 1937-39)

Henry Anderson was a mechanical engineer who served the University for 38 years. He served as dean for only two years before stepping down for health reasons.

Ivan Crawford (Dean, 1940-1951)

Ivan Crawford was the first dean of the College from outside, a civil engineer and former dean at the Universities of Idaho (14 years) and Kansas (3 years). He led the College during the war years and then during the early stages of growth as returning veterans enrolled through the GI Bill.

George Granger Brown (Dean, 1951-1957)

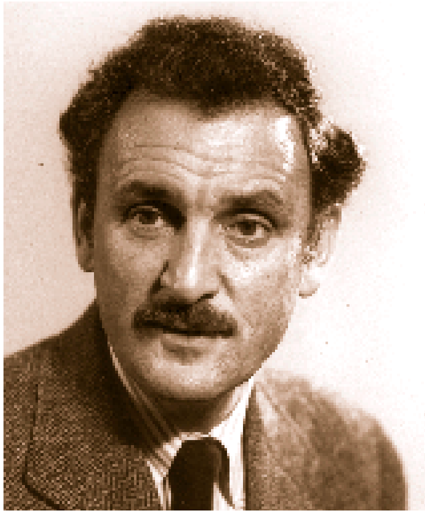
George Granger Brown served on the Michigan faculty for over 37 years, as a leader in chemical engineering education and research (developing the key textbook for Unit Operations), then as chairman of the Department of Chemical and Metallurgical Engineering. As dean, he developed the early plans for the engineering laboratories on the North Campus and was key in building industrial support of the College. He also was instrumental in developing new programs such as science engineering and nuclear engineering. Although his tenure as dean was relatively short, he must be regarded as one of the most significant leaders of the College.

Stephen Attwood (Dean, 1957-1965)

Stephen Attwood became dean of the College in 1957, after obtaining his B.S. and M.S. from Michigan in 1918, then serving on the faculty and chairing the Department of Electrical Engineering for five years. This was a time of status quo for the College, largely solidifying the accomplishments in research, graduate education, and facilities launched under G. G. Brown. Attwood’s age and ill health limited his tenure as dean.

Gordon Van Wylen (Dean, 1965-1972)

Gordon Van Wylen served as faculty member and later chair of the Department of Mechanical Engineering, earning widespread recognition for his work in thermodynamics and authoring a widely used textbook on this subject. As dean, he led the College during a transition period from the high point of the space race to the days of student protests and hostility toward technology. Despite his concerted efforts, the College was able to make only modest progress toward completing its move to the North Campus. Van Wylen also presided over a shift in College priorities away from graduate education and research to undergraduate instruction. He stepped down in 1972 to become president of Hope College.



David Ragone (Dean, 1972-1980)

A former MIT graduate and faculty member, David Ragone came to the College as its dean after a brief, two-year period as dean of engineering at Dartmouth. He was given the assignment of leading a major private fund-raising campaign to complete the move of the College to the North Campus. Unfortunately, the campaign was only a modest success, raising only $8 million for facilities, an amount inadequate to trigger the North Campus move. During the decade, the University support of the College declined precipitously (the College lost 30% of its support, equivalent to the loss of roughly 70 faculty members). This led to a crisis situation by the time Ragone left to become president of Case Western Reserve University in 1980.

James Johnson Duderstadt (Dean, 1981-1986)

Since much of this book concerns my period as dean, I'll only mention here that like Greene, Cooley, Sadler, and Brown, I had been a long-time faculty member of the College (although I assumed the deanship at the age of 37). Several of the milestones during my tenure as dean include moving the College to the North Campus, tripling its base budget, hiring 120 new faculty, and boosting the rankings of its academic programs.

Charles Vest (Dean, 1986-1989)

Charles Vest was also a long-standing faculty member in mechanical engineering, serving first as associate dean and then as dean of the College. During his brief tenure before being appointed as the University's provost, he completed the North Campus move and recruited some of the College's leading faculty members. In 1990, he was named president of the Massachusetts Institute of Technology where he has served with great success for over a decade.

Peter Banks (Dean, 1990-1995)

Peter Banks came to Michigan from Stanford, where he had been a faculty member in electrical engineering and a national leader in remote sensing. He was instrumental in several major efforts of the College, including the completion of the Lurie Engineering Center and Lurie Tower. He left the College to become the president of the Environmental Research Institute of Michigan.

Stephen W. Director (Dean, 1996-present)

Steven Director came to the College from a position as dean of engineering at Carnegie Mellon University. Under his leadership, the rankings of the College have continued to climb, with the launch of new programs in biomedical engineering, nanotechnology, and environmental systems.

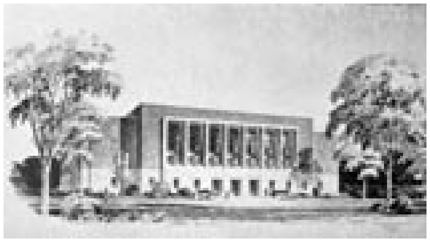
Epilogue

Despite the fact that during its first century the College of Engineering enrolled roughly 25% to 30% of the students attending the University and played an important role as a source or catalyst for other University programs (e.g., architecture, art, modern languages, chemistry, public health), the University rarely gave Engineering priority for resources or facilities. Despite the demanding needs of its technology-intensive programs, the College frequently had to make do with cast-off facilities—e.g., Cooley's scientific blacksmith shop, the power plant, the old Dental School, the old University pavilion hospital, and Tappan Elementary School. Occasionally an energetic dean (e.g. Cooley) or sympathetic president (Angell, Burton) would break this pattern, but for the most part, the College of Engineering, just as the Literary College, has languished in the shadow of the more generously favored professional schools such as Medicine, Dentistry, and Law.

Yet there is a more disturbing trend in this history: the cyclic nature of University support of academic units that frequently has little correlation with either program needs or national priority. For example, despite the very significant enrollment growth in the College during the middle decades of the 20th Century, increasing from 1,400 students in 1920 to over 4,000 students in 1950, and the clear importance of engineering education and research to national priorities such as economic recovery from the Depression and national defense during the war years, the College of Engineering spent these decades confined to budgets and facilities that were increasingly inadequate for either its enrollments and the technical needs of its programs.

Early in the history of the College in 1872, as the University continued to suffer from inadequate state support, Interim President Henry Frieze suggested to DeVolson Wood that perhaps he should prepare a proposal to seek an endowment to support a school of engineering, similar to that supporting the Sheffield Scientific School at Yale. Wood's proposal sought an endowment of $500,000 for the purpose of establishing a school of technology. Unfortunately no donors came forward, nor did the state respond to the proposal. Hence the College would continue to evolve slowly, constrained by the weak public support of the University.

Late in Cooley's life, this dream of an endowed school was revisited. The University, after giving much thought to the problem created by the increasing inability of the state to provide money to keep the College of Engineering adequately funded, reached the conclusion that state funds must be supplemented by donated funds from other sources. The Board of Regents therefore approved the creation of the Mortimer E. Cooley Foundation. Its objectives were to supplement the regular funds as required to insure the maintenance of a strong and adequate faculty for teaching, to furnish facilities and laboratory equipment; to encourage and foster graduate work; to encourage research in pure and applied sciences, and to meet other needs of the College. The general plan was to create a board composed of alumni and faculty members to secure endowments and to administer the funds acquired. However, once again, the dream was ahead of its time, and the effort to raise the endowment was not successful.



Cooley Memorial Hall (proposed)

However, good ideas keep coming back, and the College was to revisit the theme of building private support to augment state support again. In the 1970s, Dean David Ragone led a major fund-raising campaign aimed at moving the College to its North Campus site. Unfortunately, the campaign was launched during a national economic recession and only moderately successful (resulting in only one relatively modest building, the Dow Building). But private fund-raising became a critical element of a far more ambitious and successful plan developed and executed in the

1980s that aimed at building a strong and diversified base of state, private, federal, and tuition support for the College. As we will discuss in later chapters, this plan not only succeeded in moving the entire College of Engineering to the North Campus, but it increased its base support by several-fold during the 1980s, with a consequent increase in the quality of the College's faculty, students, and programs.

Sometimes it simply takes time to translate good ideas into action!

Chapter 2

The Post War Decades: 1945 to 1970

Like much of the rest of higher education, the fortunes and fate of the College of Engineering were very much influenced by the ever-changing nature of social issues and national priorities following WWII. From the GI Bill, the Cold War, the Nuclear Age, and the Space Race to the Great Society, Vietnam, student protests, and Earth Day, social change was in the winds, and higher education was blown along with the rest of society.

The College of Engineering grew and flourished during the early part of this period, due in part to the importance of engineering education and research to national security, as well as to the forceful leadership of Dean George Granger Brown, a distinguished faculty member and chair of the Department of Chemical and Metallurgical Engineering. Yet this burst of momentum and growth was short-lived, as University priorities shifted in the late 1950s, and Brown's strong leadership was cut short by his premature death in 1957. Stephen Attwood, a senior faculty member, former chair of electrical engineering, and acting dean of the College, was named dean of engineering, although he was already 62 at the time. Although Attwood served in the role for 8 years, it was not a time of significant progress for the College. He was followed by Gordon Van Wylen, another strong faculty member and chairman of the Department of Mechanical Engineering. However, the College continued to languish under Van Wylen's leadership, both because of shifting University priorities, away from science and engineering and into the social and health professions (dentistry, social work, education, public health), and because of Van Wylen's own efforts to refocus the College on undergraduate education and away from its traditional strengths in graduate education and research.

The Post-War Era

After World War II, the nation was faced with the challenge of assimilating large numbers of young veterans who were returning from overseas with a perspective different from any previous generation. They looked forward to a life with more promise and opportunity than even they or their parents had expected just a decade earlier during the Great Depression. Yet the American economy simply could not absorb the labor glut as the industrial war machine was dismantled. In part to compensate the returning veterans who had interrupted their lives to serve the nation, and in part to buy time to create new jobs in a peacetime economy, Congress enacted the GI Bill to provide veterans with the opportunity for a college education, to repay a debt to those who had defended the nation.

Few legislative acts have had the sweeping long-term effects on our society as the GI Bill. Millions of veterans, many without even a high school education, chose to attend college simply because it was their only option following the war. The law of unintended consequences was never better illustrated than in the results of this single act. Sleepy little college villages became busy cities, construction boomed, classrooms were overcrowded, and once-tranquil communities changed forever. Local economies changed to meet the needs of older students, and colleges took on a fresh face, albeit somewhat older and more mature. These older students brought a seriousness and commitment to higher education that was new and creative. They challenged the stodgy conservatism of the academy and prepared the way for change. Just as with the Morrill Act, the GI Bill represented an instance in which social and political change stimulated federal policy and investment with transforming impact on higher education.

The Ann Arbor campus boomed, doubling in size, and then doubling yet again to over 30,000 students. To accommodate the expanding need for higher education, the University of Michigan established branch campuses in Flint and Dearborn, first appending upperclass programs to the local community colleges, but then later expanding these to four-year and eventually comprehensive campuses.

In the decades following World War II, the federal government extended this social contract to broaden the opportunities for a college education through a series of other legislative actions such as the Higher Education Acts and federal financial aid programs such as the Pell Grants. The intent was to use higher education to help eliminate class distinction and racial discrimination by providing equal educational opportunity to diverse individuals and groups, thereby enabling all citizens to enjoy the benefits of a free society. During this period both public and private higher education expanded from the traditional role of educating the elite for leadership roles to providing mass education, a trend perhaps best captured by the belief of the Truman Commission in 1948 that every high school graduate should have the opportunity for a college education.

The concern for national security did not subside in the wake of World War II, as new adversaries appeared and the Cold War smoldered. Drawing on the experience of the war years, the federal government turned once again to academic scientists for the science and technology necessary for national security. It offered the universities a partnership in which the federal government would sponsor research on the campuses in return for the knowledge base necessary to address national priorities. The universities responded by creating strong incentives for faculty to focus on research and graduate education in areas of national interest. The role of the federal government in university research and graduate education accelerated rapidly following the launch of Sputnik with the National Defense Education Act of 1958. With each escalation in the arms race—the spread of nuclear weapons, Sputnik, ballistic missile technology—the federal government increased its investment in campus-based research, and the culture of the university shifted further toward research and graduate education. A new form of institution evolved, the *research university* that today has become the dominant species of the higher education ecosystem.

Change continued, as the first of the baby boomers reached college age in the early 1960s. The Higher Education Act of 1965 gave the federal government the role of ensuring access and affordability through nondiscrimination laws and student financial aid programs. Enrollments reached record numbers; faculty recruitment was a seller's market; state appropriations were growing; and higher education was widely regarded as the *sine qua non* for success and fulfillment. Yet again, society would demand changes, as social unrest and upheaval struck the campuses in the late 1960s. Although causes were just—the civil rights movement and an unpopular war in Vietnam—to much of America, the campus protests appeared as an attack on the establishment. The social contract through which the public granted autonomy to the university in return for its neutrality appeared to be undermined by the increasing political activism of many faculty members, perhaps manifested today by the public concern about political correctness on the campus. Yet, throughout the 1950s, 1960s, and 1970s, higher education flourished, sustained by strong social policies and public investment aimed at providing educational access and opportunity to a growing population.

Responding to National Priorities and Opportunities

One of the most significant initiatives of the University following WWII was the Michigan Memorial Phoenix Project, a major nuclear research laboratory established by the University and funded by private gifts as a memorial to the 579 members of the Michigan family who had lost their lives in the war. Interestingly enough, it was a student committee that pressed the University to action on the matter and urged the Regents to accept the idea of the Phoenix Project after it was first developed and approved by student government. The students sought to commemorate the memory of those who made the supreme sacrifice by attempting to develop a project that would aid all mankind in living in a war-free world rather than to attempt to build "a mound of stone the purpose of which might soon be forgotten."[1]

In May, 1948, the Regents adopted a resolution that "the University of Michigan create a War Memorial Center to explore the ways and means by which the potentialities of atomic energy may become a beneficent influence in the life of man, to be known as the Phoenix Project of the University of Michigan." Under the leadership of University President Alexander Ruthven and Albert Lang, president of the General Electric Company, the Phoenix Campaign quickly grew into a well-organized national effort that raised $6.5 million for a research building, a research endowment, and thanks to a one-million-dollar gift from the Ford Motor Company, a nuclear reactor (called the Ford Nuclear Reactor). It is noteworthy that the membership of the fund-raising committee included three students who were all veterans of World War II.

Ruthven called the Phoenix project "the most important undertaking in the University's history." The University was paying tribute to the sacrifices of its men and women during the war by accepting the momentous responsibility of studying the peaceful applications of atomic energy. Even President Eisenhower highlighted the importance of the Phoenix Project: "Few causes are more urgent today and more noteworthy of your support. In war or in peace, the atomic research being done at the University of Michigan will strengthen America."[2]

The Phoenix Project Laboratory was constructed as one of the first buildings on the North Campus of the University.

The construction of the Phoenix Laboratory (upper left)

Although all programs in the University were involved in the Michigan Memorial Phoenix Project, the College of Engineering had a particular responsibility to develop both instructional and research programs in nuclear energy. A professor of electrical engineering, Henry Gomberg, was named as the first director of the Phoenix Project. It is interesting that the actual plans for the nuclear reactor in the Phoenix Laboratory were classified during the early phases of its construction, and the associated Department of Nuclear Engineering that would utilize the facility was the first such program in the United States. It is also important to note that some 50 years later, the Phoenix Laboratory, the Ford Nuclear Reactor, and the Department of Nuclear Engineering all continue to make significant contributions to nuclear energy research and application, including the first observation of gravitationally induced quantum interference, seminal experiments involving neutron scattering, and the first demonstration of low-enrichment (non-weapons-grade) uranium fuel for research reactors, a major contribution to anti-proliferation efforts. The Phoenix Project enriched University life through the visits of distinguished scientists such as Robert Oppenheimer and Hans Bethe. It also provided support and facilities for the hundreds of nuclear engineers and scientists who have studied and trained in the Phoenix Laboratory. The Michigan Memorial Phoenix Project was recognized in 2001 by the American Nuclear Society as "a unique and pioneering atomic research program, as a permanent memorial to the University's soldiers who fought and died in World War II, and as a symbol of the University of Michigan's commitment to the peaceful and socially responsible use of science and technology."[3]

The fission chain reaction in the Ford Nuclear Reactor

The Ford Nuclear Reactor in the Phoenix Laboratory

The College of Engineering played an important role in other areas of national security during the post-war decades. Following World War II, the University developed laboratories at the site of the old Willow Run bomber plant to conduct research on the technologies of radar, infrared, acoustics, seismic, information processing, and navigation and guidance. Many of the faculty members of the College, particularly from the Department of Electrical Engineering, became actively involved in the Willow Run Laboratories' *Project Michigan*, the effort to develop the technologies of radar, remote sensing, and satellite imaging. Michigan engineers developed some of the most important technologies of the 20th Century through this effort, including maser and laser technology (Chihiro Kikuchi), holography (Emmett Leith and Juris Upatniek), and stealth technology (Thomas Senior and Ted Birdsall). The close collaborations between the College and the Willow Run Laboratories greatly benefited both organizations, providing state-of-the-art research experiences for students and faculty, while providing Willow Run with access to top engineering and scientific talent.

Unfortunately, reacting to the turbulent anti-war protests of the 1960s, the University decided to spin off the Willow Run Laboratories as an independent research laboratory, renamed the Environmental Research Laboratory of Michigan or ERIM. At the same time it also applied major restrictions to the ability of faculty and students to participate in classified research, which quickly led to the demise of such work on campus and greatly inhibited collaboration between the College and ERIM. As an aside, I have long believed that this decision to place the Willow Run Laboratories at arm's length was not a wise decision on the University's part. One need only look at the impact of other major national research laboratories on the quality of science and engineering programs at other top universities—e.g., Lincoln Laboratory at MIT, the Lawrence Berkeley Laboratory and Lawrence Livermore Laboratory at UC-Berkeley, Argonne National Laboratory at the University of Chicago, and the NASA Ames Research Laboratory at Stanford—to realize that something important was lost in severing the University's relationship with the Willow Run Laboratories.

The College of Engineering also played an important role in the nation's space program. Its aeronautical engineering program had long been a national leader, and as the space program began to develop in the 1950s, the College renamed it the Department of Aerospace Engineering and added a number of new fields such as rocket propulsion, orbital mechanics, and space science. A major NASA laboratory in space physics was established, with extensive capabilities in upper atmosphere research and satellite instrumentation. The College conducted numerous tests with first high-altitude balloons and then rocket launches. In fact, the University acquired property on the Keweenaw Peninsula in upper Michigan for the purpose of launching satellites into polar Earth orbit.

Upper atmosphere balloon experiments

The Department of Atmospheric and Space Science associated with the Space Physics Research Laboratory became one of the world leaders in space and planetary sciences (although as a predominantly science department, it sometimes was neither well understood nor appreciated by the College leadership at the time).

The College's strong reputation in aerospace engineering and space science not only attracted significant funding from NASA but also the training responsibilities for a number of astronauts, including Jim McDivitt and Jack Lousma. In fact, the entire three-man crew of the Apollo 15 moon mission consisted of Michigan

Apollo 15: The Michigan Mission to the Moon

engineering graduates, leading to the establishment of the first University of Michigan Alumni chapter in outer space!

The College of Engineering also played a major role in the development and application of digital computing. The close relationship between the College and the Ford Motor Company through operation of the Ford Nuclear Reactor in the Phoenix Laboratory enabled students and faculty of the College to use the computers at the Ford Scientific Laboratory. Several faculty members had been involved in the early development of the digital computer, including Arthur Burks who participated in the development of the ENIAC computer (and arranged for 10% of it to be on permanent display in the College's Electrical Engineering and Computer Science Laboratory). Furthermore, faculty members from chemical (Donald Katz), aerospace (Robert Howe), electrical, and computer engineering played important roles in developing specialized computers at Willow Run and elsewhere.

By the end of the 1950s, one could well make the case that the College of Engineering was a world leader in many of the most exotic areas of high technology: nuclear energy, aerospace engineering, space science, and computer engineering. Its graduates spread out to provide leadership in these fields across the nation, around the world, and even into outer space! Yet, what about those technologies of most direct relevance to Michigan industry, e.g., automotive engineering and manufacturing engineering?

Ironically, Michigan's efforts in these more traditional areas actually deteriorated during the decades following the war. Although the College built important facilities such as the Automotive Laboratory on the North Campus with its array of sophisticated automobile engine test cells, it was not generally regarded as a national leader. In numerous discussions with technology leaders in my role as dean of engineering during the 1980s, it became apparent that the College had decided to focus its efforts on rather conventional, even mundane, areas of research such as dynamometer testing and conventional combustion experiments, while other programs such as MIT and UC-Berkeley moved into very novel, science-based areas that would catch the wave created by pollution control requirements in the 1970s. While Michigan continued to hire rather traditional mechanical engineering faculty, MIT was hiring experts in areas of statistical mechanics, physical chemistry, and computer simulation. Similarly, in the area of manufacturing, Michigan focused on areas such as machine tool development and mechanical design rather than the emerging areas of numerically controlled machines and CAD/CAM. This stood in sharp contrast with the College's leading-edge activities in high-tech areas such as aerospace, electronics, and nuclear energy.

There may be another explanation for the College's tendency to focus on high technology rather than the needs of its backyard industry. The automotive and manufacturing industries of the 1950s and 1960s were based far more on in-house practical experience than scientific research. Furthermore, they provided far less support for university-based programs than rapidly growing industries in areas such as electronics, computers, and aerospace. Finally, most support for graduate education and research came from the federal government, through agencies such as the Atomic Energy Commission, the National Aeronautics and Space Administration, the Department of Defense, and the National Science Foundation. The national security needs of the nation drove major investments in these high-tech areas of research, and the College responded by developing both programs and excellence in kind, perhaps to the neglect of the needs of local industry.

The North Campus

As the University faced growing enrollments in the years following the war, it soon realized that its central campus site was simply too confined by the surrounding city of Ann Arbor to accommodate significant growth. The Regents agreed in the late 1940s to acquire 300 acres of farmland across the Huron River from the University Hospital, just in case the University needed the room to expand, although there were no immediate academic objectives for the use of this space.

The farmland lying north of the University's Ann Arbor Campus

The noted Finnish architect, Eero Saarinen (director of the Cranbrook Institute and son of the former University faculty member, Eliel Saarinen) was retained in 1951 to develop a master plan for the site. It should be noted that Saarinen had recently completed the design for the General Motors Technical Center in Warren, Michigan, and his design for the University's North Campus bears a striking resemblance to this earlier project.

The original Saarinen master plan for the North Campus

Although there were some early thoughts given to relocating the School of Education, Natural Resources, Music, and Fine Arts to the North Campus, the construction of the Michigan Memorial Phoenix Project soon repurposed the site for engineering research and eventually the entire College of Engineering. The first buildings were the Mortimer Cooley Electronics Laboratory (1951) (where much of the classified research associated with Willow Run was

Early development of the North Campus (the Cooley Laboratory in the foreground)

conducted), the Phoenix Laboratory (1955), the Automotive Laboratory (1957), the windtunnel and a small laboratory for Aerospace Engineering (1957), and the Fluids Laboratory (1958) (later renamed the G. G. Brown Laboratory).

The Cooley Electronics Laboratory (1951)

As enrollments continued to expand, the University launched a series of planning exercises that considered the relocation of additional academic programs to the North Campus. One plan even envisioned growth of the University to perhaps as many as 100,000 students, with the North Campus becoming one of a chain of campuses, similar in size to the Central Campus, and extending to the northeast of Ann Arbor.

During the 1950s and 1960s the University built a number of large student dormitories and married student housing complexes on the North Campus. However, for most of this period, the Department of Nuclear Engineering was the only academic program located entirely on the North Campus, because of the proximity of the Phoenix Laboratory.

Although the College of Engineering was the first major University academic unit earmarked for moving to the North Campus, this objective was soon set aside in preference to other priorities. First, the School of Music was given a major new complex on the North Campus (1964) (its building designed by Eero Saarinen himself),

Saarinen's School of Music

followed soon afterwards by the School of Architecture and Design (and later in 1974, the School of Art when it separated from Architecture). The North Campus Commons (now renamed the Pierpont Commons)

The Schools of Architecture and Art

(1965) and the Chrysler Center for Continuing Engineering Education (1971) soon followed. The University also located other major research facilities on the North Campus, including the Cyclotron Laboratory (Physics), the Institute of Science and Technology (1963) (another Saarinen building), and the Highway Safety Research Institute (1965).

The Institute of Science and Technology

The Highway Safety Research Institute

These latter two research institutes are of interest, since both were strongly opposed by the College of Engineering. They, along with the Phoenix Laboratory, which also fell under University authority, represented an effort by the University's vice-president for research to build major research programs competing directly with the College for both state and federal funding. In each case, they led to significant weakening of the programs in the College associated with these areas.

Perhaps the best illustration that the University had largely turned away from its early plans to move the College of Engineering to the North Campus is provided by the photograph, taken during the late 1960s.

The North Campus (1970)

The Schools of Architecture, Art, and Music are clearly visible, along with the Institute for Science and Technology. And where is Engineering? This can be seen in yet another photograph, taken at about the same time, which shows only four small buildings: the Cooley Electronics Laboratory, the Automotive Laboratory, the G. G. Brown Laboratory, and a small building for Aerospace Engineering.

Engineering Buildings on the North Campus

Shifting University Priorities

A recurrent theme of this book suggests that the priority given the needs of the College of Engineering waxed and waned not only with national priorities but as well by both University leadership and College leadership. The postwar years erosion in the support of the College began in the 1960s and accelerated into the 1970s. To be sure, this was a time when our nation was shifting from the Cold War and the space race as priorities to the Great Society and a range of social programs such as Medicare. The University responded by emphasizing academic programs in areas such as Education (recruiting as dean Wilbur Cohen, former head of the U. S. Department of Health, Education, and Welfare, who proceeded to double the size of the school), Social Work (moving it from Detroit and expanding it significantly), Dentistry (building the largest dental school in the nation), and Public Health. Similar commitments were made in the social sciences, particularly through the Institute for Social Research. Additional commitments were made in the 1970s to develop expensive graduate programs in Nursing and Pharmacy. And most significantly for Engineering's goal of moving to the North Campus, the University decided to approach the state for a $180 million appropriation for a replacement University hospital. Both engineering and the physical sciences began to suffer from benign neglect (and, perhaps in some cases, outright malice of forethought, by some members of the central administration). But one cannot lay all of the blame on the University for the plight of the College. One of the first responsibilities of a dean of a school or college is to gain both the attention and support of the leaders of the University, and through them, open up opportunities for state, federal, and private support. Mortimer Cooley had done this at the turn of the century, working with Presidents Angell, Hutchins, and Burton to build much of the College's Central Campus complex and sustaining its reputation. G. G. Brown led the early effort to move the College to the North Campus, and perhaps more significantly, established Michigan Engineering as a leader in research and graduate education. Unfortunately, his successors (just as Cooley's successors) were less able in their efforts to sustain this momentum and University priority, and the College suffered as a consequence.

The replacement University hospital

Chapter 3

Decline, Fall, and Revolution: The 1970s

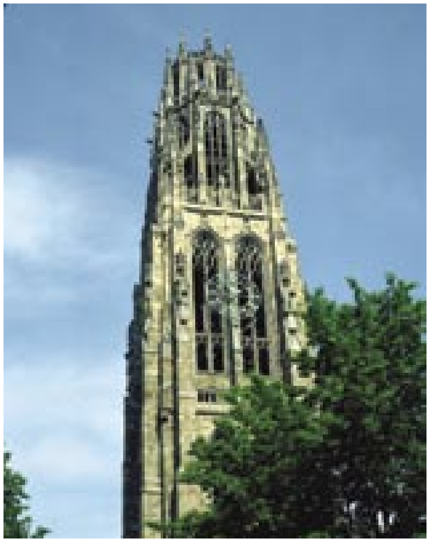
The 1970s were a difficult period for engineering education in general and the College of Engineering in particular. The end of the space race, an unpopular war in Vietnam, and an emerging environmental movement all converged to undermine public confidence in technology. While the image of Ph.D. scientists and engineers driving taxicabs was a myth, it was nevertheless true that public perception ran against careers in science and engineering. The Great Society commitments of the 1960s propelled national priorities away from investments in science and engineering and into health care and social services.

The College of Engineering felt these shifting national priorities both through the decline in federal research support and in student interest in engineering careers in the early 1970s (although the corresponding enrollment drop was modest and brief). But even more significant was the continuation of the 1960s trend that saw University support of the College decline still further. In fact, during the 1970s, the College of Engineering would rank last among all academic units in the change in funding from the University. Although the College experienced surging enrollments during the latter years of the 1970s, growing by almost 20% during the decade, the University actually cut its instructional budget by almost one-third. Furthermore, the long-awaited move of the College out of its decaying facilities in West and East Engineering and into new facilities on the North Campus stalled in the face of other University priorities (including major new buildings on the North Campus for the Schools of Music, Art, Architecture and Urban Planning, and even for research units such as the Institute of Science and Technology). Put more bluntly, the College had not only ceased to be a priority for the University, but it had dropped off the State Street radarscope entirely.

I will return later to discuss the decline and fall of the College of Engineering during the 1970s, considering its antecedents, probable causes, and consequences. But first it is useful to take a detour for a brief biographical memoir, since this was precisely the period when Anne and I moved to Ann Arbor to begin my academic career as a new Assistant Professor of Nuclear Engineering.

The Path to Ann Arbor

My path to Ann Arbor led from a small farm town in Missouri to Yale University in the East, then back to a top-secret nuclear research laboratory in the mountains of New Mexico, then on to Pasadena, and finally back across the country again to Michigan. Both Anne and I had grown up in Carrollton, Missouri, a small farm town (population 4,000) located about 70 miles northeast of Kansas City. Carrollton was located on the Missouri River, in the heart of some of the richest farmland in the world. Most of its residents were involved in farming in one way or another. Anne was raised on a farm. Although my father was a highway paving contractor, my grandfather and other relatives all had farming backgrounds.



Yale University

Yale University

In a strange twist of fate, rather than following in the Missouri traditions of my family, I headed east for college to Yale University—lured in part to play football. This requires some explanation. When I graduated from Carrollton High School, few in my town had ever considered going out of state to college—in fact, I was the first student from Carrollton ever to take the SATs. Largely at the encouragement of my family, I decided to apply to several of the more popular national universities, with a particular interest in Stanford (rather, in California). However, since I suspected the odds of acceptance were long, I also applied to several other schools, including Northwestern and Michigan. During the application process, I learned that blue-blood schools like Yale and Harvard were located in New England rather than England (where I had always thought they belonged with Oxford and Cambridge), so I decided on a whim to apply to Yale, knowing absolutely nothing whatsoever about it. Surprise, surprise, when not only did I receive an early acceptance to Yale (and also Stanford, as it turned out), but I also received a telegram (the first I had ever seen) from the Yale football coach encouraging me to attend and play football. The thought of playing football at an exotic institution like Yale was just too enticing, although one of Dan Devine's coaches also called later to recruit me to Missouri (where I would have not only been on a team with our current Michigan football coach, Lloyd Carr, but likely trampled in the dust).

So, sight-unseen, my parents put me on a TWA Constellation the next September—my first airplane trip. I flew to New York (again a first) and managed to find my way to Grand Central Station to take the train up to New Haven to enroll at Yale and to start freshman football practice. The old saying, "You can take the boy out of the country but not the country out of the boy!" certainly applied in my case. Despite the prep-school, blue-blood nature of Yale at that time, it had relatively little impact on my social sophistication, although it certainly

Yale's Old Number 71

shook my academic confidence to the ground. However, after a shaky start, I managed to adjust to both the intellectual and social rigors of Old Blue—although football lasted only two years. In 1964, I graduated summa cum laude in electrical engineering and accepted an Atomic Energy Commission fellowship to attend graduate school at Caltech (turning down Stanford for the second time, which was later to become a regular occurrence as I rose up the academic ladder).

A bit of explanation about my undergraduate education is appropriate here: A Yale "engineering" degree is a bit of an oxymoron. In fact, all undergraduates at Yale were not only required to take a broad liberal arts major, but also required to select a minor area of concentration in addition to their major. Since the minor and major concentrations had to be in different areas, I selected psychology as my minor area, with a specialization in child psychology. Many years later I would realize the fortuitous nature of this minor concentration since this training was of critical importance in my various roles in academic administration—not so much for understanding students, but rather for understanding the faculty (stimulus, response, reward, reinforcement...).

So leaving Yale, the Ivy League, and the East Coast behind, I headed west, stopping in Missouri where Anne and I were married, following her graduation from the University of Missouri, and then heading for California. But first we stopped off in New Mexico, where I had a summer appointment as a visiting research physicist at the Los Alamos Scientific Laboratory.

Los Alamos

In the mid-1960s, atomic energy was still shrouded in top-secret security. In fact, I was required to qualify for an A.E.C. "Q" (top-secret) security clearance even to receive an Atomic Energy Commission Fellowship. Needless to say, security was an even higher priority at Los Alamos, where the town adjacent to the Laboratory housing the families of lab employees had only been opened to the public a few years earlier. In fact, families of visiting scientists lived in WW II vintage barracks dating from the days of the Manhattan Project.

Los Alamos Scientific Laboratory

Even though we spent only a summer at Los Alamos, it proved to be one of those formative experiences with important later consequences. I worked in a technical group supporting the Rover nuclear rocket program, a top-secret program intended to develop and test rocket engines powered by nuclear fission reactors. During the mid-1960s, it was felt that after the successful completion of the Apollo program to land a man on the moon, a manned mission to the planet Mars would follow rapidly, perhaps as early as 1980. Many scientists believed that chemical rockets were inadequate for manned planetary missions because of the radiation exposure associated with extended space flight. Hence the nation had launched a major program to develop nuclear rockets for future interplanetary missions at Los Alamos. The Rover Program was quite successful in designing, building, and static-testing a sequence of nuclear rocket engines at the Nevada test site—the Kiwi engine rated at 1,000 megawatts, the Phoebus engine

(1964) Our Los Alamos apartment

rated at 5,000 megawatts (five times the power of today's nuclear power plants), and eventually the NERVA rocket engine (for Nuclear Energy for Rocket Vehicle Applications). I worked on the test programs for these nuclear rocket engines, acquiring in the process a strong interest both in nuclear power and spaceflight.

The Phoebus Nuclear Rocket Engine

The NERVA nuclear rocket

Since nuclear rocket development was classified as a secret project, I was required to record all of my work in bound notebooks, which were then locked in a safe each evening when I left the Laboratory. This routine of recording my work—and my thoughts—in bound notebooks became a habit that continued throughout my research as a faculty member and then later as an academic administrator. Today our bookshelves are filled with these notebooks, accumulating at a rate of several each year.

There was another consequence of the Los Alamos work. During the 1960s, as the United States became more heavily involved in the Vietnam war, the conditions for deferment from the draft became more and more restrictive. Because I held a Q security clearance and had had access to classified nuclear technology at Los Alamos, I received a deferment from the military draft because of critical skills and sensitive knowledge. In fact, after another summer research assignment in 1971 at the AEC's other nuclear weapons laboratory at Livermore, I found that even my international travel became tightly restricted.

Caltech

After our summer experience at Los Alamos, Anne and I returned to Missouri to pile the rest of our belongings in our VW, and then off we went again across the country to Pasadena where I had an A.E.C. fellowship for graduate study at Caltech. Like many others, we had formed our image of Pasadena and Caltech from the television broadcasts of the Tournament of Roses Parade and the Rose Bowl, when the skies were blue and the San Gabriel Mountains ringing the city stood out sharp and clear. It was quite a contrast when we arrived in late August in the midst of a smog alert that continued for weeks, blotting out the mountains and trapping the heat.

California Institute of Technology

Thomas Laboratory at Caltech

Although Pasadena was an important chapter in our family history—Anne's early career in management and merchandising, my M.S. and Ph.D. degrees, the birth of the two Duderstadt daughters, Susan and Kathy—it spanned a remarkably short period of only four years. Part of the reason was the Vietnam War. The threat of the draft always lurking in the background provided strong

The Duderstadts' Pasadena house

Our daughters in Pasadena (1968)

motivation for graduate students to complete their degrees as rapidly as possible. But it was also a time of ample job opportunities, with the space and defense programs in high gear, and universities continuing to expand their faculties.

I took advantage of Caltech's highly interdisciplinary character by earning my degrees in subjects spanning a range of topics in physics and mathematics. Since I had managed to complete my M.S. and Ph.D. in three years, my dissertation advisors suggested that I might want to spend an additional year as a postdoctoral fellow, broadening my research interests. This was also the traditional path toward a faculty position at Caltech. With this possibility in mind, I applied for and won a prestigious A.E.C. Postdoctoral Fellowship for the year 1968, with a generous stipend of $1,000 per month, roughly three times that of my graduate student support. We felt so flush that we rented a small house right across the street from Caltech with wonderful gardens (including two large avocado trees that would periodically rain fruit on the roof of the house). Ironically, this house is used today by Caltech as the office for its university treasurer.

Although I was interested in completing my postdoctoral appointment before considering more permanent employment, with remaining on the faculty at Caltech a definite possibility, I agreed to two job interviews at the request of my Caltech faculty advisors: UC-Berkeley and Michigan. The Berkeley interview was hosted by the chair of their Department of Nuclear Engineering, Hans Mark, who was later to become Secretary of the Air Force and then President of the University of Texas.

The Michigan interview was more problematic. To be sure, Michigan's Department of Nuclear Engineering was not only the first such program established in this country, but also it ranked among the top such programs in the world. Despite this, I was not particularly enthusiastic about visiting Michigan to explore the opportunity, particularly in the late winter cold. I

Jim's Caltech commencement

(1968) The UM Department of Nuclear Engineering

agreed to do so as a favor to my thesis advisor, who portrayed Ann Arbor as "nirvana," although not on the gray, drizzling day in March when I visited. However, Anne had grown weary of the smog and traffic of Southern California and longed to return to the Midwest. While I was flying back to California after the interview, the department chairman called Anne and told her they were going to make an offer. By the time I arrived back in Pasadena, Anne had already made up her mind. The Duderstadts were headed to Michigan.

On to Michigan

Although we had accepted Michigan's offer in spring, 1968, I still had to finish the year at Caltech as an A.E.C. Postdoctoral Fellow. In November I was able to stop by Michigan on my way to Washington to receive the Mark Mills Prize for the outstanding Ph.D. dissertation in nuclear science. While in Ann Arbor I learned that the University was just completing some new housing units for married students, and that new faculty members were occasionally permitted to rent some of these townhouse apartments until they found more permanent residences. This seemed like the simplest solution to the housing question, and so, in December, 1968, we loaded our furniture and our VW onto a moving van in the 90 degree heat in Pasadena (a Santa Ana condition) and boarded a plane for Michigan. We arrived in a sub-zero blizzard and moved into the Northwood IV housing complex on the University of Michigan's North Campus.

The Phoenix Memorial Laboratory

Interestingly enough, during the same week another new staff member arrived at the University: Bo Schembechler. I would later joke with Bo that the personnel department must have mixed the assignments for the two of us; I suggested that perhaps Bo was supposed to teach nuclear engineering, and I had been hired to coach football. For the next decade, I climbed the usual academic ladder, progressing through the ranks as assistant, associate, and then full professor of nuclear engineering. My Department of Nuclear Engineering was ideally suited to the generalist approach of a Caltech education. It was small, research-intensive, highly interdisciplinary, and almost totally focused on graduate education. Its reputation allowed it to attract both outstanding faculty and graduate students of unusual breadth and ability. Hence, it was well suited to my roving intellectual interests, first in nuclear systems analysis, then to nonequilibrium statistical mechanics, on to laser-driven thermonuclear fusion, next to supercomputers, and so on. In the early stages, most of my work was highly theoretical, requiring only a blackboard and chalk. However my interests later evolved into using very large computers (so-called supercomputers) to simulate highly complex phenomena such as nuclear fission and thermonuclear fusion. Throughout this period I usually had five or six Ph.D. students working with me of comparable age who became closer friends than most of my faculty colleagues.

Lecturing in nuclear engineering

Northwood IV apartments (1969)

In 1971 we returned to California, first for a brief period where I served as a visiting faculty member at Caltech and then for several months as a Visiting Research Physicist at the Lawrence Livermore Laboratory. The Livermore experience was interesting from several perspectives. I was working in the top-secret Q Division, a group trying to develop the new technology of laser-driven

As a researcher

thermonuclear fusion. Ironically, a small company in Ann Arbor, KMS Fusion, was also trying to develop this technology, in direct competition with the A.E.C. scientists at Livermore and Los Alamos. The classified and competitive nature of the work led to some bizarre situations in the subsequent months. For example, on one occasion I found myself forbidden to discuss my research with several Michigan colleagues with offices across the hall who had served as consultants to KMS Fusion.

While many university faculty members focus on teaching only a few courses closely related to their area of expertise, I rarely taught the same course twice in a row. As a result, I not only ended up teaching most of the undergraduate and graduate

As an author

courses offered by our department, but I designed and developed many of them. I enjoyed creating new courses and curricula, including one of the first courses taught at the University on microcomputers, then the Apple II! Since I usually produced copious lecture notes for each of these courses, it was natural that I would soon be drawn to writing textbooks to expand my pedagogical efforts.

Both the quality and quantity of my research and teaching were sufficient to propel me rapidly through the academic ranks, with promotion to Associate Professor in 1972 and to full Professor in 1975. I soon began to realize, however, that the traditional faculty role, while enjoyable for the moment, would probably not hold my attention for the longer term. Indeed, I always had great envy and admiration for my more senior colleagues who had been able to maintain both scholarly interest and momentum through the several decades of their careers. Perhaps it was my field of theoretical physics and mathematics that frequently led to burnout at an early age, or perhaps it was just a character flaw. Whatever the reason, I soon found my concentration and attention beginning to wander to other activities in the University as I began to be drawn into faculty service and eventually administrative activities. Fortunately, even though my traditional faculty career as a teacher and scholar only spanned the decade of 1970s, my research activities and publications, Ph.D. production (supervising 22 Ph.D.s), and writing (six textbooks and 60 research papers) built sufficient scholarly reputation to be recognized in later years with several of the nation's top awards, including the E. O. Lawrence Award of the U. S. Department of Energy (the nation's top award for nuclear research), the Arthur Holly Compton Prize of the American Nuclear Award (the top award for teaching in nuclear energy),

Receiving the National Medal of Technology from President Bush (1991)

and the National Engineer of the Year award from the National Society of Professional Engineers. Finally, in 1991 I was honored with the National Medal of Technology (the nation's top award for career-long achievement in engineering and technology), presented by President Bush in a White House Rose Garden Ceremony.

There were several key features of this first phase of my career that would have an impact later on my role as an academic leader. Perhaps most significant was that both my educational experiences and later my faculty career had been associated with institutions that were clearly among the very best in the world—Yale, Caltech, and the UM Department of Nuclear Engineering. I had developed a keen sense for not only being able to recognize excellence, but knowing first hand the commitment it takes to achieve it. Second, both my education and scholarly career had been in environments characterized by unusual intellectual breadth and creativity with exceptionally strong scientific foundations. Although occasionally I would later hear the complaint that "Duderstadt is a physicist, not an engineer," in truth I was fortunate in being able to span both pure and applied scientific fields. And finally, my career had been spent in institutions with exceptionally strong programs in research and graduate education, a focus that had been lost in much of the College of Engineering. All of these experiences would serve me well as I moved into leadership roles during the 1980s.

The Decline and Fall of the College of Engineering

As I noted earlier, the College of Engineering had already entered a state of decline during the 1960s, as it apparently lost favor with a University administration committed to Great Society themes (e.g., the health professions, social services, and K-12 education) rather than science and technology. The erosion in University support became even more serious in the 1970s. While the rest of the University experienced a compound growth of +7% per year during this decade, the College of Engineering was cut at an average rate of -2% per year. During this decade, the instructional faculty of the College dropped from 302 to 232 full-time-equivalent (FTE) faculty. Yet these cuts were in the face of a 44% growth in enrollments during this decade, driving instructional loads from 12 FYES/FTE in 1970 to 17.5 FYES/FTE in 1980. Put another way, the College effectively lost 30% of its University support during the 1970s, leading to what would later be called "the Engineering Gap" of roughly 70 faculty positions or an effective funding gap of $7 million per year, relative to other campus units.

How might one explain such devastating erosion in University support? Certainly it was not due to any weakness in state support, since throughout the 1970s, state appropriations continued to increase at an adequate pace. In part some of the blame must rest with the University administration, which made the health sciences a clear priority. Schools such as Medicine, Dentistry, Nursing, Pharmacy, and Public Health were funded year after year with generous increases. The School of Dentistry benefited from the state funding of a new, massive complex (ironically at just that moment when the impact of fluoride began to reduce the needs for dental care). Medicine also was in a favored position, with a new hospital rising to the top of the University's priority list for state capital outlay dollars. Nursing and Pharmacy received substantial budget increases to fund new graduate programs, while additional funds were shifted to Public Health to compensate for the loss of federal support.

To some degree, the shift in University priorities away from science and engineering and into the health sciences was an understandable reflection of shifting national priorities, with the end of the Apollo space program, the withdrawal from an unpopular war in Vietnam, the environmental movement, and a decade of student protest targeting areas such as defense research. But it is also the case that the University administration was simply not paying attention to the impact of its budget decisions, since it continued to fund units such as the Schools of Education, Dentistry, and Natural Resources at generous levels even as their enrollments dropped precipitously throughout the 1970s. Although there was a perception that enrollments in the College dropped dramatically, thereby triggering the budget cuts, in reality engineering enrollments dropped only very slightly (less than 8%) between 1970 and 1972-roughly the same enrollment dip experienced by most other academic units during this period. Furthermore, Engineering enrollments then began to steadily climb throughout the remainder of the decade, swelling over 44% to 5,600 students, while the enrollments of other well-funded schools such as Education and Dentistry dropped by as much as a factor of two or more. Whether the University made a conscious effort to reduce the funding for Engineering (as some believe) or whether the central administration was simply asleep at the wheel is a debatable issue. But the result was that the College of Engineering suffered serious declines in faculty morale, research productivity, and reputation as a consequence of its neglect.

Yet, here, it is important to understand that the College of Engineering was also partly a victim of its own behavior. The impact of this shift in University priorities was compounded by an internal shift in College priorities away from research and graduate education to focus instead on undergraduate education. For example, Ph.D. production in the College dropped in half over the decade, from 115 per year in 1972 to 51 per year in 1980 (and fell far behind peer institutions such as Illinois, Purdue, MIT, and Stanford that were graduating 150 to 200 Ph.D.s per year). Although the faculty had grown substantially during the 1960s, many of the new professors had been hired primarily for their instructional skills rather than their scholarly abilities. Furthermore, during the 1960s and continuing into the 1970s, the College invested heavily in building its own Department of Humanities, with instruction not only in areas such as technical communication (rhetoric) but also in literature, history, and philosophy. Engineering students were required to take their humanities courses from this department rather than enrolling in the courses offered by the University's College of Literature, Science, and Arts. In fact, the Department of Humanities was the only academic unit in UM Engineering to experience growth during the 1970s, growing by 20% to 30 faculty members by 1980 (and making it one of the largest departments in the College).

Finally, the leadership of the College was simply not an effective advocate during the decades of the 1960s and 1970s. Whether because of their lack of awareness of the serious of the situation, their temperament, or their inadequate effort in making the case for the College, Deans Stephen Attwood, Gordon Van Wylen, and

David Ragone were unable to persuade the University's central administration to provide adequate funding for the College during their tenures.

The College faced other challenges during the 1970s, foremost among them their urgent need for adequate facilities for its research and teaching activities. For all effective purposes, the North Campus move was stalled, dead in the water.

The North Campus Move

When Dean Gordon Van Wylen resigned to accept the presidency of Hope College, the University of Michigan, after a brief search, named David Ragone, the dean of engineering at Dartmouth, to be the next dean of the College. Ragone had been a consultant to Chrysler on automobile emissions control where he had become friends with George Heubner, a Chrysler vice-president and husband of Gertrude Heubner, a University Regent. Heubner brought Ragone to the attention of President Robben Fleming and Vice President Allen Smith, and after a brief search, he was named dean.

Ragone was given the mandate to launch a major fund-raising campaign that would be key to completing the move of the College to the North Campus. The University offered the following deal: if the College would raise $12 million in private support for the North Campus complex (out of a $20 million total campaign goal), the University would seek a $18 million match from state funds to build a four-building complex that would be sufficient to move all of the departments to the North Campus. In this four-building plan, the largest building, Engineering Building I, would house Mechanical Engineering and Applied Mechanics, Civil Engineering, Industrial and Operations Engineering, Humanities, and the College administration. Engineering Building II (the only building which was actually built as the Dow Building) would contain Chemical and Metallurgical Engineering. Engineering Building III would be for Electrical and Computer Engineering and Nuclear Engineering, and Engineering Building IV would be for Naval Architecture (with a possible new towing tank on the North Campus).

Here it should be acknowledged that there was considerable sentiment within the College against completing the North Campus move. Although the deteriorating quality of space in West and East Engineering was a major concern, many faculty members believed it important to remain in renovated space on the Central Campus close to their colleagues in LS&A (particularly physics, chemistry, and mathematics). Furthermore, many faculty members and students enjoyed the ambiance of the South University area and worried about the detached, sterile character of the North Campus. Ragone and his colleagues in the College administration dismissed these concerns, arguing that the interaction between the College and other Central Campus programs had been quite modest, and the isolation on the North Campus was a necessary inconvenience for obtaining higher quality space.[1]

Ragone was smooth, worldly, and some would even say charming—valuable attributes for successful fund-raising. With Buildings I, II, III, and IV on the drawing boards, and a major fund-raising campaign in the works, there was optimism that the College would finally complete its three-decade long quest to move to the North Campus by the end of the 1970s. In fact, when I was hired by the University, both the dean and other faculty told me to be sure to find a house near the North Campus so I would not have to drive too far to work. Being more pragmatic souls, Anne and I decided to ignore this advice and bought a home on the south side of Ann Arbor near the best schools.

Ragone immediately hired a team of expensive fund-raising consultants who began to identify prospects for the upcoming fund-raising campaign

Jim Knott and Dave Ragone announcing the Campaign aimed at raising a total of $20 million, of which $12 million would be the College's share of the North Campus move. A retired General Motors executive, Jim Knott, agreed to chair the campaign volunteer effort. Yet, despite the initial optimism, the campaign was largely a bust. Part of the difficulty was that the campaign was launched just as the nation was entering a recession triggered by the OPEC oil embargo and the rise in energy prices. But it also soon became clear that Ragone really did not enjoy fund-raising, and it became increasingly hard to get him to solicit gifts from donors. His personal commitments to various corporate boards and advisory committees kept him away from campus for extended periods. Hence he appointed a long-time faculty colleague, Maury Sinnott, to serve as associate dean for administration and delegated to him the operational responsibilities for the dean's office.

Although the campaign was launched with a flourish, the deepening recession and the wanderings of the dean soon slowed activity to a crawl. After several years it soon became apparent that only a miracle would save the fund-raising effort from embarrassment. But one of the true angels of the University, Dr. Harry Towsley, came to the rescue. The business manager of the College, Harold Harger, suggested that Ragone drop by to see Dr. Towsley, hat in hand, to talk about the faltering campaign. Towsley's wife, Margaret, was the granddaughter of Herbert H. Dow, the founder of the Dow Chemical Company. The Towsleys had long been among the University's most generous donors, and after Ragone's visit, they contacted the Dow family and arranged for a $5 million gift to fund the construction of a new building on the North Campus for Chemical and Metallurgical Engineering (so-called Building II in the original plan). In return, the building was named the Herbert H. Dow Laboratory. This would turn out to be essentially the only major accomplishment of the decade-long fund-raising effort. Although the College claimed raising $20 million, only $8.6 million was for construction, and over $3 million was in deferred gifts (e.g., future bequests). Less than $3 million was raised for endowment, probably the most urgent need of the College.

Provost Billy Frye breaks ground for the Dow Building while Dean Ragone watches on, in the best of Chaplinesque styles…

The trials and tribulations of the North Campus move were made even more difficult by the decision of the central administration to bump the Replacement Hospital Project ahead of Engineering in priority for state funding, essentially backing away from their earlier commitment to Ragone. Although the State Legislature passed a resolution in 1977 stating that it would fund 60% of the $30 million project when the College had raised its $12 million, the University pushed this aside and sought instead a state contribution of $180 million toward the $300 million hospital construction project (a project second in magnitude only to the Mackinac Bridge in the state's history). Not surprisingly, this mammoth request not only sidetracked the Engineering North Campus projects but effectively eliminated all state support for University capital projects for almost a decade. With inflation rapidly eroding the funds raised during the Campaign, the College decided to direct the entire amount (and then some) to the construction of the Dow building (Building II) and defer indefinitely any further effort to continue with the rest of the four-building project.

Hence the College approached the 1980s with only a very modest beachhead on the North Campus: several research buildings, the Phoenix Laboratory and Institute for Science and Technology (both of which really reported to the Vice President for Research), a modest concrete block building for Aerospace Engineering, another small building for the water resources program (hopefully named Engineering Building 1-A), and the construction site for the Dow building.

The Aerospace Building

Engineering Building 1-A

It is perhaps ironic that the activities of my own department and my own teaching and research were conducted entirely on the North Campus. In fact, I drove into Central Campus only a few times each year for various committee meetings, at least until I began to be drawn into University service activities in the late 1970s.

Revolution

As instructional loads soared and the faculty struggled with inadequate laboratories and classrooms and the inconvenience of Central Campus-North Campus split, the research activity and reputation of the College declined, and faculty morale plummeted. Particularly frustrated were younger faculty at the assistant professor and associate professor level who increasingly viewed the inadequate environment for teaching and research as harmful to their careers. Beyond the burden of inadequate facilities and crushing teaching loads, they also had to struggle against an apathetic cadre of senior faculty, many of whom were quite inactive in research, and yet resisted any change. The absence of rewards and incentives that recognized excellence and achievement rather than simply age and rank was particularly frustrating.

The leadership of the College contributed to the low morale of junior faculty. Ragone's extensive travel soon convinced the faculty that he would be an absentee dean, with little direct involvement in College or University activities. Ragone once observed that "In any political system, especially around universities, power belong to those who take it." Unfortunately for the College, he chose not to follow this advice.

Ragone's decision to delegate to his associate dean most decisions involving detailed activities in the College only compounded this sense of detachment, since the blunt style of the dean's administrators and their abrasive defense of the status quo further isolated the dean's office from the concerns of the faculty.

One by one, the College's most outstanding junior faculty members began to look elsewhere. Yet even as this attrition accelerated, the leadership of the College seemed unconcerned. Typical was the experience of William Powers, the rising star of the Aerospace Department, who when he visited Ragone to point out the vast discrepancy between a recent offer from Ford and his current compensation in the College, was simply told, "Well, I would take the Ford job if I were you." And so Powers did, eventually becoming Ford's vice president for research and director of the Ford Scientific Laboratory!

The discouragement of the junior faculty did not begin with Ragone and the 1970s, but actually can be traced back to the 1960s and the earlier tenure of Van Wylen. In interviews with many faculty members, it became clear that the lack of encouragement and support of junior faculty had been a problem in the College for many years. Both the College administration and several of the department chairs were portrayed as quite discouraging to junior faculty, especially in some of the larger departments where faculty attrition was particularly high.

From this perspective, the isolation of my own department, Nuclear Engineering, and its activities on the

North Campus, far from the rest of the College and the dean, was a distinct advantage, since most of our faculty, including its senior members, were quite active in research and graduate education. But even here it is worth noting that the malaise in the College and the absence of recognition for achievement and excellence took its toll. Each year across the College, senior faculty members were paid more and more, while junior faculty members fell farther and farther behind. It was clear that senior faculty had benefited not only from the more generous University support of the College in the 1950s and early 1960s, but also from a salary program that tended to reward years in rank rather than productivity and achievement.

By the late 1970s, the situation had become so desperate that a small group of the most active younger faculty finally agreed that something must be done. This group, consisting primarily of younger professors at the peak of their academic careers (and including Charles Vest, Scott Fogler, Dave Sonstegaard, John Meyers, and, of course, me), were appalled by the absence of leadership, by a dean's office that seemed unable (or uninterested) in the decline of the College and the loss of some of its most valuable younger faculty. We decided to address the matter head-on by meeting directly with Ragone. The meeting was a bizarre one, in Ragone's large office in West Engineering. Before we could get very far into our bill of particulars, Ragone informed us in confidence that he expected to be announced that weekend as the next president of Case Western Reserve University and would be gone within a few months. Needless to say, the meeting unraveled after that. (We later learned that several of our colleagues had been contacted by the CWRU presidential search committee about Ragone and had given him rave reviews, primarily to make certain that he was soon on his way.)

Any near-term hopes of relief from Ragone's departure were soon dashed when the University appointed Hansford Farris as interim dean. Although Farris was well respected, he was close to retirement and unlikely to challenge the status quo, leaving Sinnott in place to continue to run the College. However, even as the search for a new dean was launched, the new provost of the University, Billy E. Frye, had the wisdom also to appoint an external review committee to assess the state of the College. This committee's work provided strong evidence of just how far the College had declined in the quality of its environment for education and research and how damaging that had been to its reputation.

The State of the College, Circa 1980

By 1980, two decades of inadequate University support and weak leadership had taken their toll. As noted earlier, University support had declined by over 30%, creating a funding gap amounting to roughly 70 faculty positions (or $7 million in General Fund budget, compared to an existing budget of $10 million). The North Campus move was stalled in midstream, with only two small departments completely on North Campus (nuclear engineering and aeronautical engineering), and many faculty were forced to commute back and forth between their research labs and their classrooms. An apathetic and ineffective College administration had largely ignored the plummeting morale of the faculty, and many of our most outstanding junior faculty members had left for more rewarding, appreciative, and supportive environments. The College leadership had compounded these difficulties first in the 1960s by hiring a large number of faculty who were active only in teaching and then later shifting resources into a growing Department of Humanities at the expense of our core disciplinary programs.

The decimation of the junior faculty ranks, the source of our next generation of faculty, was compounded by a large cadre of senior faculty, inactive in scholarship or sponsored research, that not only resisted change but thwarted attempts to achieve excellence. In many cases this “impacted wisdom group” had not only lost the capacity to recognize excellence—the best people and programs across the nation—but actually felt threatened and resisted attempts to hire people better than they were. The College had fallen far behind other leading engineering schools in the standard measures of quality: its sponsored research volume per faculty member had dropped to only a fraction of those of leading institutions; its Ph.D. production had dropped to only 25% of that of peer engineering schools. Its representation in national organizations such as the National Academy of Engineering was essentially nonexistent.

The challenges facing the College were formidable. Engineering education was facing a new era in which major curriculum changes would be necessary to accommodate new fields such as manufacturing engineering, robotics, bioengineering, and microelectronics as well as new tools such as computers and networks. The competition for the best faculty and students would be severe. And yet beyond this, the College faced the unique challenges of inadequate University support: a stalled move to the North Campus trapping its programs in woefully inadequate facilities and dividing its faculty; an aging faculty that had lost the capacity to regenerate and improve itself; a frustrated and increasingly restive junior faculty; a culture that not only failed to recognize and reward excellence, but moreover actively discouraged innovation and entrepreneurial behavior; and the legacy of two decades of unwise decisions tending to emphasize areas of little relevance to excellence in the core of engineering education and scholarship (e.g., humanities instruction in Engineering rather than LS&A).

Put more bluntly, two decades of benign neglect by the University of Michigan’s central administration had driven the decline and fall of the College to the point where it no longer had the capacity to achieve excellence. It had lost not simply the will, but even the understanding and desire to attract, retain, and develop outstanding faculty. Bold action was necessary if the College was to reclaim its historical legacy for leadership in engineering education.

Chapter 4

A Late Evening Phone Call

Late one evening in the spring of 1981, our phone rang. It was Billy E. Frye, provost of the University, with a request: "Jim, I would like to ask you to accept an appointment as dean of the College of Engineering…" Both Anne and I were surprised (perhaps shocked is a more apt description). To be sure, both of us had been quite active in University affairs for a decade. I had served on, been elected to, and chaired numerous University-wide committees. Anne had also been quite active as a leader in various University-wide organizations such as the Faculty Women's Club.

Yet we were taken back by the request to become dean of an academic unit with over 300 faculty and staff, 6,000 students, and a budget of $20 million. My administrative experience was essentially zero. I had never been a department chairman. In fact, I did not even have my own secretary, and I had never supervised anybody other than Ph.D. students. Furthermore, I was only thirty-seven and relatively unknown inside the College. After all, I had spent my academic career at Michigan entirely on the North Campus, separated from the bulk of College activities and faculty on the Central Campus.

Perhaps because of the naiveté and brash confidence of youth, I quickly accepted Frye's offer. After all, for the last several years I had been one of a number of junior faculty members complaining loud and bitterly about the deplorable state of the College. Now my bet had been called. I had been challenged with an opportunity to actually do something about it. Yet, although a relatively unknown quantity to the College of Engineering and clearly inexperienced as an administrator, in other ways I was exceptionally well prepared for this role. In fact, during the late 1970s I had worked closely with the leadership of the University across a broad array of complex issues, acquiring both experience and knowledge and building important relationships that would prove invaluable in the years to come.

A Brief Career as a Campus Politician

Most faculty members are loath to become involved in University service activities. After all, we are attracted to academic careers because of a love for teaching and scholarship, not administration and bureaucracy. Yet I also realized early that most scholars in my particular areas of theoretical physics and abstract mathematics had relatively short productive careers–typically only a decade or two–before they lost the creativity that frequently accompanies youth and fell into the ruts that had trapped their predecessors. Most of my best research was already behind me, at least in my current fields of interest. Hence my choice was to either broaden my academic interests (which I did, into areas such as computer simulation), shift into other areas of scholarly interest (which I also did, into writing textbooks), or explore other careers, including entering the dreaded swamp of academic administration.

College of Engineering Activities

Actually, although I did have some interest in academic administration, it was largely closed off to me. My department was a small one, and we already benefited from a relatively young and effective chairman in Glenn Knoll. (In fact I had chaired the search committee that resulted in his appointment, after Dean Ragone had first called me to note that although I was probably qualified to also be a candidate, at age 35 I was still too young. Little did he suspect that two years later I would move into his office instead.)

The alternative was to become more actively involved in the myriad faculty service activities that characterize research universities. Of course I had been quite actively involved in department activities, chairing our curriculum, reactor safety, and department review committees. But by the mid-1970s I had graduated to College-wide activities, first chairing the College's Curriculum Committee and then serving on several department review committees (including mechanical engineering, mathematics, and naval architecture).

Like most younger faculty members, I tended to approach each assignment with an activist agenda. For example, when I chaired the curriculum committee for the College of Engineering, we eliminated half of the courses in the College catalog on the grounds that they were rarely taught. Not surprisingly, the resistance to such actions was intense as senior faculty members fought tooth and nail against any changes. Yet the committee was insistent that "truth in advertising" demanded that the catalog reflect what was really taught, not what advertised a faculty member's past efforts or future wishes. In much the same spirit, my efforts on the mathematics committee to insist that mathematics courses should be taught by mathematicians rather than by engineering faculty eventually led to a strengthening of the applied mathematics program at Michigan.

These early experiences also gave me my first taste of interacting with more senior academic administrators. Each term we would invite the dean to meet with the Curriculum Committee, and it was through these meetings that we began to understand the real nature of Ragone's leadership. I also had the opportunity to develop an unusually broad understanding of the instructional activities of the College of Engineering across the full spectrum of its programs. It was through this experience that I also became better acquainted with the faculty of the College, since as chairman of the Curriculum Committee, I would have to appear at each faculty meeting to propose a series of motions associated with our instructional programs. None of these were particularly memorable, except for the time that I had to make the presentation the day after breaking my ankle in a challenge basketball game with our undergraduates.

University-Wide Activities

My involvement with broader University-wide issues began with my election to the Executive Board of the Rackham School of Graduate Studies. Here I should note that the Rackham Executive Board, whose members are elected by the entire faculty of the University, is one of the very few faculty bodies with real executive powers, in the sense that it is charged with making actual decisions rather than simply offering advice. The creation of new graduate programs, the closure of old programs, the awarding of fellowships and faculty research grants, and the evaluation of the quality of various graduate programs were typical responsibilities of this board, which would meet for an afternoon each week with the Dean of the Graduate School, Alfred Sussman.

I look back on this experience as one of the more intellectually stimulating and rewarding of my faculty service activities, since many of the University's most distinguished faculty members were elected to serve on the Rackham Executive Board, and the issues it considered were both fascinating and consequential. It stimulated me to think more broadly about the University and higher education, while developing both a better understanding of and relationships with academic programs across the University. Because of the executive nature of our activities, we frequently met with deans and department chairs from various academic units. Here I should also note that I served on this body through two important transitions, first as Harold Shapiro succeeded Frank Rhodes as provost of the University, and then later as Shapiro succeeded Robben Fleming as president of the University.

But I had an even better ringside seat of the provost's office, since I was asked to serve on and later chair the faculty advisory committee to the provost. The Academic Affairs Advisory Committee (AAAC) was a committee of the University's Senate Assembly (the faculty senate), charged with advising the provost and undertaking studies on various issues of concern to the Office of Academic Affairs. Since the provost at Michigan was not only the chief academic officer but also the chief budget officer of the University, the AAAC could get into almost anything having to do with the University.[1]

When I first joined the AAAC, Frank Rhodes was Vice President for Academic Affairs, but in 1976 he left to accept the presidency at Cornell University[2]. After a brief period, during which the dean of the Rackham Graduate School, Al Sussman, served as Interim Vice President, Harold Shapiro was appointed to succeed Rhodes. Shapiro had been chairman of the Economics Department, but more key to his new role was the fact that he had served as chairman of the University's Budget Priorities Committee, a joint faculty-administration committee with responsibilities for strategic budget planning. Furthermore, Shapiro had long led the effort to analyze economic models of the Michigan economy, and hence he was well aware of the challenges that the state would face in the years ahead. However I should also note that he was optimistic–at least when meeting with the AAAC–that any decline in state funding of the University would be short-lived, and that the 1980s would be a decade of strong state support (thereby demonstrating once again that the state of the economy is as unpredictable as the weather).

After a year as a member of the AAAC, I was asked to chair the committee, which I did for the next two years, bridging the transition from Rhodes to Shapiro. During this period a broad array of issues came before our committee, including the policies for discontinuing academic programs, the evaluation of faculty teaching, more general faculty evaluation, and several budget-related issues. Although the committee responded to any requests from the provost, it also had the mandate to generate its own issues for study.

It was in this spirit that the AAAC launched a major study to evaluate the quality of the research environment on campus, including controversial issues such as indirect cost recovery and cost-sharing as well as administrative and technical support of research and faculty incentives for generating sponsored funding. This entire study was a bit sensitive since it overlapped several vice-presidential areas. Although we had strong support from the provost, we were somewhat threatening to both the vice presidential areas of research and finance. Nevertheless we plowed ahead, stirring up considerable interest, and releasing a hard-hitting report warning the University that it needed to move quickly to address the deteriorating state of the research environment before it lost both top faculty and research funding. This was an issue that I would continue to keep front-and-center both during my tenure as dean of engineering and eventually as provost and president. In fact, I believe that it was largely because of the persistence and effectiveness of this effort that we were able not only to improve the research environment on campus, but also to propel Michigan during the 1980s up the ladder from eighth to eventually first in the nation in sponsored research activities, a position of leadership that the university was able to maintain throughout the 1990s.

After three years on the AAAC (overlapping somewhat with my service on the Rackham Executive Board), I was asked to serve on the Budget Priorities Committee (BPC). This joint faculty-administrative committee was to play a particularly important role as the University entered a period of financial stress during the late 1970s and early 1980s with the weakening of the Michigan economy. Although the BPC reported to the provost, it advised all of the executive officers of the University on budget strategies. It was delegated executive authority during the years of economic retrenchment, reviewing academic and administrative units for major budget reductions including possible discontinuance. In fact, I was asked to chair one such review for the University Extension Service, a committee that included hard-nosed administrators such as Gil Whitaker, Dean of the School of Business Administration, Tom Dunn, chair of Chemistry, Judy Bardwick, associate dean of LS&A, and Ken Warner, a senior professor of Public Health. Ironically, the student member of the review committee was Brad Canale, then one of the leaders of student government and later to become the College of Engineering's director of development.

My final service assignment as a faculty member occurred just prior to being selected as dean of engineering. Two years before I had been elected as a member of the Senate Assembly, the University's faculty governance. The month prior to my selection as dean, I had been nominated for membership on the Senate Assembly Committee on University Affairs (SACUA), the executive body for faculty governance. At the time I would probably have viewed my career as a faculty politician as just about complete had I been able to serve on SACUA and eventually be elected as its chair–the chair of faculty governance at the University. However, fate was to intervene in the form of Bill Frye's phone call in March of 1981 offering me the position of dean.

The Selection of a New Dean of Engineering

Aside from a brief meeting with the external review committee, my involvement with the search for Dave Ragone's successor was quite limited. Although I vaguely remember brief meetings with the search committee, I naturally assumed that the committee would view as the leading internal candidates several of the chairs of our major departments (e.g., electrical engineering, mechanical engineering, industrial engineering). Therefore I was a bit surprised as the search approached its endgame phase when I learned through the grapevine that I was the only internal candidate, with Bill Brown, president of ERIM (and a former professor of electrical engineering at Michigan) and Robert White, chairman of electrical engineering at Stanford, the external candidates. It was natural to assume at this point that the University administration would go outside, and White seemed like the logical choice.

As a finalist, I went through the usual process of interviews with Bill Frye and finally with the Regents. (Here my only memory is that while the Regents were courteous, they were not particularly attentive. In fact, I can recall that one Regent spent the entire interview reading the sports pages of the Michigan Daily, perhaps prophetic of my future dealings with the University Regents as president.) At this point, the search moved into the deliberation phase, and I put any thought of it aside, assuming that they would never appoint someone as young or inexperienced as I was.

Yet looking back over these various roles, assignments, and responsibilities, it is clear that my experience, knowledge, and contacts went far beyond those of most faculty members. Although most of my teaching and research activities were confined to the Siberia of the University's North Campus, my service activities spanned essentially all aspects of both the College of Engineering and the University of Michigan more generally. At the College level, my service as chair of the Curriculum Committee and then on several department review committees gave me both a broad understanding of the academic programs as well as relationships with the various department chairs and deans of the College.

Of even more importance was my service on perhaps the four most important faculty bodies in the University: the Rackham Executive Board, the Academic Affairs Advisory Committee, and Budget Priorities Committee, and the Senate Assembly. These bodies not only exposed me to a very broad array of academic, financial, policy, and political issues across the University, but also gave me valuable experience in leading groups of faculty from diverse disciplines and backgrounds as committee chairman. Furthermore, during the five years I spent in these activities, I was able to develop direct personal relationships with most of the leadership of the University, including President Harold Shapiro, Provost Billy Frye, most of the other executive officers, and many of the deans. Perhaps equally important were the relationships developed with key administrative staff in the offices of the president, provost, research, finance, and state relations.

Hence, in retrospect, perhaps it is not so surprising that Bill Frye made that late night phone call in March, 1981. Yet I doubt that even Bill suspected the depth of my experience, knowledge, and networking in university affairs. But he would soon find this out.

Actually, Anne has a far more logical explanation for my selection as dean. The chairman of the faculty dean search committee was Bill Richart, one of the College's most distinguished faculty members. Although he had no idea who I was at the time, his wife, Betty, had worked closely with Anne in leadership roles in the Faculty Women's Club. When Bill asked Betty if she had ever heard of this guy Duderstadt, she responded, "Well I don't know him but I sure know his wife Anne. She'd make a really great dean's wife. Put him on the list!" And he did.

Should I become dean?

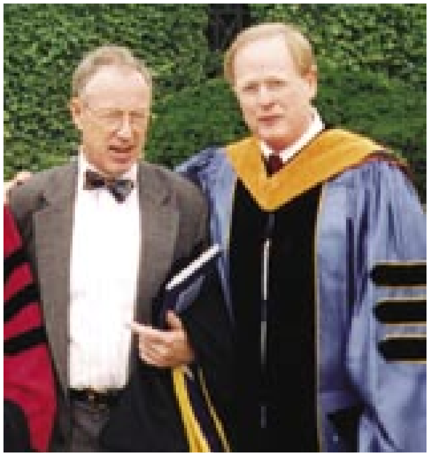
The new dean's team

Meeting My New Bosses

The day after Bill Frye's phone call offering me the position of dean of engineering, I met with him to discuss details concerning the appointment. But first I met with Harold Shapiro for an hour or so at the President's House.

His assessment of the weakened state of the College agreed with mine. He stressed the importance of "breaking out of the blocks fast" to deal with many of these issues, since he believed them to be quite critical. He encouraged experimentation and innovation, noting that he was willing to support unusual efforts for a single academic unit that might be more problematic for the entire University. He cautioned that at a time of serious budgetary constraint for the University, proposals to the central administration would be most effective if they included some degree of cost-sharing by the College. He wanted to be kept in the loop on major issues, and we

President Harold Shapiro



Provost Billy Frye (in 1992)

agreed to meet together with Bill Frye later in the term.

The meeting with Bill Frye was more extensive for the obvious reason that he was now my new boss, since deans reported to the provost. We began by discussing the usual details of my appointment, since in our brief conversation the night before, there had not been an opportunity to consider matters such as term of appointment, compensation, and the needs for resources. Most senior appointments involve such negotiations, in which the candidate tries to negotiate both the best possible personal situation as well as resources for the unit to be led. In fact, one of the most important responsibilities of a dean, provost, and president is to conduct these negotiations successfully and land the candidate, much like a big fish on a light fishing line. However, I threw an unusual twist into this first meeting by ignoring the normal negotiation protocols that characterize academic leadership appointments. When Frye had made his offer of the dean's position, I responded immediately with, "Yes, I'll do it." As he raised the possibility of negotiating the details, I simply said, "Bill, I trust you, and I know you will help later when I need it." This approach threw Billy Frye off balance, but as he was later to learn, I would indeed be back…many, many times.

Our discussion then turned to the task at hand. Frye asked me to come back with a draft of a long-range budget plan by fall, identifying goals and objectives, what the College could do on its own, what support it needed from the University, and possible sources and estimates of outside support. Frye noted his desire to provide the College with relief from the 6% cut then levied across all academic units to respond to the financial emergency triggered by declining state support, but noted that this might prove difficult. (As it turns out, we agreed later that we would take the full 6% cut like all other academic units, but then Frye would give us the funds back to use for our own priorities.)

Frye acknowledged that the College was underfunded, but he was uncertain of the magnitude, suggesting it might be "as much as $1 million/year in base support." (We were later to demonstrate that the real "engineering gap" was closer to $7 million/year, or roughly 50% of the current budget of the College. As challenging as this estimate was, it was the target for budget growth and restoration that we were to set, achieve, and exceed over the next several years.) In discussing the current state of the College, Frye raised his concern about the conscious effort by the College over the past decade to stress undergraduate instruction at the expense of graduate education and research, an action that seemed to be in contrast with peer institutions. He was aware of the precipitous decline in Ph.D. productivity and sponsored research support during the decade and believed one of my first priorities should be to change the course of the College back to stressing research and graduate education. We also agreed that we needed to differentiate more among faculty roles, lightening the instructional load on those who were most active in research.

We discussed the starting date for my appointment as dean. Although the current interim dean, Bill Farris, wanted to serve until July, both Frye and I wanted to get on with it, so we set May 1 as the start date. Frye echoed Shapiro's encouragement to start off with a bang—but he added the modifier "carefully."

Finally, we agreed to keep my selection as dean confidential until I was introduced at a special meeting of the College of Engineering faculty the following week.

March 16, 1981
MEMORANDUM

TO: College of Engineering Faculty
FROM: Hansford W. Farris
RE: Special Meeting of the Faculty

On behalf of Vice President Billy E. Frye, we are calling a special meeting of the Faculty of the College of Engineering with regard to the search for an individual to serve the College as Dean of Engineering. Your attendance will be appreciated.
The meeting will be held in the usual place, Room 311 West Engineering, and near the usual time, 3:00 on Tuesday, March 17, 1981. We regret the necessity for such short notice.

Listening and Learning

Thus read the memorandum circulated to the faculty on the following Monday. There was an unusually large turnout for a College faculty meeting, in part because there was great curiosity about whom Frye had selected. When I walked in the room with Frye, I suspect that there were many in the room who had no idea who I was, even though I had been a member of the College faculty for twelve years. But to many others, particularly among the junior faculty, there was the immediate recognition that Frye was going to take a chance and turn the reins of power over to "the young Turks." I could see the smiles on their faces.

After a brief introduction by Frye, I made some remarks to the faculty, intending both to reassure them as well as to let them know clearly and from the outset that my highest priority would be "the achievement of excellence, in education, scholarship, and research, and in the professional achievements of our faculty and students." I acknowledged the current challenges of the College: inadequate funding, decaying physical facilities, obsolete equipment, and an overloaded faculty. I also suggested that as a College we had occasionally been more concerned with secondary goals such as the North Campus move or improving instructional efficiency than with the quality of our research and instructional programs. I went on to note a theme that I would sound again and again, first as dean, then as provost, and finally as president: "The key to excellence lies with people, with their abilities, their attitudes, and their commitment. Hence I believe the most appropriate role for the College administration is to attract outstanding faculty and students; provide the environment, encouragement, and support needed to push to the limits of their talents and dreams; and then get out of their way!" I pledged to work with the faculty to build an environment that not only allowed for excellence, creativity, and innovation, but actively stimulated, rewarded, and, indeed, demanded such efforts.

My remarks assured them that I intended to be a full-time dean, receptive and responsive to student and faculty needs and concerns and totally dedicated to working with them on behalf of the College. I concluded by stating my intent to open up new lines of communication with the faculty, to learn of their needs and concerns and to seek their advice and suggestions. (The complete text of this first speech to the faculty is provided in an appendix.)

And listen I did, spending the next several weeks before formally assuming the position of dean by visiting every member of the faculty and administration who would meet with me, asking questions, and listening to their concerns and their aspirations in an effort to learn about the College and begin to develop a strategy. I was particularly interested in meeting with the current leadership of the College, the department chairs and my predecessor as dean to learn as much as I could. I realized that I probably would not agree with much that I heard, but at least I would understand where they were coming from.

The Dean's Office in West Engineering

Interim Dean Hansford Farris (on left)

To this end, I first began to meet regularly with the interim dean, Bill Farris, since he was a veteran who had spent most of his career in the College.

I also met regularly with the business manager of the College, Harold Harger, who was really the source of continuity in the College, the keeper of its corporate history, and, as we were to appreciate later, the wise old hand that kept those of us who were young Turks from flying off the edge.

I remember well my first visits to the dean's office in the College, trudging up stairs in West Engineering that were so old that they had ruts worn in them from a century of students and faculty. The sense of an old, musty, decaying building was almost overpowering, as was the gigantic paneled office of the dean, originally designed by Mortimer Cooley, and serving each dean since his time. I would note that this is the only office I had ever seen with seven—I counted them—seven doors. It was rumored that these doors had served well the previous dean, Dave Ragone, when he had to avoid faculty and students. But in reality, these doors, like the large, walk-in safe in the office, were relics of an age long past. It did not take long to realize that getting the College out of these quarters, truly

Victorian both in age and design, would be an immediate priority.[3]

In many ways the administration of the College was equally Victorian in character. The two mainstays were Harold Harger and the dean's executive secretary, Elaine Harden, two longtime administrators who had served engineering deans reaching back to the years of G. G. Brown and Stephen Attwood, and who were deeply loyal and committed to the College. However there was a much larger staff of more questionable value, largely recruited by Dave Ragone and his colleagues, for an array of activities ranging from fund-raising to corporate recruiting to personal speech-writing. And there were two associate deans, Maury Sinnott and Joe Eisley, who had assumed the thankless task of running the College in the dean's absence.

Here, I might note that my naiveté proved particularly valuable in dealing with these individuals. I naturally assumed that associate deans served at the pleasure of each new dean of engineering, so during my first meeting with each, I thanked them profusely for their service and offered to assist them in their return to the faculty in any way that I could prior to the beginning of the fall term. As I was to learn later, it was not general practice that there would be a complete turnover in associate deans with each new administration, but my ignorance of the traditions of academic administration immediately opened up positions into which I could recruit several of my young colleagues: Chuck Vest, Dan Atkins, and Scott Fogler.

As I met with each member of the College administration, it rapidly became clear that they could be characterized as highly defensive, territorial, and distrustful of any and all comers. And little wonder. With an absentee dean, a central University administration that had beaten them down, and a faculty with low morale and high apathy, it was hard to be open and optimistic. Over the years the College had pulled apart from the rest of the University, teaching within the College many subjects more appropriate for LS&A such as humanities, writing, and mathematics; establishing its own alumni association separate from the University's; and even refusing to transfer the records of the College over to the central University archives.

My predecessor's frequent absence from campus and tendency to over-delegate had created another administrative challenge. Like most of the University's schools and colleges, the College of Engineering had an Executive Committee, comprised of four faculty members elected by the College faculty, who were charged with working with the dean on key policy matters. Since the faculty tended to elect its most senior and distinguished faculty to this body, it was a particularly valuable source of wisdom and advice. Yet the dean's absence had allowed the Executive Committee to evolve into a management committee rather than an advisory body. It tended to delve into all matter of administrative detail, much to the consternation of the department chairs who believed (and rightly so) that they reported to the dean and not the College Executive Committee. They were particularly incensed that the Executive Committee had recently

Harold Harger

Elaine Harden

taken a far more aggressive role in promotion and tenure decisions, reversing department decisions and recommendations on a large number of faculty members–although it was also clear that the standards for promotion had eroded quite considerably in several departments. Nevertheless, it became apparent that without strong leadership by the dean, the Executive Committee had filled the vacuum by becoming involved in many of the management details of the College. It would be a challenge to get it refocused on its proper role concerning policy issues.

The inappropriate involvement of the College Executive Committee in the detailed operations of the College was only one of many concerns that I heard from the department chairmen as I met with each one, going in each case to their office for extended discussions. The chairs felt isolated from the College administration, with little input to key decisions that affected their departments. They also were very cynical about Ragone's effort on behalf of the College, suspecting that much of the deterioration in University support of Engineering had occurred because Ragone was not inclined to make a serious case to the central administration for adequate support. They viewed Sinnott largely as someone Ragone had put in place to make sure nothing happened while he was out of town. It was clear that the dean's office had never had a plan or an objective, beyond the fund-raising campaign objectives. The dean's low opinion of peer organizations such as the Big 10 Deans Council and the Engineering Deans Institute effectively cut the College off from contact with peer institutions. The chairmen were concerned that many important strategic issues such as College computing needs, technology transfer, and strengthening relationships with the science departments in LS&A were simply being ignored by an absentee dean and a defend-the-status-quo-fort administration.

Despite my decision to replace the associate deans, I believed it important to keep the department chairmen in place to sustain the continuity of our academic programs. Besides, the general quality of the chairmen was high, due in part to the strong role that their department faculties had played in their selection. Yet, there were problems, and here too, my naivete may have had a practical benefit. In meeting with the department chairs, two of the most powerful chairmen, who had also been candidates for the dean's position, attempted the usual power play by threatening me that they would step down if they didn't get their way. I had been warned about this possibility (and had confirmed that their resignation would be no great loss for the College). Hence I thanked them for their service and asked them for help in searching for their successors, leaving each of them a bit stunned as I left their offices.

My listening and learning went far beyond College administrators to include a significant fraction of the rank-and-file faculty of the College as well as student leaders and key alumni. Although there was considerable diversity concerning faculty attitudes, the feelings of frustration, alienation from the dean's office, and pessimism about the future of the College were consistent with those I had heard from academic leaders. The sense of frustration was particularly acute among the junior and mid-career faculty, who saw few incentives for their achievements, continued erosion in the quality of the environment presented by the College for their research and teaching, and serious questions about whether it was in their best interests to remain at Michigan. Although there were many highly productive and distinguished senior faculty, there were many others in the senior ranks who had long since lost their scholarly momentum and were largely going through the motions, teaching the same courses in the same way that they had taught for years, and earning top dollar in a College compensation program that rewarded years in rank rather than achievement and excellence.

Students, too, displayed a similar sense of apathy toward the College. Little wonder, since their classes and laboratories were burdened by the inadequate space available in West Engineering and East Engineering and the frustration and apathy of the faculty frequently propagated into the curriculum. Engineering is a difficult and demanding major in the best of circumstances, and when facilities are poor and the faculty is unhappy, it can be burdensome indeed. This was compounded by the loss of student class identity, as students were herded from one part of the curriculum to the next, without any sense of belonging to a professional school or a graduating class identity.

There were also challenges beyond the campus. While many alumni had fond memories of their College years, the preoccupation of the fund-raising efforts of the 1970s, coupled with the failure to make any significant progress on the move to the North Campus, left them discouraged and disengaged. So too, industry sensed that the College had slipped during the 1960s and 1970s, was no longer at the cutting edge in key areas, and was falling further and further behind key competitors such as Illinois, Purdue, Stanford, and MIT.

Clearly our work was cut out for us!

Chapter 5

Hitting the Ground Running

Suffice it to say that during the six weeks between my selection as dean and my first day in the dean's office, my cram course on faculty, student, and external perspectives had revealed a situation even more critical than I had first imagined. Two decades of declining University support and ineffective College leadership had taken a serious toll on the quality of the academic programs of the College and the morale of faculty and students.

I remember well one of my early discussions with Harold Harger, the long-time College business manager, as I tried to understand just how the decline and fall of the College could have occurred. Harger had a conspiracy theory: He believed that the University administration had intentionally driven the College to the brink—whether because they believed it overfunded, or because they preferred to fund other priorities such as Dentistry and Medicine, or perhaps because they became irritated with earlier College leaders (an earlier administrator had referred to G. G. Brown, the College dean of the 1950s, as "the Great God Brown"). But whether from malice of forethought or simply benign neglect, the damage had been done.

To meet the instructional needs imposed by rapidly growing enrollments during the 1970s in the face of year after year of budget cuts imposed by the central administration (averaging a 2% reduction in base budget each year through the 1970s), the College had been forced to cannibalize its ability to meet other needs. It cut 18 technical support staff and eliminated entirely the discretionary current account funds it provided to the departments. It raided salary programs in order to maintain instructional staff, with the largest impact on junior faculty. And yet it still lost the equivalent of 70 faculty positions through these budget cuts.

Of course, part of the problem arose from the very effort of the College to optimize its operations within the constraint of whatever budget it was given by the University—an all-too-natural tendency for engineers accustomed to making the best of any situation. Unlike LS&A, which built its budget during the 1970s by consistently overrunning accounts each year only to be bailed out at year-end by the provost, the College made whatever cuts were necessary to stay within the budget parameters given to it by the provost, to the detriment of its academic programs.

Another consequence of inadequate support was the relative dearth of junior faculty hiring during the 1970s. By 1980, over 200 College faculty members were at the full professor rank—tenured, at the top of the pay scale, and, in many cases, relatively inactive in research. Of course, the best of our faculty were highly mobile and subject to raids from other universities and industry because of the deteriorating research environment. But many other faculty members, who had been hired to meet growing instructional needs during the 1960s, did not have strong research interests or capability. In many cases, these instructional faculty members had fallen far behind in their rapidly evolving technical disciplines. Although outdated, they were tenured, in many cases outspoken squeaky wheels, and imposed an increasingly heavy burden on the shrinking number of faculty members attempting to sustain the momentum of the College's graduate and research programs.

Yet achieving relief from the University administration would be a formidable challenge in the face of the financial crisis looming before the institution in the early 1980s. Harold Shapiro's prediction of economic prosperity for the decade had collapsed under the weight of rising energy prices and a domestic automobile industry increasingly vulnerable to competition from Japan. I remember well a visit to General Motors where a senior GM executive boasted "As long as we can put a car on the showroom floor for fewer dollars per pound than anybody else in the world, America doesn't need to worry." The only problem was that people stopped buying cars by the pound and instead began to focus on quality. The entire domestic automobile industry went into the tank and drove the nation into recession.

The old saying that "When the nation gets a cold, Detroit gets pneumonia!" had become true once again, as a national recession threw Michigan effectively into a depression in which tax revenues dwindled even as the welfare rolls expanded. Inflation was rampant, exploding to double-digit levels. The University of Michigan had already experienced a series of executive order budget cuts in its state appropriations and was expecting still further cuts on top of inadequate appropriations for several years to come. During this five-year period the University would lose effectively 30% of its state support, with serious implications for its academic programs.

This was compounded by the demographic changes in the number of high school graduates associated with the post-WWII baby boom and bust cycle. In particular, the number of high school graduates in Michigan would decline by over 25% by the mid-1990s. This predicted decline eroded the political urgency to protect higher education from the deep cuts sweeping other state services.

Harold Shapiro launched a three-pronged strategy to cope with declining state support: First, the University ramped up tuition levels (and more quietly increased out-of-state enrollments) to increase tuition revenues. Next, it launched a major University-wide fund-raising effort that would culminate in a major campaign destined to raise over $300 million during the 1980s. Finally, it launched a program of cost containment, program review, and reallocation (unfortunately referred to as the "smaller but better" strategy) to protect University priorities. As I noted in Chapter 4, the provost had lead responsibility for this program, with the Budget Priorities Committee serving as the key strategic support group.

The College would have to cope with this environment of financial exigency in its effort to make the case for increased University support. As a clear sign of his understanding of our plight, Bill Frye had already offered to help by returning to the College as flexible dollars the 6% budget cut levied on all academic units. But in future years the political environment of shared hardship would require us to participate in the Five-Year Plan to reallocate 10% of all academic budgets, even as we benefited from budget growth fueled by this very reallocation. Getting ahead of my story a bit, we were eventually able to eliminate roughly $3 million of the $7 million Engineering Gap in annual support through University reallocation in response to our desperate appeals, even in this difficult budget climate. But to eliminate the remaining funding gap and to begin to build funding to more competitive levels, we would eventually have to turn to the state for direct line item support (which we were fortunate to achieve through the state's Research Excellence Fund to be discussed in the next chapter).

The Team

Immediately after being named as the new Dean of Engineering, I turned my attention to building the leadership team that would work with me in rebuilding the College. Since engineers are trained to work naturally in teams, I sought an administrative structure that would draw many of the College's most energetic and talented faculty into leadership roles. I quickly settled on a structure patterned after the executive-legislative-judicial branch organization of the federal government. More specifically, I viewed the College deans (the dean, associate deans, business manager) as the executive branch, with executive responsibilities for leading and managing the college. I viewed the chairmen as comprising the legislative branch, akin to the Congress, representing the interests of their departments as key constituencies. Finally, the College Executive Committee was, in effect, the judiciary equivalent to the Supreme Court, with key responsibility for policy approval as well as the final authority on key decisions such as faculty promotion and tenure.

My meetings with the chairmen confirmed my suspicion that they had not been adequately involved in key College decisions that had tended to be made (if at all) by the deans or the Executive Committee. I established the Chairmen's Advisory Committee, a new body designed to provide both a forum and mechanism for chairmen involvement in College-wide issues. When I first formed this group, I proposed that it meet weekly with the deans for the first two months as we assembled the strategic plan for the College. Afterwards it would meet every two weeks. Although College rules prescribed a Standing Committee that included deans, chairmen, and other staff, this group was so large that two-way communication was very difficult, hence the need for the new chairmen's committee.

It was important for the Executive Committee to resume its appropriate role in policy matters and withdraw from direct involvement in management issues. I felt that if we could challenge the Executive Committee with substantive policy roles—and demonstrate competence in handling management issues—it would quickly retreat to its appropriate role. Here I would note, however, that after I left as dean, the Executive Committee would occasionally lapse once again into management details when not appropriately led from the dean's office—a tendency not particularly surprising considering the strength of the senior faculty members usually elected to this body.

My most immediate concern was building the team that would comprise the dean's office. It was an easy decision to turn to the same group of junior faculty who had joined with me in earlier efforts to push the College to a more aggressive and enlightened commitment to faculty quality and achievement. The first member of this team was obvious: Chuck Vest. Both Chuck and I had joined the faculty at about the same time (although Chuck had received his Ph.D. at Michigan in Mechanical Engineering while I came from Caltech), worked up the promotion ladder side-by-side, and even shared the College's award for outstanding junior faculty achievement (the Class of '39E Award). Chuck had also been a member of the dean search committee and was well aware of the challenges faced by the College. Of course it did not take a rocket scientist (or rather, a nuclear rocket scientist) to realize that Chuck had extraordinary leadership skills. He was later to succeed me as both dean of engineering and later as provost. He was lured away from Michigan to become

Chuck Vest (with the Towsley family at the Dow Building dedication) president of MIT in the early 1990s, where he has served for many years as one of the true leaders of American higher education. Chuck agreed to accept the assignment of associate dean for academic affairs—in effect, the second-in-command in the college administration.

Dan Atkins

The second key appointment was Dan Atkins, a young professor of computer engineering, whom we brought into a new position of associate dean of research. Dan not only had extensive experience in attracting sponsored research support from the federal government and industry, but he also was at the cutting edge in computer technology, an area we realized would become of great importance to the College. Once again, Dan's leadership and entrepreneurial skills were evident, and after a brief period as interim dean of the College, he was to become the founding dean of the University's new School of Information. Beyond that, Dan was probably the most creative and original thinker on our team, frequently coming up with novel ways to solve very complex problems.

The third member of the team was Scott Fogler, long recognized as one of the real national leaders in chemical engineering education (and yet another member of the young faculty who led the revolution in the College during the late 1970s). Scott agreed to accept the position of associate dean for educational affairs. After serving in this role for several years, he returned to become chairman of the Department of Chemical Engineering.

Scott Fogler

Over the next several years we were to attract others into administrative roles in the College: Lynn Conway, a nationally recognized computer scientist from Xerox Palo Alto Research Center, who headed up our new initiatives effort, and Walt Hancock, a distinguished senior member and former chair of the Department of Industrial and Operations Engineering, who headed up our manufacturing science and engineering efforts. But it is worth noting here that all of the members of our original deans team were exceptionally young—all under the age of 40, and all at the peak of their academic careers. Yet they were willing to commit the time and effort, at the almost certain sacrifice of their scholarly momentum, to rebuild the College.

The concept of leadership team was extended to include the department chairs and the College Executive Committee. The chairs along with the deans comprised the Chairmen's Advisory Council, which met weekly or biweekly to consider college-wide issues such as resource acquisition, budget priorities, space allocation, and major strategic initiatives. We operated this as a principals only-no substitutes meeting where we could have a very candid discussion of important issues facing the College such as junior faculty development, the research environment, and fund-raising. In a similar way the deans met weekly with the College Executive Committee on policy matters such as promotion and tenure, and program evaluation. These meetings were not only valuable in tapping the wisdom and experience of some very capable people, but they were important in keeping the College leadership united as we moved forward with a very aggressive transformation agenda.

The Plan

Although Bill Frye had asked me to come back with a detailed plan for the College by early fall, I began to work on this project almost immediately. In fact, within several weeks (mid-April, two weeks before I would begin my appointment as dean), we already had developed a detailed first draft of the plan. We continued to polish and revise the plan as I conducted my series of listening-and-learning discussions throughout the spring. Hence by the time I formally moved into the dean's office on May 1, we already had a reasonably clear sense of where we needed to head.

Although I was quite inexperienced as an administrator, I was determined to keep my focus on the developing plan and not become chained to the in-out basket and manipulated by the agendas that others would attempt to force upon us. In particular, I fought against the natural tendency to begin work immediately on the various and sundry matters that inevitably pile up during the interim period characterizing a change in leadership. If these items had waited for the many months of the dean search, they could certainly wait a few more weeks until the new administration was firmly established.

The External Review Committee for the College had made specific mention in their 1980 report of the absence of planning in the College: "We saw no evidence of a comprehensive long-range plan or of any formalized

The First Plan for the College Submitted to the Executive Officers in 1981

planning." Hence I believed it essential to give highest priority first to the development of just such a plan. Beginning with our initial draft, we worked closely with the deans and chairs throughout the summer of 1981, with the target of completing the first version of such a plan by early fall. As it happens (and as it usually happened), we came in ahead of schedule, completing the plan in early August and submitting it to the University Executive Officers on August 18. We circulated complete copies of the plan and all of the supporting materials to the entire faculty of the College in January, after we had completed the early rounds of discussion with the central administration to make certain we were on the right track.

The plan was accompanied by an array of memoranda to key University leaders on specific topics (e.g., eliminating the engineering funding "gap", a special salary program to retain our best faculty, completing the North Campus move, seeking a component of the College's indirect cost recovery to improve the research environment). Throughout the 1981-1982 academic year we met with key elements of the central administration on each of these issues, including a major presentation of the plan to the entire Executive Officer team in November, a presentation concerning the North Campus move to the Plant Extension Committee (the Executive Officers sitting as a committee to consider capital facilities) in January, a presentation to the Budget Priorities Committee on the Engineering Gap, and a presentation to the Central Operating Committee of the University's fund-raising campaign concerning the College's development needs.

Key in engaging faculty and maintaining the momentum of the planning process were a series of ad hoc faculty committees (so-called "hit-and-run" committees) to flesh out specific elements of the plan. Topics considered by these committees included:

- Faculty recruiting
- Faculty development
- Programmatic review and reallocation
- The research environment
- Graduate programs
- College equipment and technical support

Development and fund-raising
Primary research staff
The College computing environment
The possible transition of the College to a School of Engineering

These committees provided valuable insight and guidance in the further evolution of the plan. They also engaged a very large number of faculty members in the development of the plan, an activity that was essential for its support in later months.

Here it should be stressed that I always viewed the strategic plan for the College as an organic document that would continue to evolve as our understanding of issues improved, as we achieved some of our early goals, and as we identified new goals and priorities. In this sense, the plan was important as much as a process to engage faculty, friends of the College, and the University administration as it was as a specific document. In fact, the planning document evolved through many versions, with each new version accompanied by new charts and tables measuring progress and success (or failure) developed and distributed each fall. As the plan evolved, it became quite a large document, with several hundred pages of narrative, supporting documentation, and accompanying proposals.

Since the plan played such a critical role in our efforts to rebuild the College, it seems appropriate to describe some of its key elements. The plan began with three simple goals that remained consistent through the five years of my tenure as dean:

1. To achieve excellence in education, scholarship and research, and in the professional activities of our faculty and students.
2. To establish an environment within the College that not only allowed for excellence, creativity, and innovation, but actively stimulated, rewarded, and demanded such qualities.
3. To seek and obtain the resources necessary to support such an environment.

The general guidelines for the effort were identified as follows:

1. The College must keep as its primary objective the achievement of excellence in its research and instructional programs.
2. It must strive to maintain the flexibility to respond to changing needs and priorities.
3. It must be prepared to shift resources when necessary, possibly reducing or even eliminating some programs and activities in order to improve or initiate others. In such decisions, it must keep in mind the important criteria of quality, centrality, and cost-effectiveness.

We laid out a series of very specific goals for the 1980s:

1. To improve the quality, achievements, and reputation of the faculty of the College by implementing policies concerning hiring, promotion, tenure, and salary that strongly emphasized excellence.
2. To increase very substantially the quality and quantity of research performed by the College.
3. To shift the focus of the instructional programs of the College more toward upperclass/graduate-level education.
4. To rapidly and dramatically improve and enlarge the graduate programs of the College, particularly at the Ph.D. level.
5. To complete the move of the College to the North Campus within a three year period.
6. To rebuild the equipment inventories and support staff lost through budget cuts over the past decade.
7. To greatly strengthen the College's relationships with industry.
8. To establish an aggressive fund-raising program aimed at securing support from both corporate and private donors.
9. To restore a level of base funding for the College commensurate with our aspirations for quality and achievement.

Here I might note at the outset that many of these goals were very ambitious, more along the line of what the business world would call *strategic intent* or stretch goals intended as much to drive major change in the College as to set the direction for our efforts. Yet, as ambitious as they were, we were not only able to achieve all of them by the mid-1980s, but we actually overshot our original goals in many respects. For example, the move of the entire College of Engineering to the North Campus was completed in three years, with additional capital facilities added over the next decade that would give the College what some peers today regard as the leading engineering campus in the nation. Although we set as an initial target the elimination of the $7 million Engineering Gap in University support, we managed to increase the College's General Fund budget from $13.2 million in 1980 to $34 million in 1985, almost a three-fold increase. Doctorate production went from 51 Ph.D.s per year in 1980 to 150 Ph.D.s in 1986. And the College's reputation, as measured by the rankings of its various academic programs, rose rapidly from eighth in the nation to fifth in the nation today (with most of its programs ranked among the top five nationally). A more thorough discussion of results will be provided after describing the execution of the plan in this and the next two chapters.

Each of these specific goals was broken down into a series of specific actions accompanied by the identification of metrics that would tell us whether we were succeeding. For example, under the general objective of improving the quality of faculty, there was a broad range of strategic and tactical actions, such as:

1. Developing and publicizing a rigorous policy for promotion and tenure review that placed heavy emphasis on research and scholarship.

2. Implementing a more flexible staffing policy that placed primary emphasis on faculty quality and programmatic needs rather than instructional load.

3. The implementation of special salary programs that recognized both merit and market pressures, particularly among junior faculty.

4. Implementing differential instructional load models that recognized the diversity of faculty activities in research and graduate education.

5. Implementing strong merit-based incentive programs that rewarded faculty with discretionary resources for achieving important College goals such as Ph.D. production and sponsored research funding.

6. Establishing strong lines of communication between the deans' office and key faculty constituencies (particularly our top scholars and our junior faculty).

Even in its earliest drafts, the strategic plan we developed for the College was over 50 pages long (single-spaced) with over one hundred specific actions and sub-objectives. These were accompanied by an array of decision charts, identifying the key decisions necessary for execution of the plan at the College, the University, and also the state and federal levels.

Also interesting is that even in this very early stage of planning, long before our deans' team would move into the action phase, we were already considering some very bold initiatives. For example, we seriously considered the possibility of moving immediately to double the salaries of all of our assistant professors, reflecting our belief that they represented the future of the College and yet had been the most disadvantaged by the College salary programs. (Within two years we had actually achieved this goal.) We priced out the cost of providing every faculty member with a computer terminal or microcomputer (estimated then at roughly $1 million) to stimulate computer literacy in the College. (Within two years we had provided all faculty with a personal computer, encouraging them to keep it at home so that their families could also use it.) We launched a process to examine the possibility of a major co-operative education program for the College (thereby anticipating somewhat the later request by General Motors that the College assume responsibility for the General Motors Institute in Flint). As a final example, we considered the possibility of negotiating the ability to attach a surcharge to the tuition paid by engineering students that would flow directly to the College to support the more costly instruction associated with engineering education. (This would soon become the mechanism we used to finance the Computer Aided Engineering Network.)

The notes from these early planning discussions contain pages and pages of ideas and proposals and possible actions. As I will discuss later, many of these were quite "out of the box" (some possibly even beyond the lunatic fringe) and reflected the energy, creativity, and perhaps naiveté of our very young leadership team.

Of course, not all of the early effort was devoted to the brainstorming process associated with strategic planning. Much of it was also aimed at more mundane, yet nevertheless very important, administrative matters. For example, we believed it very important to immediately put in place a fair and transparent process for allocating resources to the departments that would provide them with as much control and flexibility as possible. We were determined to bring to an end the allocation of resources through individual negotiations between the deans and the department chairs (in smoke-filled back rooms), instead preferring to work directly with the Chairmen's Advisory Committee and the Executive Committee to develop rational allocation principles with strong incentives for resource generation and wise expenditures.

We also faced the near-term challenge of deciding just how we would handle the 6% base cut to be levied against all academic units in the year ahead (although Frye had committed to giving us these funds back for other purposes as his first step toward restoring the General Fund support of the College.) Our predecessors had proposed to take the part of the cuts from a forced merger of two departments, Chemical Engineering and Metallurgical Engineering, that had formerly been together but by now had drifted far apart intellectually. They were also going to pass along the remainder of the cuts across-the-board to the various academic departments. We were skeptical about this plan and wanted to explore other alternatives including the possible discontinuance of some units.

But the development and execution of the strategic plan came first. And key in this effort would be making the case to the central administration of the University that they needed to take bold action to address the urgent needs of the College.

Making the Case

One of the lessons learned over the years and stressed in this book is that the College of Engineering thrives most when it has strong relationships with the University in general and the central administration in particular. It is when it turns its back on "State Street" (the term long used to describe the president, provost, and other executive officers of the University) and tries to go its own way, ignoring the important role it has played over the years as a key element of the University community, that it is most at risk.

Although I was unaware of the earlier history of the College, I had spent much of the past five years heavily involved in central administration activities. I realized immediately that no matter how visionary and energetic our planning activities, our success in rebuilding the College would depend heavily on making the case to the central administration for support of the College.

It is important here to understand the organization of the University's administration. At the top of the hierarchy was the president, in this case Harold Shapiro, serving as chief executive officer of the University.

Although the president spent much of his time on external activities such as fund-raising and state and federal relations, he nevertheless was the final authority in all University matters and managed the process of seeking approval of major initiatives by the Board of Regents, when this was necessary. The provost and vice-president for academic affairs—Billy

President Harold Shapiro

Frye in our case—was just as critical, since as both chief academic officer and chief budget officer, he was not only at the key decision point on most issues affecting the College, but he also held the purse strings.

Although other executive officers such as the vice-president and chief financial officer (Jim Brinkerhoff), the vice-president for research (Charles Overberger), the vice-president for development (Jon Cosovich), and the vice-president for government relations (Dick Kennedy) were not in direct line-reporting roles with the schools and colleges of the University, they were key players in many issues of great importance to the College. Such issues included the North Campus move (Brinkerhoff), the research environment (Overberger), private fund-raising (Cosovich), and seeking state support for buildings and operations (Kennedy). As dean, I made it a point to interact frequently with each of these executive officers, seeking to build a relationship of mutual trust and respect.

Provost Billy Frye (receiving an honorary degree in 1992)

However, almost as significant was a cadre of key staff reporting to each vice-president, with whom I and the rest of my team would interact frequently both on lesser matters and to tee up major proposals and decisions for their bosses. Michigan was fortunate in being able to attract some truly extraordinary individuals into these administrative roles, including several who were considered among the very best in higher education, and we soon developed a great sense of respect for their experience and judgment. Of particular note here were Susan Lipschutz in the president's office; Bob Holbrook and Bob Sauve in the provost's office; Ralph Nichols and Keith Molin in the vp-government relations office; Paul Spradlin, Chandler Mathews, and Norman Herbert in the business and finance office; and Joe Roberson in the development office.

But perhaps the key person in our early effort to make the case for Engineering was Allen Spivey, one of the most distinguished faculty members in our School of Business Administration, who was on leave to the provost with the special assignment of heading up the University-wide planning effort as it navigated through the storm of state budget cuts to find its "smaller but better" landfall. Spivey had a keen sense of the nature of the University, writ large, and he was able to see the entire forest beyond the trees that distracted many others. He was an invaluable source of wisdom and advice throughout both our planning activities and our efforts to make the case for University support along a number of fronts.

Since the success of such efforts is as dependent upon the nature of people as it is upon the rationale (or truth and justice) of the argument, it was important that we spun our case in the right way. I had learned from years of experience that academic leaders such as Bill Frye were more interested in intellectual arguments than data presentations. (Harold Shapiro was an exception, but even he made sure that the data did not obscure the substance of what an issue meant to the University.) I also had learned that consistency and persistence were sometimes more important than highly refined presentations. Hence we made it a point to interact as frequently as possible with both the president and provost and their staffs on a key set of issues, all carefully chosen as what we believed to be the key decision points.

The first issue had to do with the University's base budget support of the College, currently at a level of $13.2 million (1980). Although both Shapiro and Frye believed the College to be seriously underfunded, they were uncertain as to the amount. It took only a few weeks for our new deans' team to establish the magnitude of the Engineering Gap as roughly $7 million, or about 30% of the target goal of $20 million in base support.

Needless to say, this estimate was far beyond anything that Frye had suspected, and we were worried that in a time of serious financial stress for the University, putting such a proposal on the table might freeze up the system and be rejected. Hence we instead decided to pursue an approach that more gradually moved the central administration to this conclusion, step by step.

To this end, we began our lobbying effort by addressing very immediate needs, the first among them being the vulnerability of many of our best faculty to raids from other institutions and industry because of inadequate salaries (arising not only from inadequate University support but also from mismanagement of salary dollars by our predecessors who stressed faculty seniority over merit). In this case, extensive documentation was necessary to make our case, and we put together not only a comparison of College salaries with peer universities, but as well a list of recruiting offers that our key faculty had received in recent months.

As I will discuss later, we were successful in making this case, and Frye provided us with $500,000 of special salary market adjustment funds in FY1981-82 and an additional adjustment of $450,000 in FY 1982-83. We continued to benefit from salary programs higher than the University average for the next several years.

The second issue continued a battle I had been fighting for several years as chair of the Academic Affairs Advisory Committee: the environment for sponsored research on campus. Beyond reducing the centralized bureaucracy of the office of the vice president for research, the College sought a new process for allocating the roughly 35% of the overhead paid by the federal government that was currently being distributed across the University to support research activities. Although the research grants and contracts awarded faculty of the College generated roughly $9 million per year of overhead, none of this was returned to the College to support research activities (including that component earmarked as overhead at the department level). We urged the University to allocate these funds to academic units based on the level of their research activity (with an implication of several millions of dollars a year flowing directly to the College).

The third issue we posed to the Executive Officers was the North Campus move. Here I should admit that we were ambivalent. Although the University had decided to relocate the College from its Central Campus facilities in West and East Engineering in 1950, and taken some initial steps in this direction by building several research buildings during the 1950s and 1960s, the momentum of the move had largely stalled during the 1970s (in large part because the University pushed the College aside as a priority for state funding in favor of the Replacement Hospital Project). Only two academic units (Nuclear Engineering and Aerospace Engineering) were then located on the North Campus. Many faculty members were wasting hours every week commuting back and forth between campuses to conduct their research. Yet in surveys of the engineering faculty, the overwhelming majority felt that the decision to move to North Campus had been a mistake. They were concerned that the move would separate them from the sciences and key professional schools on the Central Campus. Furthermore there was a belief that if adequate investment had been made in their Central Campus facilities, no move would have been necessary. Although we both sympathized and to some extent agreed with these views, we also believed that it was too late to reverse the decision. The College was stalled in midstream, and it needed to complete the move before it sank still further in quality. Therefore we decided we had to develop a creative plan to complete the move and then exert maximum pressure on the central administration to gain their support of this plan.

Finally, although we were concerned that the magnitude of the Engineering Gap was beyond the level that could be dealt with (or even imagined) by the University, we nevertheless believed that we needed to make every effort to convince the central administration that even during difficult financial times, it simply had to make progress toward this target, no matter how long it took to actually achieve it. We continued to build our case for a dramatic increase in University support and kept strong pressure on the president, provost, and their staffs to persuade them to continue to chip away at the Engineering Gap.

Following Shapiro's advice, we made certain that each proposal to the University was accompanied by a strong statement of College commitment, participation, and sacrifice. For example, in making the case for additional support, we agreed to launch major program reviews of a number of College activities for possible elimination and fund-reallocation, ranging from discontinuing major but obsolete facilities such as "the foundry" (the process metallurgy lab) to discontinuing an entire department (the Department of Humanities). In presenting plans for the North Campus move, we immediately sacrificed the grandiose plans developed by the Ragone administration for four major new buildings, and instead proposed a series of reassignments and modifications of existing facilities that not only substantially reduced the price tag of the move, but reduced the number of new facilities to one (the so-called Engineering Building I). We eventually went even further and actually offered the University a $2 million loan from College discretionary accounts to get the move started!

Although we were firm in the pressure we applied to the central administration, we were rarely strident. Rather, we always tried to take an optimistic approach. For example, in late summer of 1981, after submitting our first version of the plan to the University, Chuck Vest and I met with Bill Frye to stress that:

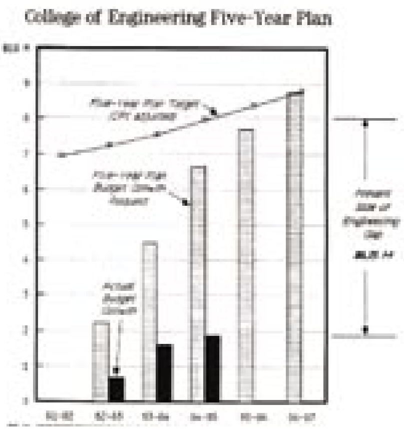
"Our team is now together. We have high enthusiasm and high hopes. We know where we want to go; we have the plans for getting there, and we have taken the first steps in this direction. But we need your help at this point to go further."

"We will leave behind a stamped, self-addressed envelope for your response, although we also accept Visa or MasterCard."

Actually, Frye was very responsive, even in these first months of our tenure, providing relief from the 6% cut and substantial resources for a special market salary program, launching the University process necessary to evaluate and execute our plans for an expedited North Campus move, and even responding positively to our proposals for sponsored research incentives-with considerable opposition from the vice president for research. (More on this later.) Although Frye was clearly on our side, he occasionally asked our help either in modifying our proposals or working behind the scenes to gain broader support among some of his Executive Officer colleagues. For example, while he believed it politically acceptable to allocate new resources to the College justified by the crushing instructional burden posed by our exceptionally high enrollments, he was reluctant to allocate funds identified as research incentives or special salary programs. Of course, he stressed that use of these new funds, like the rest of our budget, was under our control, and if we chose to use them for a special salary program or research incentives, then, of course (wink) that was our prerogative.

The Engineering Gap

Of course, from a resource point of view, the elimination of the Engineering Gap—that is, the restoration of adequate funding for the College—was our highest priority. Earlier in this book we discussed the magnitude of the underfunding, estimated at $7 million of base funding or roughly 70 FTE faculty positions. We also suggested possible causes for the erosion in University support of the College occurring during the 1970s and 1980s. We documented for the executive officers the negative impact of the Engineering Gap to the University: 1) the degree to which our research and instructional programs were handicapped by deteriorating physical facilities, the campus split, and a badly overloaded faculty; 2) the low faculty morale and apathy in the College; 3) the serious deterioration in research and graduate programs; and 4) the major turnover which had occurred in faculty (including loss of many junior faculty). Most seriously, we stressed to the provost the degree to which the faculty and staff of the College had been beaten down by a decade of neglect by the University. They had lost the degree of intensity and drive necessary to achieve excellence.



One of our typical charts portraying the Engineering Gap

Harold Shapiro and Bill Frye accepted the seriousness of the Engineering Gap and its impact on the College. They also committed to taking action to address it. Yet they believed it important to build support among a broader campus constituency if restoration of support was to occur, and here they needed our help. It was clear that the usual quantitative arguments that we, as scientists or engineers, tended to use to document our case were not always compelling to people who thought more qualitatively. There was also sensitivity about the argument of equity, since there was always difficulty in cross-comparing the support of various schools and colleges. (An example here: How does one compare the support of Medicine with the support of Art?)

As I indicated earlier, we were willing to settle for progress through a series of small steps, as long as the vector of support from State Street pointed toward eventual elimination of the Engineering Gap. And for a time we made good progress, with base budget increments of $1 to $2 million each year. But we also realized that it was likely that the University would eventually run out of the capacity to meet our needs, and we would need alternative plans (e.g., differential tuition or special state support).

The Faculty Challenge

One of our most immediate challenges concerned the state of the faculty. A decade of eroding support had left our faculty as worn as the stairs in old West Engineering. Many of our best faculty had become frustrated and had left for greener pastures. Others were on the brink. We realized we had to act rapidly to change the faculty culture. We had to convince our faculty members that excellence mattered once again and give them confidence that the College would not only support their efforts but reward them. We needed to shift the priorities of the College rapidly away from focusing simply on measures of instructional productivity and instead to the quality of our research and educational programs, particularly at the graduate level. We had to act rapidly to retain our strongest junior faculty and to begin the effort to recruit outstanding senior faculty.

This would be a very considerable challenge. In many parts of the College, the faculty had lost the ability not only to achieve excellence, but even to recognize it. Indeed, in some departments, they were actually threatened by excellence, to the degree that they resisted bringing in new faculty better than they were.

There were some actions we could take immediately. I began the practice of meeting with the faculty of each department every academic year, both to hear their concerns and suggestions, and, in large part, to give them a pep talk, to boost their spirits. The entire deans' team made a special effort to open lines of communication with junior faculty, and we would meet each term with this cadre. We also alerted the department chairs that we would be measuring their own performance (including their merit salary adjustments) by their success in developing their junior faculty.

We significantly strengthened the requirements for promotion and tenure, although in such a way that we provided early feedback (and occasional warning) to junior faculty so that they could assess their progress. Actually, this particular effort was made much easier by the role that Harold Shapiro and then Bill Frye had played in strengthening the provost's role in tenure and promotion decisions, which had placed all of the University's schools and colleges on alert that mediocrity would not be tolerated.

Our most significant near-term action, however, was to completely overhaul the faculty reward system in the College. For years, faculty compensation had been determined primarily by time in rank. Full professors always made more than associate professors; all associate professors made more than assistant professors, and so on. Faculty members who had been in rank the longest were paid the most—unless, of course, they were administrators, in which case they were paid at the top of the scale.

In the course of two years we turned this practice completely topsy-turvy, in such a way that compensation became primarily determined by productivity, achievement, and excellence. The complete restructuring of the College salary program was one of our boldest steps and deserves some attention here. We began by making an appeal to the provost, Bill Frye, explaining that unless we took bold action we were likely to lose some of our very best faculty to outside offers. We provided extensive documentation both of salary comparisons with peers as well as specific offers received from other institutions. In response, Frye provided us with a $500,000 base budget increment over and above the University-wide salary program for each of two years that we could use for special salary programs to address market needs.

In each of the first two years we gave substantial market salary increases, beyond the normal University merit program, to all assistant and associate professors and to selected full professors of particular merit. When we began the program in FY1981-82, the average assistant and associate professor salaries were $22,000 and $30,000, respectively. In the first year, we gave each assistant professor a raise of $7,000; each associate professor received $7,500; and selected full professors received $8,000, on top of the usual merit program. In the second year we made similar adjustments of $5,000, $5,500, and $6,000 respectively, again superimposed on the normal merit program. The consequence was that in two years we essentially doubled the average assistant professor salary to $38,000 and the associate professor salary to $50,000. Since only those full professors with strong achievement received the special market adjustment, the College faculty salary scale was completely restructured so that compensation became strongly correlated with merit and achievement. Of course, this led to considerable compression, in the sense that associate and even some assistant professors passed inactive full professors in salary. But it also sent out the clear message that we intended to strongly reward excellence and achievement.

Since we did not have the additional funds to award in a special market salary program in later years (although Bill Frye continued to fund the general merit salary increase program in the College for the next several years at a level several percent higher than other academic units), we shifted to an entirely merit-based reward structure. Each year, working with the department chairs, the deans and the College Executive Committee would grade the achievements of each of the 300 faculty members of the College. We would then provide raises based on this absolute measure of achievement. Here I should note that we provided half of the raise in percentage increases and half in absolute amount, to prevent faculty of comparable achievement from drawing further apart simply because of base salary (e.g., to prevent the rich from becoming even richer).

There was an interesting wrinkle to this new approach to faculty salaries. The State of Michigan's Freedom of Information Law opened up our salary books to anyone who wished to see them. Each December, just before the Christmas holidays, the Michigan Daily would publish a special insert listing the salaries and raises of every faculty and staff member in the University. Many of our faculty members actually kept spreadsheets of their own salary relative to their colleagues. Both department chairmen and even the deans would occasionally be challenged by faculty who believed their salary was inappropriate. Hence we knew that we would always be held accountable for our salary decisions, and we made certain we had accurate documentation to support our recommendations.

There were three additional elements of our effort to strengthen the faculty. The first was a budget allocation matter: We adopted the policy that whenever a department released an untenured faculty member, the position would revert to the department (to remove any incentive to keep mediocre performers). On the other hand, positions that opened up because of faculty resignations or retirements reverted to the College for reallocation based on programmatic need.

Second, we discarded the use of enrollment or instructional load in determining where to allocate new hunting licenses. We responded to enrollment fluctuations by allocating dollars for hiring flexible instructional staff (e.g., adjunct faculty or graduate teaching assistants), not new permanent faculty. Permanent faculty positions were allocated, in part, according to programmatic needs of the departments.[1] I say, in part, because in later years we moved to what we called a "Target of Opportunity" program in which ten or so new faculty positions would be withheld by the College administration and then awarded to the very best candidates identified by the faculty, regardless of area. In this way we conveyed to the faculty our interest in hiring outstanding faculty, regardless of rank or disciplinary area. (Later, when I was serving as provost and then president, I used the same target-of-opportunity approach in minority faculty hiring.)

Finally, we realized that we would simply be unable to improve the faculty rapidly enough if we could only recruit new faculty on additional budget dollars. Faculty turnover had to be part of the strategy. We simply had to find a way to encourage the retirement or resignation of inactive faculty members that no longer could keep pace with the College's new expectations for excellence and achievement. Of course, the massive restructuring of the College salary structure stimulated some of these changes, since less active faculty members saw their salaries rapidly bypassed by more active junior faculty. But we also explored other mechanisms, offering inactive faculty financial incentives to take early retirement or assisting with outplacement services. We tried to be as compassionate as possible, since many of these individuals had been hired and had served the College during much different times when achievement was not so highly valued, particularly in research and graduate education. But we were determined to transform the College, and over a five-year period roughly 120 new faculty members joined the College, even though our total faculty headcount remained at 300.

The North Campus Move

Although we viewed the effort to move the College of Engineering to the North Campus as a frustrating distraction from what should have been the College's highest priorities of seeking excellence in its teaching and research, we nevertheless believed we had no choice but to bring this 30-year saga to an end by completing the move as rapidly as possible. Although very few of our faculty and programs had actually been moved to the North Campus site, the commitments had been made long ago, and we saw no possibility that they could be reversed at this late date.

After a thorough review of the existing plan to move the College into four new buildings, funded from state and private sources, we concluded that in the current budget climate, this plan was clearly both impractical and unworkable. The College's fund-raising efforts of the 1970s had demonstrated how difficult it was to raise gifts for buildings, with only a relatively modest building for the Departments of Chemical Engineering and Materials and Metallurgical Engineering as the result (the Herbert H. Dow Building, then under construction and scheduled for completion in late 1982).

The Herbert H. Dow Building

Furthermore, the impact of the Replacement Hospital Project on the state's capacity to fund new construction in higher education would be long lasting and likely prevent major new construction until the state's economy improved.

Therefore we proposed a far more modest plan, based on the reassignment and renovation of several existing North Campus buildings:

- A small North Campus building housing the University's research administration would be reassigned and renovated to accommodate the Department of Industrial and Operations Engineering (while research administration would be moved to the West Engineering building).

Industrial and Operations Engineering (formerly Research Administration)

- G. G. Brown Laboratory would be extensively renovated, adding a third floor for offices and renovating its high bay research wing area so that it could accommodate the Departments of Mechanical Engineering and Civil Engineering.

Adding a floor of offices to GG Brown Lab

The entrance to Civil Engineering in the high bay of GG Brown Lab

The Instructional Center in the Dow Building

- The College would build a library and instructional center (with additional classrooms) in the excavated, but uncompleted basement of the Dow Building

The Stearns Building used for Engineering Placement

- An unused fraternity building adjacent to the North Campus, the Stearns Building, would be used to house the Engineering placement offices.

The old cyclotron laboratory on the North Campus

- The Department of Naval Architecture and Marine Engineering was moved into a small building adjacent to the old cyclotron laboratory.

- The College administration would move temporarily into the Chrysler Center for Continuing Education (compressing the deans offices and our staffs into about one-third the space that we had been using in West Engineering).

Chuck Vest preparing to move to the North Campus

The new Dean's Office (in the Chrysler Center) A bit of a contrast in size from West Engineering

Executing these actions would result in the relocation of all of the College, with the exception of Electrical and Computer Engineering to the North Campus, within 18 months. We proposed that the University elevate to its highest priority the state capital outlay request to Lansing for Engineering Building I, which would be used to house this very large department. That is, we proposed that the earlier state commitment of $18 million (appropriately scaled for inflation) be used for a single building.

Although this plan required some modest expenditure by the University for the necessary renovations as well as the reassignment of space belonging to other units, we believed it to be a very pragmatic and efficient approach to completing the North Campus move in a relatively short time period. It would also release to the University all of the College's Central Campus space, with the exception of the naval architecture towing tank in the basement of West Engineering.

We were invited to make a presentation on our plan to the Executive Officers in January, 1982, as they sat as the Plant Extension Committee. Chuck Vest made the presentation, and I then summed up the case by stating that a positive response by the University to our proposal could finally bring to an end the agony posed by the College's division across two campuses for the past 30 years and its struggle to conduct its research and instructional programs in physical facilities which were clearly inadequate for quality engineering education. We stressed that the College had reached the crisis point where it was no longer capable of handling its exploding enrollments while maintaining even marginally adequate programs in antiquated facilities on the Central Campus. We also noted that the recent ABET accreditation visit had expressed their amazement that quality students and faculty could be attracted to learn and work in such dismal facilities.

Normally such a complex plan would take many months of negotiation before a University decision. But two factors quickly put this plan on the fast track. First, just two weeks earlier on Christmas Eve, an arsonist had burned to the ground the University's Economics Building, adjacent to West Engineering. Ironically I had been taking an early

Christmas morning jog over to the Central Campus when I noticed the smoke, and jogged over to find Bob Holbrook, associate vice president for academic affairs and also a faculty member in economics, amidst a group of firemen and police, watching his office go up in flames. This event put great pressure to find new quarters for the Economics facility, and our proposed rapid departure from East and West Engineering could provide just such an opportunity.

Second, we were fully prepared for the expected early reaction from Bill Frye when he moaned that he just did not know where he could find the funds for these projects in the face of other budget pressures. We immediately responded with an offer to lend the University $2 million from the College's discretionary funds to get the projects started. Frye quickly responded, "You've got a deal!" And we were off and running. (I should also note that some months later Frye mysteriously found $2 million in his own accounts, so we never actually had to transfer the funds for the loan.)

Within two months Dick Kennedy and his state relations officer Ralph Nichols were able to ignite the state capital outlay process for Engineering Building I, getting language into the state budget bill for $500,000 of planning funds to begin the project. There were still many hurdles to overcome in getting final legislative approval of what was to be a $30 million state-funded project, including persuading the governor that this building should be identified as his highest priority, but the North Campus move train was now rolling, and if we could keep it on schedule (and on the track), we anticipated that the entire College would finally complete its move by early 1986.

The Research Environment

One of the most difficult battles we had to fight involved changing the University's policies on sponsored research funding. My earlier AAAC committee on research incentives had documented the deteriorating environment for sponsored research on campus, increasingly burdened by the bureaucracies of the office of the vice president for research, inadequate support for sponsored research project development and management, the plight of primary research staff, and the absence of strong incentives to generate sponsored research funding. Among many recommendations, one that stood out as most controversial and yet probably most significant was the recommendation that the University return to academic units and principal investigators some portion of the indirect cost or overhead they recovered from federal agencies, in proportion to the amount of sponsored research conducted by the unit.

Of course we knew that this overhead, in theory at least, was recovered to pay past overhead costs in conducting federally sponsored research. But we also knew that in the University's budget, roughly 35% of this recovery was reinvested in research activities, both to cover cost-sharing and overruns as well as to support new research development. However this allocation was largely at the whims of the vice president for research and was not correlated with the success of a unit in generating research funding. Furthermore, over the past decade, the College had received none of these funds, despite the fact that it generated roughly 30% of the overhead paid to the University ($8 million in 1980). Hence our proposal was a simple one: allocate the 35% of indirect cost recovery based on the volume of a unit's sponsored research activity, minus its overruns, cost-sharing, and underrecovery, and then allow the academic units to utilize these funds in such a way as to create maximum incentives for sponsored research activities.

Although this made perfect sense (at least to us) and was the practice adopted by many other universities, our proposal was very strongly resisted by the vice president for research (Charles Overberger) who viewed such action as a clear threat to his power base. After a great deal of effort, we were able to persuade Harold Shapiro, Bill Frye, and even Jim Brinkerhoff that our proposal made sense. But they were also leery of triggering a battle among the Executive Officers since Overberger so strongly opposed this proposal. Allen Spivey was an important ally on this matter, since he believed quite strongly it was supportable both on the grounds of strengthening research incentives and decentralizing control of these resources to the unit level where they would do the most good. He also kept us apprised of debate among the Executive Officers. (As he put it, "Great battles are being fought" on our behalf!) In the end, however, Shapiro finally decided that the risk of alienating Overberger was too great to implement the proposal on a University-wide basis, and he left it to Bill Frye to find another less direct response to our proposal using Engineering as a special case.

At first Frye decided to commit $1 million of additional base funding to the College over three years, with the understanding that we could use it for any purpose we chose, including providing research incentives to our departments and faculty. (Even this was controversial, since Overberger strongly opposed any relief for the College.) Spivey then pulled out of his pocket a series of charts he had compiled demonstrating that while the compound growth rate in University support for academic units ranged from 7% to 10% per year throughout the 1970s, the College had actually been cut 2% per year, even as its enrollments were growing by 44%. After seeing these data, Frye agreed to raise the commitment to $2 million over three years, and then after further thought he front-loaded the commitment to a $2 million base increase over two years. Frye was able to push this commitment through the Executive Officers (and over Overberger) with Shapiro's help.

In subsequent discussions, Frye agreed that we could use the entire amount for any purpose, so we responded that we would use the entire amount as research incentives to stimulate, develop, and sustain sponsored research. We also were able to reach an agreement, in principle, that after two years this support would continue to increase and be correlated with the volume of our sponsored research activities. Hence, although for political reasons we could not publicly label these funds as "the return of 35% of our indirect costs" to use as research incentives, we achieved essentially the same objective.

However, because of the political sensitivity of the vice president for research and perhaps other deans to Frye's very unusual commitment to Engineering, he asked us to keep this action at a low profile. He also suggested that it would be helpful if the College could continue its efforts to bite the bullet and reallocate internal resources to highest priorities, as they were asking other units to do. The Department of Humanities was the obvious candidate for such considerations. (More on this topic in a moment.)

We immediately began to develop policies for the allocation of these resources. We decided that the entire amount should go back to both the departments and individual faculty as discretionary funds indexed to their actual indirect cost recovery on research grants (minus any cost-sharing or overruns). For individual faculty, we also added funds indexed to Ph.D. production and graduate student support. Each faculty member participating in sponsored research was provided with an account containing the discretionary funds allocated through this program, under their complete control. This program continues to the present day, although we modified it slightly during my last year as dean by agreeing to pick up in addition the tuition support of all graduate students supported on research grants.

The final issue involving the research environment involved the plight of research scientists, faculty members whose entire appointment consisted of research supported by sponsored research grants and contracts. In the past these faculty members, many of whom were quite distinguished, had been treated much like second-class citizens, without the opportunity to supervise graduate students or to have any employment security in the event that a grant was not renewed. We modified these policies (with the help of the Graduate School) and created a fund that could be used to provide support for a limited period, depending on years of service, in the event of the loss of grant funding. We also modified completely the standards and process for promotion, to bring it in parallel with instructional faculty, thereby providing both higher visibility and prestige to research scientists. Again, most of these practices and policies remain in place today.

And As If This Was Not Enough...

Although most of the first six months of my tenure as dean focused on strategic internal priorities—e.g., building the team, developing the plan, making the case, and dealing with our most critical priorities—a number of other important issues arose as opportunities and challenges with serious implications for the future of the College. Some of these were rather surprising external opportunities such as the state effort to build a robotics research center in Ann Arbor (later to become the Industrial Technology Institute) and a proposal from General Motors for the College to take over the General Motors Institute as a "branch campus" in Flint. Some involved internal matters, such as the launch of a series of reviews for possible program discontinuance of academic units such as the Department of Humanities. Several of our activities really involved leftover matters, such as rebuilding the development (fund-raising) activities of the College and merging them into the planning for the University-wide Campaign for Michigan, and preparing for the major accreditation review of the College's academic programs by ABET (the Accreditation Board on Engineering and Technology) scheduled for fall of 1981. And much of our effort was directed to beginning to modify the culture of the College to create once again a sense of optimism, excitement, and commitment to excellence.

The Robotics Institute (The Industrial Technology Institute)

Within a week after my selection as dean (and even before I formally began my appointment), Harold Shapiro called to ask me to lead an effort to respond to a major state initiative to build a "world-class research institute on robotics and industrial automation" in Ann Arbor. He suggested that the startup costs for the robotics institute would be roughly $50 million with annual operating costs of $15 M/year, funded jointly from state sources and private foundations and corporations. He asked me to lead a team of Michigan engineering faculty to develop both a plan and a proposal for such an institute.

Clearly this was a BIG deal, so I immediately pulled together a small team of faculty leaders including George Haddad, Don Chaffin, Dick Volz, and Ken Ludema to scope out the task.

The origin for the concept went back to a High Tech Task Force, established by Governor Milliken, and consisting of a number of leaders of higher education, business, and industry (including Harold Shapiro) with the charge of developing a technology-based strategy for strengthening and diversifying the Michigan economy. After several meetings the group focused on industrial automation as a key area for investment (and later added to this two more areas of focus in biotechnology and advanced materials). The intent was to establish a world-class center in robotics research in Ann Arbor, funded with an initial investment of $200 million for the first 10 years, and then evolving to a self-supporting status after this. The hope was that a major research park would form about this institute, resulting in numerous spinoff companies and technology transfer to Michigan industry.

Of course, as with any public initiative of this magnitude, politics quickly entered, with lots of lobbying to change the location to Detroit, or to establish additional centers of excellence in other parts of the state (East Lansing, Midland, Grand Rapids, the Upper Pennisula). Although Shapiro and others managed to convince the group that such an effort would only survive if located adjacent to a world-class research university with strong capabilities in engineering (i.e., the University of Michigan), there was great resistance from many members of the Task Force to any close relationship with the University. These members were adamant that the robotics institute be formed independent of the University, both because of concern that the politics would kill the effort if this were perceived to benefit the University too greatly, and because of their skepticism that the University culture and administration would scuddle the effort and attempt to grab the funding for themselves.

Yet, as good soldiers, our team in the College moved ahead to develop a plan. As it turns out, we already had formed within the College a closely related activity known as the Center for Research on Integrated Manufacturing (CRIM), which spanned a number of areas such as robotics, industrial automation, CAD/CAM, and management information systems. Therefore the technical and financial plan for the robotics institute was straightforward enough. As the funding was assembled (including $20 million from the state and $50 million from Michigan private foundations), a faculty member from electrical engineering, Arch Naylor, was selected as the startup director, and the University provided the necessary facilities and administrative support.

Yet, even though the College played a key role in designing the robotics institute (later named the Industrial Technology Institute or ITI), housing it during its incubation stage, and supporting its activities, we were hampered by the insistence of the High Tech Task Force that the institute had to be financially independent of the University. From the very beginning, financial firewalls were constructed between ITI and the College that prevented the flow of any funding between the two organizations. Although faculty and graduate students were sought as research staff, these were retained much like hired hands, working on narrow topics of interest to ITI staff rather that participating as equals in developing and conducting a joint research agenda. It soon became apparent that the barriers constructed between ITI and the College made it very unattractive for faculty participation, and despite strong encouragement on our part, the faculty soon began to back away.

Throughout the 1980s, the College was to make every effort to make ITI a success. I served on its board of directors and assisted in the recruiting of a permanent director. The Kellogg Foundation made a $40 million gift to the effort, joined by the Dow and the Upjohn Foundations at $10 million each. The University provided ITI with a site on the North Campus, adjacent to the College, for a modern glass and steel laboratory building, and we continued to encourage faculty and graduate students to participate in their activity. But those on the High Tech Task Force continued to oppose any direct financial relationship between the College and ITI, and its relatively small size as an independent research center left it overburdened with administrative costs and unable to compete for competitive grants. After fifteen years of modest activities, it was eventually phased out.

In the meantime, however, the College used the expertise developed in designing ITI to build its own internal Center for Research on Integrated Manufacturing into one of the strongest programs in the nation. Faculty were recruited, graduate students were trained, and grants were received that soon made the program a national leader, as evidenced by the awarding of a major NSF Engineering Research Center grant in the early 1990s.

The Industrial Technology Institute

As a parenthetical note, although the College played a key role in helping to design and build ITI, we were frustrated by the constraints placed upon the effort by the state. The irony was that at a time when the College was desperately seeking to recover from a decade of inadequate support, the state along with Michigan foundations made a massive investment (eventually totaling over $100 million) in a new research center, kept at arm's length from College programs and in many ways directly competitive with them. In the end, the far greater faculty and graduate student strength of the College managed to build a truly world-class center in industrial automation using internal funds. One can only imagine what could have been accomplished if the state had decided instead to build ITI within the College to take advantage of these significant assets.

The General Motors Institute

Our next major fire drill was triggered only one month after I began my tenure as dean by yet another phone call from Harold Shapiro. He had picked up intelligence that General Motors was looking for a way out of their corporate university, the General Motors Institute. Located in Flint, GMI conducted an undergraduate engineering program for roughly 2,500 students in a co-operative education mode, in which students would attend school half-time and work in General Motors plants half-time. Over the years, GMI had produced not only much of the first-line management for GM, but it had created throughout the GM management a GMI "mafia." General Motors was concerned not only about the roughly $25 million per year it spent to subsidize GMI but also about the inbreeding of its management team attributed to GMI graduates.

Shapiro's concerns were somewhat different. He was worried that GM might put pressure on the Governor and Legislature to provide state funding for GMI, yet another drain on the state coffers during a very difficult period for public higher education. He was also worried that the University of Michigan's Flint campus might make a play for GMI, thereby expanding its programs with a major engineering program that would compete with both UM Dearborn and UM Ann Arbor. He therefore encouraged me to begin quiet discussions with General Motors to see what I could learn and whether we could influence GM's eventual decision.

I contacted two GM staff who had worked with the College in the past and confirmed Shapiro's intelligence. Based on their advice, I sent a letter to a senior GM vice president stating that if GM was seriously considering alternatives to the GMI operation, the College would be willing to work with GM to develop appropriate transitional and long-term arrangements. Within a few days GM responded with an invitation to visit GM headquarters in Detroit to discuss the matter with two of their executive vice presidents, Steve Fuller and Dave Collier, who had the direct responsibility for GMI.

Chuck Vest and I drove into Detroit, and after a luncheon with polite discussion, Collier handed us across the table a piece of paper that stated that General Motors would give the College GMI, along with $25 million, if we would take it off their hands. They stressed that they wanted to keep GMI a quality operation and therefore wanted it to become a part of the UMAA College of Engineering, not UM Flint. Although Chuck and I were a bit taken back by the proposal, we agreed to discuss the offer with Shapiro and give the matter very serious consideration.

At this point the fire drill began. Immediately after returning to Ann Arbor, we arranged a meeting with Shapiro and other executive officers to discuss the GM proposal. The matter was complicated by the fact that the University was preparing a $10 million request for a General Motors contribution to the upcoming fund-raising campaign. Not only would the size of the GM gift determine similar contributions from Ford and Chrysler, both Engineering and Business would be the lead programs in the solicitation.

We concluded that just as we would hope that GM would give the Michigan fund-raising proposal serious consideration, we should devote considerable effort to evaluating the GMI proposal. I contacted General Motors to begin a several-month process of carefully assessing GMI, the quality of its students, faculty, and programs; its financial and facilities assets; and the pros and cons of various alternatives. On the positive side, we found that the students were of exceptionally high quality (particularly the minority students in the program), attracted in part because of the co-op nature of the education and the assurance of a significant job in General Motors. However, balanced against this was a faculty that was quite different in character than the research-focused faculty in the College. Furthermore, GMI was a very expensive operation, with staff benefits characteristic of General Motor's executive programs rather than higher education.

In the end, we concluded that we could indeed absorb GMI and operate it as a branch campus of the College, but we could only maintain the quality of their programs by requiring their students to transfer to the Ann Arbor campus for the final years of their studies, in particular engineering disciplines. That is, we would create a 3-2 program, in which students would attend GMI and be taught by GMI faculty for the first three years and then transfer to Ann Arbor for the final two years to finish their degree, all within the existing co-op education model (50% study, 50% work). However, we also believed that we could not absorb the additional enrollments without additional resources, and for this reason we asked General Motors to commit to providing a $100 million endowment for the GMI component over a ten-year period.

Although Harold Shapiro liked the plan, he was a bit taken back by the idea of asking GM for $100 million. (In fact, he characterized it as “highway robbery.”) However, we finally convinced him that this was quite reasonable, and he agreed to present our proposal to Roger Smith, then CEO of General Motors. Smith’s reaction to the proposal was very encouraging. He stressed that Michigan was the only university GM had approached, and he was delighted to receive not only a quality proposal but a highly creative effort with ideas they had not considered. The request for $100 million did not scare him, and he was very intrigued about the 3-2 concept. He believed this to be an excellent response to General Motors’ needs.

Over the next several months GM considered the Michigan proposal, along with other options, very carefully. In the end, however, they decided to back away for political reasons. GM was in the midst of a series of very difficult negotiations with the UAW, seeking concessions during a difficult financial period for the automotive industry. The leadership of GM was populated by several GMI graduates, and Smith worried that the Michigan proposal, which would essentially end GMI’s existence as an independent college, might divide the leadership team at an awkward time. Hence GM decided to try to reconfigure GMI as an independent private college, opening its enrollment to other companies. I must say that we were not disappointed. The process of absorbing GMI (not to mention the frequent commutes to Flint) would have been highly distracting as we attempted to achieve our important strategic objectives.

The Department of Humanities

Another of our early tasks was to assess the viability of the College’s Department of Humanities, an academic unit providing service instruction to undergraduates not only in skills such as English composition, but in literature (Great Books, Shakespeare, Chaucer, Science Fiction, British and American Writers, among many other courses), philosophy, and history. Although this unit clearly duplicated courses offered by LS&A, it was one of the few priorities of both deans Van Wylen and Ragone, and the department had grown to over 30 instructional faculty members. Engineering students were required to take their humanities electives from this Department rather than from LS&A, isolating them from the rest of the University.

The University’s central administration had long been skeptical about the quality of the College’s humanities programs. Student course evaluations gave low marks to the required courses on Great Books and technical writing, and few engineering students would have taken the courses had they not been required, preferring to take their humanities and social science courses in LS&A with students from other majors. Assessments of faculty quality portrayed the unit as a “second-rate English department,” with only two or three of the faculty with credentials comparable to those of their LS&A colleagues.

Beyond the quality and centrality of the Humanities Department, I had yet another concern. By offering our own courses in humanities and social sciences and requiring our students to take these courses, we were isolating engineering students from students in other programs such as those offered by LS&A. I believed strongly that one of the great benefits of a college education at a comprehensive university such as Michigan was to experience a broad range of academic subjects, to rub shoulders with students with quite different interests, and to take advantage of all the University had to offer. Ironically, the first two deans of the College, Charles Greene and Mortimer Cooley had also worried about separating the early Department of Engineering out of LS&A and establishing it as a separate college for just this reason. I viewed the Department of Humanities as a regressive activity, a waste of valuable College resources and, more seriously, antithetical to the concept of a liberal education that should be the underpinning for undergraduate education.

These views were well known, and the Department was not surprised when I first met with them in fall of 1981 to warn them that the continued existence of a predominantly service department, duplicated elsewhere in the University, was in great doubt in the face of our urgent budget needs. The University had a well-established and highly cumbersome process to discontinue academic programs that, in effect, put the unit on trial in what most felt was an awkward public display. But we preferred a different approach. We would present to the Department a "statement of intent," with a proposed course of action to: 1) transfer all instructional activities of the Department to LS&A, 2) continue all tenured appointments of faculty in the College (although they would teach in LS&A) until faculty members retired, transferred, or resigned, and 3) retain the technical communications component of the Department, but seek to redirect it toward the new tools beginning to appear such as computers and networks. We would then ask the Department to choose between this action and the formal discontinuance review process. We had little doubt that most faculty members would prefer the former approach, since it was both compassionate and low key.

Although Bill Frye found our approach very appealing, he was eventually persuaded by the University attorneys that we had no choice but to go through the formal academic program discontinuance process, complete with a formal review committee, open hearings, appeals, and the other elements of due process. We therefore began such a process in late 1981, which eventually concluded with our original suggestion. All instructional activities to LS&A—thereby allowing Engineering students to take their humanities electives along with other University students—and the Humanities faculty were gradually phased out through transfers and retirements. Although we had to transfer some of the budget for the Department to LS&A to compensate for the additional instructional load from engineering students, in the end we were able to reallocate roughly half the budget of the Department to the engineering departments of the College. Furthermore, through this discontinuance action we demonstrated both to the central administration and to rest of the University our willingness to take strong action to reallocate resources to our highest priorities. This helped to make the decision of the central administration to provide substantial budget relief to the College more politically acceptable.

Here it is important to note that the Humanities Department was not the only program examined for major restructuring or possible discontinuance. We also reviewed and discontinued the separate degree programs in computer-aided design and environmental sciences. Reviews were also conducted of the Departments of Naval Architecture, Chemical Engineering, Materials and Metallurgical Engineering, and Atmospheric and Oceanic Sciences, with the possibility of restructuring, redirecting, or merging these departments with other academic programs.

Development

I noted earlier my concern that the College had focused too much of its attention on development—i.e., private fund-raising—during the 1970s instead of making the effort to build strong support within the central administration and in Lansing. Although I was determined not to repeat this mistake and allow most of my time to be consumed by development activities, I realized this would nevertheless be an important responsibility. Here we faced two immediate challenges: First, the development capability of the College had been largely dismantled following the campaign of the 1970s, with little remaining in the way of development staff or volunteer networks. Second, the University was spinning up a major University-wide fund-raising campaign for the 1980s that did not yet include the College, since an interim dean could really not speak to Engineering's development priorities.

Hence I had to move rapidly to rebuild a development team, identify our key objectives, and lobby the central administration to get these included in the University-wide effort. Over the longer term, I realized that private fund-raising would be a critical component of our strategy. In fact, even in my earliest speeches to alumni I began to weave in language suggesting that the College would become increasingly a "privately supported island in a public university sea."

The first step involved rebuilding relationships with industry, focusing first upon General Motors, Ford, and Chrysler. Of course, I had already developed contacts at the very highest level of General Motors because of our discussions concerning GMI. Ironically, however, this put a temporary dent in our efforts to build support of the College because General Motors decided to delay a decision on our $5 million request until the GMI matter was settled, although they went ahead and made a commitment to the Business School. As the months wore on, I became increasingly frustrated, to the point where I even contacted Roger Smith to express our concern.[2] We were finally able to break through the GM bureaucracy when Bob Eaton, then head of the GM Tech Center (and later to become CEO of Chrysler) was assigned as our corporate contact. Bob worked hard to build the necessary relationships that eventually resulted in a $3 million gift to establish our Computer Aided Engineering Network.

Relationships with Ford were easier to develop, both because of their close proximity to Ann Arbor (indeed, it was estimated that over 200 members of Ford's senior management lived in or near Ann Arbor) and also because we had excellent contacts such as Bill Powers (who had left the College for Ford during the Ragone days). Chrysler was also a company with which the College had long had excellent relationships because of the efforts of Chrysler executives with strong College ties such as Harry Chesbrough, George Heubner, and Hal Sperlich. The challenge was Chrysler's precarious financial condition, as it avoided bankruptcy only with the help of a bailout by the federal government. Nevertheless, even during tough times for the company, we maintained our flow of graduates and consultants to Chrysler, and when Lee Iacocca finally turned the company around, they began to support the College once again. (I remember well one visit to Chrysler headquarters when I was seated on a couch between Iacocca and Bob Lutz, each of whom was blowing smoke in my face from foot-long cigars. Guess the automobile industry was just not my style.)

As one of the nation's leading engineering colleges, we also had strong relationships with other industries such as the electronics and computer industry (e.g. IBM, Intel, Motorola), the aerospace industry (Lockheed, Boeing), the energy industry (Exxon, Mobil, Schlumberger), and the manufacturing industry (3-M, General Electric, Dupont). I was to spend an increasing fraction of my time traveling to visit these companies, building relationships with their leadership, and seeking their support.

As I became more experienced in fund-raising and developing relationships with industry, I became aware of one of the more puzzling aspects of the College's history. Although we were located right in the backyard of the automobile industry, our strongest relationships were with high-tech industries such as aerospace and electronics. In fact, for a time, Michigan was the largest source of engineers to the California aerospace industry. And the level of our support was always greater from these industries than from GM, Ford, and Chrysler. Perhaps part of the reason was that the majority of our faculty worked on cutting-edge research supported by the federal government, and this tended to be in high-tech areas related to the defense industry. It may also have been due to the "familiarity breeds contempt" syndrome, in which companies preferred to look beyond their backyard for college relations.

Equally important was rebuilding relationships with alumni of the College in general and key donors in particular. Once again, much of this activity had been largely abandoned during the late 1970s and had to be rebuilt again from scratch. One of the first steps was to integrate the College's alumni within the broader University of Michigan Alumni Association, since they had been separated during the earlier paranoid days. We also had to rebuild the lists of key donor prospects with the capacity for major gifts.

In an effort to rebuild our capacity for fund-raising, I decided to go with intelligence, energy, and loyalty rather than experience, and hired Brad Canale, a recent UM graduate (and leader of student government) who had just come off a year of fund-raising for the Republican Party in Ohio. We began to work with the central administration to weave the College's efforts into the planning for the broader University-wide Campaign for Michigan. Although we included support for the student instructional center we intended to build in the basement of the Dow Building as a priority, most of our efforts aimed at building support for people: scholarships and fellowships for students and endowed chairs for faculty.

Brad Canale with Anne

The Early Results

By the start of the Fall Term in 1981, we had already made very substantial progress. Our leadership team had been assembled. The plan for rebuilding the College had been developed and presented to the Executive Officers. The proposals in key areas—eliminating the Engineering Gap, implementing a special faculty salary program, completing the North Campus move, and securing University support of research incentives in the College—had been developed and presented to the Executive Officers, and we were well along in building the necessary support among key officers and their staff for eventual action.

Hence, I was able to begin the first faculty meeting in the fall by stating: "Today I don't want to dwell on the past. The litany of our difficulties and problems is all too familiar to you. Rather I would like to point to the future, where we think we should head, the actions we propose for getting there, and review with you some of the steps we have already taken in that direction." Throughout the next several months we were able to secure the first set of University decisions so that by the end of our first year in the dean's office, we had great confidence that we would be successful in completing the ambitious agenda we had set for the College.

During the summer Frye had agreed to return to the College the 6% budget cut levied on all academic units ($629,000). He had responded to our request for a special salary program ($500,000) and would do so again the following year ($450,000) so that we were able to totally restructure the College's salary program, essentially doubling the salaries of assistant and associate professors and providing our most outstanding senior faculty with compensation sufficient to protect them against market competition from other institutions.

Our plans for the North Campus move were approved by the Executive Officers (initially with our offer of a $2 million loan), and the University had successfully reactivated the state capital outlay process for Engineering Building I (a $30 million project). The plan would succeed in moving all but Electrical and Computer Engineering to the North Campus in 18 months, with this large department then moving into Engineering Building I when it was completed in early 1986.

Although we had been unsuccessful in persuading the Executive Officers to adopt our proposal for the return of sponsored research overhead as a research incentive across the entire University, we did accomplish this for the College as a special case, with a $2 million base increase commitment over two years. We were able to double the number of technical support staff and equipment funds during the first year as well while addressing the needs and concerns of primary research staff. We were able to successfully navigate our engineering program accreditation process, and our development activities were once again up and running.

It is worth noting that the series of budget commitments we were able to achieve during the first year would increase the College's base budget by almost $4.9 million over the next two years, amounting to a 36% increase (during a period in which most University academic units were losing support with the "smaller but better" retrenchment effort). While this did not erase the Engineering Gap (estimated at $7 million), it was an excellent start and demonstrated the very strong support provided by Bill Frye and Harold Shapiro. In fact, when Frye visited the faculty in spring of 1981, I made certain that the faculty realized just how significant his efforts were to rebuild the College during a most difficult time for the University.

Some Early Lessons Learned

Although our leadership team was inexperienced, we were committed, energetic, and willing to learn from each experience...and each mistake. Among the valuable lessons from that first year were the following:

First Get the Commitment from the Top

Our major objective during the first year was establishing the College of Engineering as a high priority of the University. We realized that until this was accomplished, most of the rest of our agenda would simply not be possible. And key in this effort was making the case for the College directly to the top leadership of the University, to Harold Shapiro and Bill Frye. Once we had earned their respect, commitment, and support, the other components of our plan began to fall rapidly into place.

Consistency and Persistence

Like contemporary politicians, we believed it essential to "stay on message." Once we had defined the primary objectives through the early planning process, we were persistent in our efforts to make the case for these objectives. For example, the elimination of the Engineering Gap was stressed in essentially every meeting we had with the provost and his staff. (The term itself eventually became a familiar—and to some dreaded—refrain on State Street.) The effort to go after the return of overhead funds as research incentives was pushed in a similar fashion. The message was always the same, unwavering and relentless.

Speed and Timing Are Everything

Looking back on the year, the pace of our activities seems incredible. For example, the day after I was selected as dean, I began working on a plan for the college, meeting with department chairs, faculty, and

Some of the Many College Planning Documents administrators to seek their advice and council and preparing the first draft within a month, even before I moved into the dean's office. The deans' leadership team, including the associate deans, the Chairmen's Advisory Committee, and key staff appointments, was in place by the end of the next month. The full plan was submitted to the Executive Officers, along with the specific proposals for each of our major objectives, by August. And we were successful in achieving a positive response to each of our proposals and executing the first steps (e.g., special salary program, research incentives, first phases of the North Campus move) by the end of the first year. During this hectic period we also managed to rebuild relationships with industry, launch a major new development program, and deal with a broad array of personnel matters. And along the way, we also built a new robotics research institute for the state (the Industrial technology Institute), worked with General Motors to determine the future of the General Motors Institute, completed a discontinuance review of the Department of Humanities, and successfully completed an ABET accreditation review of all of our academic programs. (And all the while I was keeping earlier commitments to two weeks of lectures in London and three weeks of lectures to the French Atomic Energy Commission in Chartres.)

It was clear from this first year that to take advantage of the opportunities that would enable us to achieve our objectives for the College, we needed to move very rapidly. Timing was everything. Windows of opportunity open and close very rapidly. And as we were soon to learn, the pace and timing of opportunities would become even more critical as we began to enter the political worlds of Lansing and Washington.

Thinking Outside the Box

One of our greatest challenges was learning how to keep the pressure on the central administration (and later the state) without overloading the system. If we asked for too much at once, the system would lock up into indecisiveness. We had to learn how to manage the flow of our requests.

But beyond that, we also learned that sometimes, in order to break a logjam of indecision, we had to think outside of the box. It took a great deal of creativity and ingenuity to keep the decision process moving ahead. For example, when the University was frozen on its decision concerning the North Campus move, we offered to loan them $2 million to get the show on the road. When Harold Shapiro and Bill Frye were unwilling to challenge the vice president for research over our proposal for research incentives, we found a way to accomplish the same objective while avoiding Executive Officer politics.

In addition to creativity, there were also times when we needed to be prepared to push all of our chips into the center of the table. An example here was our special salary program, which completely restructured the College salaries, reestablishing achievement and excellence as the primary determinants of compensation. To double the salaries of assistant and associate professors to the point where they passed the salaries of many less active senior faculty was controversial, particularly when the state's Freedom of Information Law required us to publish all salaries. Depleting our entire discretionary funding capacity to get the North Campus move started was an example of yet another major (but successful) gamble.

We were to encounter many similar situations, requiring both creativity and boldness, in subsequent years. But we had learned our lessons well during this first year of leadership.

The Importance of Teamwork

As I noted earlier, engineers are accustomed to working closely as teams to which each member brings unique talents and skills. Our core team consisted of the deans (JJD, Chuck Vest, Dan Atkins, Scott Fogler, and Hal Harger). Although each of us had particular responsibilities and assignments, we worked together on major strategic issues, trusting one another, backing each other up, and sharing and exchanging roles when necessary. For example, each member of the team developed close relationships with key members of the central administration. I handled the Executive Officers (Harold Shapiro, Bill Frye, Jim Brinkerhoff, and such). Chuck Vest developed close relationships with key staff, including Paul Spradlin (Plant), Allen Spivey, Bob Holbrook, and Bob Sauve (provost), Ralph Nichols and Keith Molin (state relations). Both Dan Atkins and Scott Folger formed the bonds with key people in their areas (research, instruction). Dan also had key relationships with people at the state and federal level, including the Governor and his staff. And Hal Harger had invaluable, longstanding relations with key staff in the business, finance, and plant operations administration. These relationships with staff were critical not only for building support within the central administration, but also allowed us to float trial balloons without risking confrontation or disappointment when the principals met.

Several of the department chairs of the College (Erdogen Gulari, Steve Pollock, William Kuhn, Glenn Knoll, Walton Hancock)

It is also important to note that the concept of teamwork extended far beyond the core deans' team. We regarded both the department chairs and the College Executive Committee as important elements of the extended leadership team of the College. The active involvement of these faculty members in our major initiatives earned their active support and allowed the College to move ahead together.

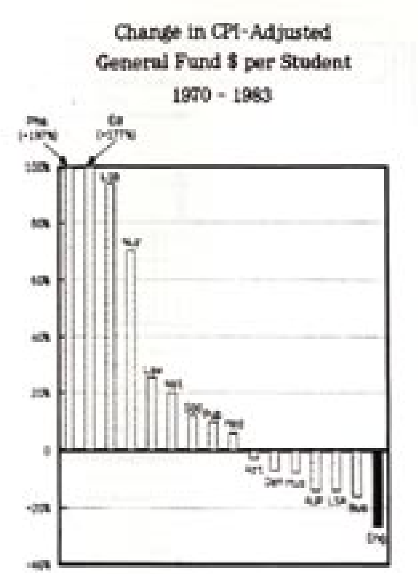
The Importance of Experience

Although our team may have been inexperienced in administration, we did bring to the dean's office extensive experience in working on College-wide and University-wide issues with the president, provost, and other Executive Officers and central administration staff. Not only did this make us a "known quantity" to key decision makers, but we also knew where the real decisions would be made and how to influence them. It seems unlikely that someone coming from outside the University (or with experience only at the College level) could have moved so rapidly to establish Engineering as a University priority.

The New Tools

Since my research in science and engineering had always been heavily dependent upon computers, it was natural that I would bring tools based on information technology into my leadership roles. Immediately after I moved into Mortimer Cooley's old dean's office, I asked to have a word processing terminal installed on my desk. (It was one of the first A. B. Dick systems.) Since I had been an early user of microcomputers, I also brought over an Apple II computer with the first VisiCalc spreadsheet software to use in budget analysis. In fact, when Allen Spivey first shared with us his own hand-calculations of the relative ebb and flow of University support of various academic programs in the 1970s, we immediately began to obtain this information on our own and enter it into VisiCalc and then later Lotus and Excel when the IBM PC appeared.

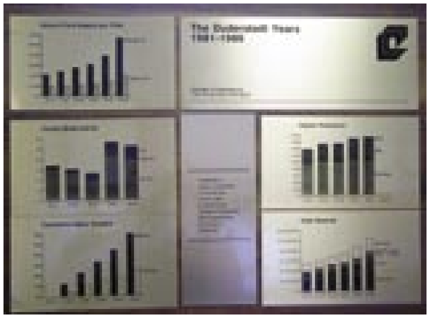
But we really moved into high gear when the deans' office began using the new Lisa computers, which were essentially a commercial version of the powerful Alto computers developed at the Xerox Palo Alto Research Center and capable of very sophisticated graphics, analysis, and desktop publishing. We began to prepare very extensive charts and tables not only documenting the Engineering Gap, but actually developing far more sophisticated databases and analyses of the University budget than were available to the provost and others in the central administration. The Executive Officers soon learned that we knew more about University budgeting that they did and would occasionally turn to us for help. (I might note that we provided the first extensive documentation to Frye that LS&A was also seriously underfunded.)



One of our many charts demonstrating the erosion in base support of the College of Engineering

We gained such a reputation for supporting our efforts with extensive data, charts, and documentation that when I left the dean's office to become provost, the College of Engineering presented me with a large brass plaque containing a number of our key budget charts.

Yet another important tool involved idea processors, such as Thinktank and later MORE. These were akin to outlining software that supported brainstorming and free-flowing discussions. We would frequently use them in group discussions to develop and refine new ideas.



The brass plaque of charts

But certainly the most important tool that rapidly became fundamental to our effort was electronic mail. Since we rapidly equipped all faculty members in the College with personal computers, we were able to communicate instantaneously and effectively using e-mail. In fact, by the time I left the dean's office, we had created a culture within the College in which most informal communications used this technology. I was later to take this technology with me as provost and then as president, thereby driving its rapid use across the entire University.

Where To Next?

We had completed the first year of our plan with incredible success on all fronts: funding, faculty morale, facilities, etc. Most significant of all, we had established the College clearly as one of the highest priorities of the University. Although I was concerned about being too forceful at times in portraying the Engineering Gap and making the case for increased University support, Frye quietly urged me to keep up the attack. He believed that we had every right to chastise both the University administration and even the Regents for the deep cuts experienced by the College during the 1970s. This gave him the ammunition to take supportive actions that would have otherwise been very difficult politically.

Yet I did have my worries. Despite our rapid progress, there were times when I felt we had taken one step forward, only to take two back. The inertia of the University administration and the College were daunting. Furthermore, it seemed that each time we finally managed to plug one hole in the dike of the College, several others would spring a leak. There were just so many things to be done, and they all had to be done immediately (or so it seemed). The amount of trivia flowing through the dean's office was sometimes overwhelming. One of my colleagues complained that sometimes the College behaved as if it were one continuous faculty meeting. We had to take care that in our efforts to swat gnats, we were not distracted from the strategic plan and what was really important.

There were also concerns about internal dynamics of the College. We had been able to take some pretty tough actions (e.g., the special salary program and the discontinuance of Humanities) in part because of the apathy of the faculty; they were simply beaten down. But there was growing recognition throughout the College and the University of just how dangerous we really were, since we not only intended to do precisely what we said we would, but we could actually bring it off. We had raised not only morale but also expectations, and we would lose credibility rapidly if we did not produce.

But I had a more serious concern: Despite the clear commitment of Shapiro and Frye, I was beginning to worry about our continued progress. The deteriorating state economy had led to a series of increasingly painful cuts in our state appropriation that was eroding the University's capacity to respond to our needs. Over the longer term, there was the potential of budget relief as the University's effort to reallocate funds through program reduction and discontinuance freed up new capacity. But in the near term, the University might not be able to do much more.

Hence, I began to suspect that the real key to completing the agenda we had set out for the College would lie in Lansing. We would have to consider going directly to the Governor and the State Legislature for assistance, if we could get permission from Shapiro and Frye for such an effort. I became convinced that we would have to go ourselves, since I was not confident that the University would (or could) make our case for us.

This growing recognition marked a major shift in strategy, away from focusing entirely on efforts to build strong internal University support (although this would still be important) and toward taking our case directly to Lansing. Of course, we realized that the University was a highly political beast, and we had to keep sufficient pressure on State Street to avoid backsliding. But as it would turn out, a direct approach to Lansing would be the second key to the success of the College in the 1980s, since through this new effort we would not only be able to pry loose the state funding for Engineering Building I and the completion of the North Campus move, but we would also achieve the Research Excellence Fund, which would provide an $8.5 million increase in the base budget of the College as a direct appropriation line from state government.

Chapter 6

Mr. Duderstadt and Mr. Vest Go to Lansing

Like many scientists and engineers, I tend to keep track of agendas and progress with "To Do" lists and "Goals Achieved" charts. As we emerged from our first year in the deans' office, I noticed that while the achievement chart rapidly filled with smiley faces, the To Do lists became longer and longer (although most items were rapidly checked off). After several years the items in these lists numbered in the hundreds, a sign that the more we accomplished, the more new objectives were added to the list.

During the first year in the deans' office, we had focused primarily on firmly establishing the College as a priority of the University, restoring adequate support for its programs, and executing a plan that would complete the North Campus move. It was now time to deal with other key issues. Foremost among these would be improving the quality of the faculty. Although we were confident that the quality and morale of our junior faculty were now very high, we believed we needed far more strength among our senior faculty.

We also needed to address the intellectual directions of the College. Of course the detailed nature of the teaching and research programs of the College were determined at the grassroots level by the activities of the faculty. However the major intellectual thrusts of the College, particularly its new initiatives, could be stimulated and shaped by the College administration. We had already demonstrated this through the effort to build programs in robotics and integrated manufacturing. We now needed to focus on other high-priority areas and opportunities.

Finally, although we had made great progress toward restoring adequate support of the College and launching the sequence of actions that would complete the North Campus move, these tasks were far from complete. Backsliding was always a concern. The continuing financial crisis facing the University because of the weakened state economy made it clear that we needed a new strategy if we were to achieve these goals.

Rebuilding the Faculty

As I have noted, one of the most important actions we took during the first year was to implement a special faculty salary program to address market pressures on our most productive and valuable faculty members, particularly at the junior level. We were able to continue these special programs throughout our years in the deans' office. To demonstrate the impact of this effort, it is interesting to compare the differential between the College of Engineering faculty salary increases and those of the University at large during the 1981-1985 period:

Year	81-82	82-83	83-84	84-85
UM	5.5%	5.0%	5.0%	5.0%
Eng	12.0%	9.5%	8.5%	8.5%

Through these salary programs, as well as the growing sense of optimism associated with the new priority given the College by the University, we were able to hold on to our best people. But it was also clear that we needed to build the quality of the faculty through new faculty hires at all levels, but particularly at the senior faculty level.

The first step in this direction was to modify the way in which new faculty positions were allocated to the departments. We sought to decouple the hiring of permanent faculty from the more immediate (and volatile) fluctuations of instructional loads. To this end, we first agreed to fund a fixed percentage of all ongoing, permanent faculty salaries in the various departments (initially at 85%, assuming that faculty members would use sponsored research funds to support the remaining 15% of their appointment). We then allocated one-time dollars to departments for flexible staff based on their instructional loads. Finally we allocated a certain number of new faculty positions each year, responding to department proposals based on programmatic considerations. We consciously avoided any tendency to spread new positions out uniformly among the departments, but rather allocated them to our highest priorities. For example, in our first year with the new system, we allocated 9 of 30 new faculty positions to Electrical and Computer Engineering. (This was one of the very few times I ever saw the energetic chair of the department, George Haddad, at a loss for words. In the past he had always made an impassioned appeal for the new positions needed by his growing department, knowing that he would be given only a small fraction of the positions he requested. When he made his annual appeal to our new team, we responded by immediately granting his full request!)

We also added a new wrinkle: the target of opportunity program. We wanted to provide maximum incentives for the departments to go after the very best people, particularly at the senior faculty level. So each year we would set aside roughly ten positions and allow departments to compete for them based on the quality of the candidate. That is, we allocated ten new positions each year based on absolute quality rather than programmatic need (or instructional load), responding to specific proposals from the departments. We also offered to help the departments with putting together competitive packages to attract these superstars, including laboratory space, graduate assistant support, and even endowed chairs.

Unfortunately, the College had only a handful of endowed chairs at the time, although this was to become our highest fund-raising priority in the years to come. In an effort to stretch these chairs, we developed a new policy in which the income from the endowment would be used to support a discretionary fund for each chair holder (typically $20,000 per year or so) rather than support a portion of their base salary. This not only made the chairs highly attractive to candidates, but it also avoided losing the base funding for the position. We tried to achieve a balance between awarding chairs to current faculty and using them to recruit new faculty. We also tended to favor awarding chairs to "stars on the rise" rather than "Mandarins," that is, senior faculty of great distinction whose contributions were largely behind them.

Although the College had considerable difficulty in attracting outstanding senior faculty during the 1970s, with the new University priority and sense of optimism, our success picked up. Among the senior appointments during this early period were John Hayes, Albert Schultz, Gerry Faeth, Ron Gibala, Pallab Battacharya, Fawwaz Ulaby, Semyon Meerkov, Duncan Steele, Lynn Conway, John Barker, Terry Brockett, Tony England, and Gerard Mourou.

As we intensified both the incentives and expectations for excellence and achievement, it was clear that many faculty members hired in the 1950s and 1960s were no longer competitive. We worked closely with department chairs to address each of these cases, sometimes providing them with the capacity for early retirement, assisting in outplacement, or finding them other positions within the University. Not infrequently the final negotiation would end up on the desk of the dean (me) or associate dean (Chuck Vest).

At the same time, we began a more strategic effort to identify and develop the future leadership of the College. We actually maintained "depth charts" for key academic leadership position such as department chairs and deans. Drawing on our own experience, we tried to encourage faculty with leadership potential to become engaged first in the array of various faculty committees both at the College and University level.

Finally, it is interesting to note that many of the ideas we used to rapidly improve the quality of our faculty were adopted by other academic units across the University and beyond. Some were even taken along by those of us who went on to more senior academic leadership positions, such as the target of opportunity program that would soon become the backbone of the University's minority faculty recruiting program when I became provost. Our philosophy on faculty compensation also propagated across the University, namely that the proper goal was to strive to achieve a salary for each faculty member that was comparable to that received by their colleagues of comparable achievement and reputation at peer institutions. We believed this policy achieved the proper balance between merit and market considerations.

Budget Woes

As we entered the second year in the deans' office, the Michigan economy continued its downward plunge. Although Governor Milliken had been warned that tax revenues would not be sufficient to meet state obligations, he refused to support tax increases and instead began to issue a series of executive order cuts in state appropriations. Since these were issued after the start of the fiscal year, when expenditure commitments had already been made, they were particularly painful to education. Bill Frye was forced to accelerate the Five-Year Plan of reallocation, and all academic units (including Engineering) were warned that there would be no relief.

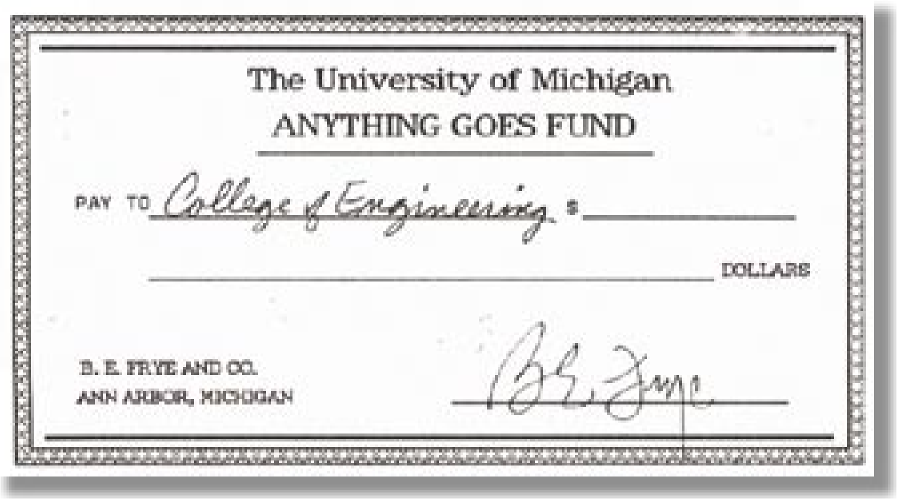
Our total budget cut for the five-year period was $530,604. We had already been given credit for the first 6% cut (that is, we had taken the cut and then been given the funds back), leaving roughly $50,000 cuts over each of the next four years, so this would not be difficult to accommodate. However, far more serious was the degree to which the deteriorating state budget situation would constrain Frye's efforts to provide the College with relief and make further progress in erasing the Engineering Gap.

As I noted earlier, we entered the FY82-83 budget year with commitments from the provost to increase our budget by $1 million for the research incentive program, a salary program growth of $450,000 (for the second year of the special market program), and roughly $510,000 for equipment and technical staff for a total growth of $1,950,000 (+15% growth). For the next year, FY83-84, we sought and achieved a growth of $2,785,000 (+18%), which included $1 million from the computer user fee that we began charging engineering students for the Computer Aided Engineering Network (discussed in the next chapter). We were pleased with this budget growth, particularly during such difficult financial times for the University. But we were also concerned that future growth would become more difficult. And so it was, since in FY84-85, Frye was only able to provide us with a budget growth of $1,700,000 (+ 10%), although we were able to augment this with an additional $1,510,000 from the special computer fee.

Although we believed that Bill Frye and his staff had the capacity to do more, we feared that they did not have the capacity to understand how to do it. Hence we began to explore other ways to make our case for additional support. One of the more interesting approaches was to develop an "all funds" accounting process that balanced the revenue generated by the College (roughly $74 million in the form of tuition, state appropriation, research grants, and gifts) against the University expenditures for our activities ($58 million). We made the case that we had become, in effect, a "profit center", generating roughly $16 million each year for the University. We attempted to make the case for the return of some of this "profit" back to the College to eliminate the Engineering Gap.

A second approach was effectively to walk the University out on a limb by taking a very calculated and deliberate gamble to maintain the pace of our staffing and facilities programs by expending our entire discretionary capacity at year-end to close the books. This demonstrated to the central administration both that we would continue to behave in a financially responsible fashion with no overruns or deficits, and at the same time, that we were not kidding when we said we were willing to bet the ranch to keep our momentum going.

Although these pressures persuaded Bill Frye that we were still far short of where we needed to be in erasing the Engineering Gap, he preferred to maintain a "positive ambiguity" rather than commit to an inadequate number. Fortunately, he (and we) also had a good sense of humor, when on one of our many forays to State Street, he presented us with a blank check:



More significantly, he and Harold Shapiro finally were willing to let us go directly to Lansing to see if we could pry loose special state support to meet our needs.

Engineering Building I: Chuck and Jim Go To Lansing

Our first adventure into state politics occurred in 1982, during the depths of the Michigan recession, when Harold Shapiro agreed to let Chuck Vest and me go to Lansing in an attempt to gain support for Engineering Building I (EBI). Since the University had already expended most of its political capital in the effort to obtain the $180 million for the Replacement Hospital Project, state funding of the $30 EBI project seemed like a long shot. Shapiro felt there was nothing to lose by letting us try. To make certain we did not get into any trouble, Dick Kennedy assigned a long-time Lansing political pro, Keith Molin, to accompany us and show us the ropes.

We began what would become increasingly frequent and regular trips to Lansing, to meet key members of the Legislature and the Governor's office, and their staffs. The objective was to reactivate the capital outlay process for EBI and then to maintain its progress through the complex political process leading to authorization and appropriation for an actual construction start. Shortly after we began to travel to Lansing with Molin, Ralph Nichols brought us a glimmer of hope: the project had actually appeared on the list of capital outlay projects to be considered during the last year of the Milliken administration.

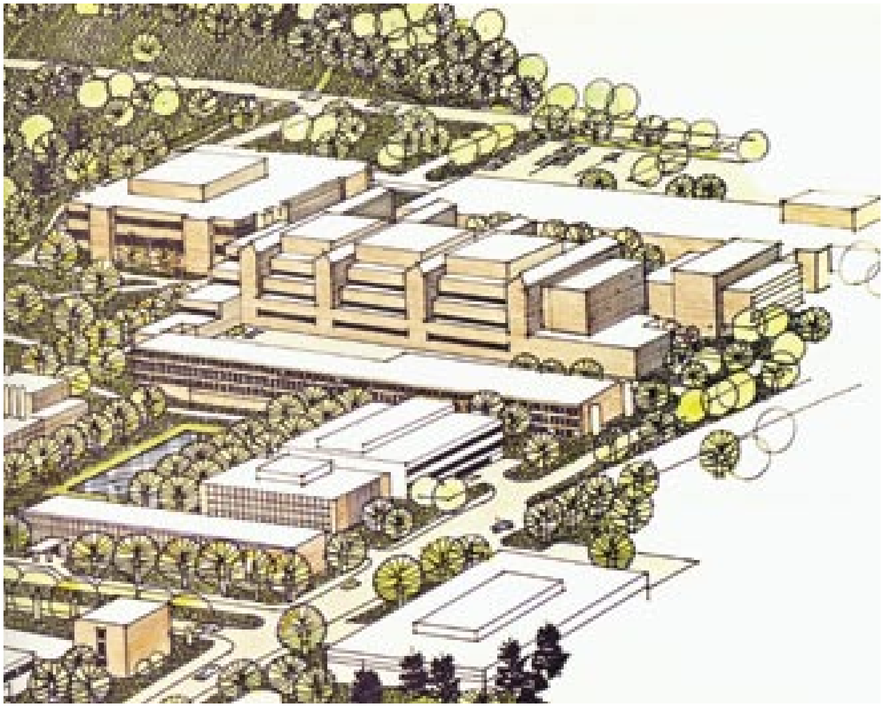
It was quite a learning experience, preparing us well for later efforts in both Lansing and Washington. Many of our meetings involved formal briefings of key legislators and staff. At other times we would lie in wait near the doors to the legislative chambers, along with dozens of other lobbyists, and simply try to catch members with a brief word. In some cases, we worked at a social level, such as the night Chuck, Keith, and I spent with three senior members of the Joint Capital Outlay Committee drinking together late into the evening at a bar in East Lansing. Whatever it took.

We also learned well the old boxing adage: "Train hard, fight easy!", since each time we were called to testify before one key committee or another, we would work for days on the presentation, only to find when we arrived at the hearing that our testimony would not be necessary after all. Yet another lesson: Sometimes not having to testify can be the most positive sign of all that the political process has been sufficiently well greased that a project will slide through without comment.

Fortunately, we were able to get to key members of the new Blanchard administration and convince them that EBI could be a critical element of their economic development plan, which was based heavily on technology. In Governor Blanchard's first capital outlay request, EBI was given the highest priority. Furthermore, Blanchard moved quickly to pass an increase in the state income tax to stabilize the budget, thereby providing funds for capital outlay projects such as ours to move ahead (although the tax increase eventually resulted in the recall of two legislators). We learned how important it was to hit critical decision points at just the right time. It was also important to avoid any actions that might require an unnecessary trip back for another approval by the Joint Capital Outlay Committee. An example here was the site of the project. Although we were going after a building considerably larger than that first proposed for Engineering Building I in the original four-building plan of the 1970s, we kept it on precisely the same site footprint to avoid any need for reconsideration by JCOC. Although EBI today (now called the Electrical Engineering and Computer Science building) looks a bit cramped between two adjacent buildings, it was built on schedule and to specifications, and that was the key objective.

The final goal was achieved in June of 1983, when the EBI project received the final construction start authorization from the Legislature. Governor Blanchard flew in by helicopter to turn the first shovel of dirt at the construction start ceremony,

Engineering Building I site design



Artist's conception of Engineering Building I

and the bulldozers quickly converged on the site. The final piece of the North Campus move puzzle was now in place!

The Research Excellence Fund

Our experience in Lansing would serve us well in yet another adventure in state politics that was to prove even more important for the future of the College: the Research Excellence Fund. Harold Shapiro had been sufficiently impressed with our ability to persuade Lansing to fund Engineering Building I

Harold Shapiro, Governor James Blanchard, and the Dean break ground for EBI

that he agreed to let us continue our efforts to make our case to the new Blanchard administration for more funding for the College. Bill Frye was a bit more reluctant to turn us loose, since he was worried that any success we might have in Lansing would come out of the general state appropriation to the University. But Shapiro convinced him to let us try, and off we went again.

Actually, I was already a frequent visitor to Lansing on a similar mission: an effort launched by the Michigan Society of Professional Engineers to seek a special appropriation for equipment at Michigan's colleges of engineering. John Selby, CEO of Consumers Power and chair of MSPE, and I spent many days traveling about the state (in John's company plane), meeting with CEOs and legislators, in an effort to enlist their support for a major "Engineering Excellence Fund" that would provide $10 million a year for equipping the state's engineering colleges. We participated in several legislative hearings along with representatives from industry, and while we would always get a warm reception along with assurances from key legislative leaders that they supported the effort, the money never came through. But this effort was not wasted, since many of the arguments and contacts would become useful as the new Blanchard administration came to Lansing.

We had also been involved in conversations with a number of members of the Blanchard team even before he was elected, as they tried to understand better the needs of the state and develop their strategy for the first term. Shortly after Blanchard moved into the state house, two major task forces were launched, one concerning the economic future of the state chaired by Doug Ross (who would become the director of the state Department of Commerce), and one concerning the future of higher education in Michigan, chaired by Philip Power (son of former University Regent Eugene Power and husband of then Regent Sarah Power). We worked closely with both committees to see if we could position the College of Engineering as a component of both strategies.

Chuck, Dan, and I began to develop close relationships with the Blanchard team (particularly Doug Ross, Pete Plasterik, Ralph Gerson, Jamie Kenworthy, Peter Eckstein, Pete Walters, and Bob Naftely). Dan worked closely with Blanchard in an effort to go after the Semiconductor Research Institute (which eventually ended up in Austin). Chuck and I met frequently with Kenworthy, Plaskterik, and Power as they developed the high-tech elements of the broader strategy of economic development designed to create jobs. Through these discussions we managed to get specific mention of the College in the strategic plan developed by Doug Ross: "Michigan must invest heavily in centers of applied research, with special emphasis on developing the University of Michigan's College of Engineering as a world leader in this field." Furthermore, Philip Power managed to get specific mention of the concept of a "research excellence fund," in which the state would invest in centers of excellence within its research universities.

As this momentum began to build, we touched bases again with Shapiro, both to make certain he still supported the effort and to ask for his specific help in keeping this issue before Blanchard. We also asked for the help of Dick Kennedy and his team to help with the effort both to get the Research Excellence Fund established as an element of the Governor's strategy, and to win legislative support for the concept. Our code name for this effort was the "MIT of the Midwest" plan, with a target of achieving a special state appropriation in our base of roughly $8 to $9 million through the Research Excellence Fund mechanism.

Working on the new governor

As the planning for the Research Excellence Fund began to take shape, it was finally announced as a $25 million initiative that would channel funds for research centers of excellence to the state's four research universities, with $11.25 million coming to the University of Michigan. Of this amount, $8.5 million would be earmarked for the College of Engineering; $2.25 million for molecular genetics; and $0.5 million for the LS&A component of the new applied physics program. Since we would eventually have to submit specific requests for our $8.5 million share, we proposed at an early stage that these funds would be used to support our Center for Research on

Integrated Manufacturing (CRIM), a new Center for Machine Intelligence, and a Center for Advanced Electronics and Optics Technology (which would fund much of the equipment and staffing required for the solid state electronics laboratory planned as the centerpiece for Engineering Building I). As we began to work the concept through the state legislature, it became apparent that roughly $3 million would have to be added to buy off the smaller state universities. We worked hard to build awareness and support for the Research Excellence Fund among our friends in industry as well as in labor (through contacts I had developed with the UAW with Philip Power's help). Similarly, we contacted members of the University's Regents to make certain they understood and supported the effort.

Everything seemed all set for approval by the legislature in spring, 1985. But then in the typical midnight massacre that happens in state politics, when the bill finally came out of the Senate-House conference committee, it had been cut to shreds, and the University ended up with only $6.6 million, designated for the College. Both the speaker of the house (Gary Owen) and the state budget director (Bob Naftely) pledged to go after the additional funding in a supplemental appropriation, but we knew we would actually have two battles on our hands: first to continue to work to make certain that the supplemental appropriation restored the full $8.5 million for the College, and next a battle within the University to keep Bill Frye from caving into pressure to divert the $6.6 million to other University needs. Here it is important to understand that the University's constitutional autonomy technically gives it authority to override legislative intent in an appropriation (although at the risk of alienating Lansing). We fought hard on both fronts, and with the strong support of the Governor, put considerable pressure on the University to carry out the original intent of the Research Excellence Fund (with Shapiro's support, although with considerable reluctance on Frye's part). Frye eventually announced at a meeting of the deans that the University intended to follow the intent of the Legislature by allocating the full $6.6 million (and the supplemental appropriation, if it was approved) to the College of Engineering, although he was not pleased by such targeted state support.

The supplemental appropriation came through in late 1985, boosting our share to $8.5 million (plus $0.5 million for applied physics, which was 50% a College program). Shortly thereafter, Bob Naftely announced that he was wiring the Research Excellence Fund into the future base budgets of the research universities so that it would not suffer from political mischief each budget cycle. Of course we still had to go through a proposal submission process for our three centers, but this was only a formality. The $8.5 million was already in our base.

It is likely that had I remained as Dean of Engineering, I would have had to fight the battle again and again each year to keep the University from dispersing to other units the $8.5 million allocated through the Research Excellence Fund to the College. After all, the provost could have simply allowed us to keep the $8.5 million, and then reduced our budget in other areas. However, once again fate seemed to take care of the College, because by the time the next budget cycle was underway, I had succeeded Bill Frye as provost. Both I and Chuck Vest (who succeeded me as provost when I became president) made certain that the $8.5 million was locked firmly into the base of the College for the future, where it remains today (although no longer identified as the research excellence fund).

Although we fought and won many battles during the early 1980s, this was a particularly important victory. With this $8.5 million increase (actually, $9.1 million with applied physics), we not only erased the Engineering Gap. We obliterated it! Over a four-year period, we had managed to increase the College's base support from the University from $13.2 million to $34 million per year—almost tripling it—while raising almost $70 million in University, state, and private contributions to complete the move to the North Campus.

It is important to understand that while the $8.5 million from the Research Excellence Fund was initially targeted to support our programs in automation, manufacturing, electronics, and optics, in reality these funds were quite flexible (particularly in subsequent years when we managed to get the Research Excellence Fund designation removed from this component of our appropriation). This budget line would increase each year with the state appropriation. I believed the flexibility of these funds was very important and urged my successors that the Research Excellence Fund budget line continue to be used as "venture capital" by the College to support new initiatives, rather than committed to the base support of ongoing activities such as faculty salaries. Unfortunately, in later years, the fund was gradually shifted to just such base support, thereby losing the advantages of its extraordinary flexibility and instead funding growth of the College. Nevertheless, the College still benefited very greatly through the significant growth in its base support.

Two final comments are in order. Although the Research Excellence Fund had a specific purpose to fund differentially the activities of the state's research universities, the political process eventually took over and leveled this temporary increase out so that it disappeared into the higher education appropriation base. Although the College of Engineering benefited greatly, there was no additional benefit for the rest of the University. After a few years, the University of Michigan's share of the state appropriation fell back to its historical level of 24% of each state higher education dollar. Second, although Blanchard had been a real champion of the College in the funding of Engineering Building I and the Research Excellence Fund, these would be among the last of his positive higher education initiatives. In his later years as Governor, he would learn from polling that he could get far more votes by holding down tuition levels than adequately funding the state's public colleges and universities. In fact, even as the Research Excellence Fund completed its final stages of approval, Blanchard was already signaling to the state's universities that he would hold hostage their capital projects unless they froze their tuitions (a difficult thing to do during a time of sub-inflationary state appropriations).

On to Washington

A disappointment during the first years of our new deans' team was the lack of success in efforts to win major competitions for federal research centers. We first tried to win one of the NSF Centers in Computing Research or a Material Research Laboratories, without success. When the NSF Engineering Research Center program was announced, with an emphasis on manufacturing, we thought we were well positioned to win, but again we fell short. Finally, we submitted a proposal that was ranked near the top for a national supercomputer center, but we eventually lost the political end game that generally accompanies such competition. Not to say we didn't win other major efforts, including an Air Force Center of Excellence in Manufacturing Technology and a Science and Technology Center in Ultrafast Optics. But our win-loss record was not good during these first years.

In part we realized that this reflected both a weakness in the strength of our senior faculty as well as the College's ability to form faculty into interdisciplinary teams to go after these very large grants. We were able to overcome some of this by recruiting superstars at the senior level (such as Gerard Mourou who won the NSF STC in Ultrafast Optics). But there was another problem. We simply did not have the clout in Washington that we needed to be competitive in these national competitions. Neither the vice president for research nor the University's federal relations team were very helpful on these efforts.

Therefore I accepted the responsibility to build the University's presence in Washington. Dan Atkins was a neighbor of Bob Teeter, a senior advisor to the Reagan administration, and through his efforts, I was appointed by the President to serve on the National Science Board. This body served not only as the board of directors for the National Science Foundation, but it also was the nation's primary source of independent advice on scientific matters. Its members included many distinguished scientists and leaders of industry and higher education. They were each appointed by the President and confirmed by the Senate to serve six-year terms. I was eventually to serve 12 years on the National Science Board, chairing it for three years during my second term.

Being sworn in as a member of the National Science Board by Roland Schmitt

Through the National Science Board, I was quickly able to develop both key insight and relationships with the federal government. Although I always took great care to avoid conflict of interest, my rapidly growing knowledge and experience in federal affairs, as well as my contacts, were to prove invaluable to the College (just as they were later to the University, when as provost and president Michigan rose to a position as the nation's leading university in research activity).

A Few Remaining Doubts in Midstream

By almost any measure, we should have been very satisfied with our progress toward our original objectives by the mid-1980s. The North Campus move was essentially finished, with only the completion of construction of Engineering Building I remaining (scheduled for early 1986). We had gone far beyond our original goal of eliminating the Engineering Gap and managed to triple the University support in just four years. Our faculty was improving rapidly, as evidenced by both the quality of our junior faculty and the growing number of outstanding hires we were making at the senior level. The College was moving into exciting new areas and beginning to compete more effectively for major national centers and projects.

Yet we were still uneasy. During the first year we had been worried about throwing too many balls in the air at one time. However as the College regained its strength and capacity, we began to worry about our ability to generate initiatives and pursue opportunities. We sensed a notable absence of vision, creativity, and innovation throughout much of the college. Much of this was probably due to the "impacted wisdom group" among our senior faculty, worn down and apathetic after years of inadequate support. There was also considerable resistance, particularly within some of the large departments, to building the teams necessary to go after major interdisciplinary projects. Our earlier experiences with the ERC, supercomputer, and CER proposals revealed the limited bench strength in the College.

I was also worried about putting too many of our eggs in one basket. We had made major commitments to the Center for Research on Integrated Manufacturing and were about to make even larger bets on the solid state electronics laboratory. Yet, if these failed, we could do considerable damage to the College's credibility in future years (particularly since we had gone after a major state initiative in the Research Excellence Fund to support these efforts). We needed to diversify our initiatives and investments, but to do that we needed more leadership horsepower among the faculty.

Finally, although we had been extremely successful in making the case for the College and keeping the pressure on the University's Executive Officers to support our initiatives, I began to worry about our very success. My paranoia suggested a theorem that states, "When you always get what you ask for, you should always be asking for more!"

Chapter 7

Moving into High Gear

Although the rapid pace we had set during the first two years in the deans' office did not slow, we became more adept at managing the unusual number of opportunities that arose from our earlier success. The "To Do" lists continued to grow in length (typically numbering 100 or more items), but then so too did the completion lists of goals we had achieved. There were some changes. Scott Fogler left to return to the position of chairman of his Department of Chemical Engineering. Lynn Conway arrived from California as a new associate dean in charge of new initiatives, with a particular emphasis on areas such as artificial intelligence and advanced microelectronics design. Walt Hancock joined us to help guide our rapidly growing activities in manufacturing science and engineering.

My own activities became even more complex because of my new responsibilities on the National Science Board (NSB). This body met in Washington for two to three days every two months. In addition, there were numerous committees of the NSB that met more frequently. I was assigned the role as chair of one of the major standing committees concerned with NSF's Education and Human Resources programs and served on several others concerning issues ranging from undergraduate education to technology export controls to the future of the NSF supercomputer program. Although the time commitments were considerable, the opportunities to learn more about the federal research environment and meet the key players proved invaluable.

We had made considerable progress on our original plan, but we were determined to remain focused on our key goals of rebuilding the faculty, restoring adequate support for the College, and completing the North Campus move. As I have discussed in the previous chapter, these efforts were well underway by mid-way through my term as dean and would soon be completed. But there were many other projects, including building a modern computing environment for the College, stimulating new intellectual thrusts capable of attracting significant external funding, putting into place new policies for intellectual property development and technology transfer, developing important partnerships with other programs in the University, and, of course, fighting the inevitable battles against the political forces that thwart change in large organizations such as universities.

The Computer Aided Engineering Network

The College faced a very major challenge in building a modern computing environment for its students, faculty, and programs. Part of the problem was developing an appropriate vision for a state-of-the-art system and then financing it. But we also faced a challenge because of the very success of the University-wide Michigan Terminal System (MTS). Developed with IBM in the 1960s, this had long been one of the nation's leading time-sharing systems. Yet it was an inhouse system, adopted by few other universities, and during the 1970s it rapidly lost ground to the new generation of minicomputers such as DEC's VAX systems for science and engineering applications. By the end of the 1970s, most engineering and science departments at top research universities had acquired their own VAX systems. Yet, Michigan remained not only moored to the increasingly aging mainframe-based MTS system, but also to centrally administrated computer policies that prevented academic programs from breaking away and acquiring more advanced computing environments. In fact, every purchase of a computer had to be approved by a central committee at the University.

The Michigan Terminal System (MTS) Computer System

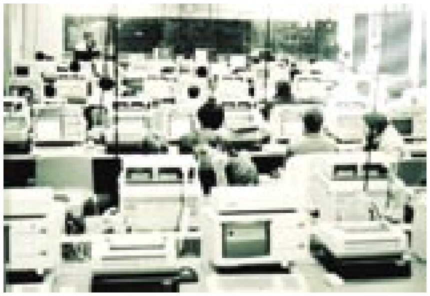
This was a topic of personal interest, since my own career had largely paralleled that of the digital computer. My particular area of research, nuclear energy systems (nuclear reactors, nuclear rockets, thermonuclear fusion), was not only heavily dependent upon state-of-the-art computing, but it had actually driven much of computer development. During the 1960s and 1970s I had done much of my work using Atomic Energy Commission supercomputers at AEC laboratories such as Los Alamos and Livermore. Although my research made use of the very fastest computers in the world, several of our faculty members (including Dick Phillips and Bill Powers of Aerospace Engineering) got me interested in the use of the first microcomputers such as the TRS-80 and Apple II for instructional purposes. In fact, I taught one of the very first introductory computer courses on these systems in the late 1970s. From these experiences, I was convinced that the College simply had to break away from the University's MTS system and build its own computing environment, more suited to its needs. I was convinced that the digital computer would rapidly evolve from simply a tool for scientific computation and information processing into an information technology infrastructure absolutely essential to all of our activities, from research to instruction to administration. Hence, to build a leading engineering college, we would have to become a leader in information technology. This view was shared by many members of the College.

Dan Atkins assumed the leadership for this effort, assisted by Dick Phillips, Lynn Conway and other members of the faculty. We set a rather ambitious goal: To build the most sophisticated information technology environment of any engineering college in the nation, an environment that would continually push the limits of what could be delivered in terms of power, ease of use, and reliability to our students, faculty, and staff. The system was called CAEN, the Computer Aided Engineering Network, a name that reflected its functional architecture as a sophisticated information technology network integrating the Colleges' instruction, research, and administrative activities together with both oncampus users (students, faculty, staff) and off-campus participants (industry, government, alumni). More technically, CAEN was envisioned as a distributed intelligence, hierarchical computing system linking personal computer workstations, superminicomputers, mainframe computers, function-specific machines (CAD/CAM, simulation) and gateway machines to national networks and facilities such as supercomputer centers. The network was designed to support not only general scientific computing, but computer-aided instruction, administrative services, and access to technical and bibliographic databases.

We first had to fight a battle on State Street to allow us to break away from the University MTS system. Not surprisingly, this involved many of our old foes in the kingdom of the vice president for research, since they ran campus computing at that time. Fortunately it was easy to convince Harold Shapiro and Bill Frye that they needed to encourage more diversity in computing, and in particular, allow some units to move far out on the curve of advanced computing as pathfinders for the rest of the University. Engineering and Business Administration were given the go-ahead to build their own environments (which would eventually lead to the disappearance of MTS, although it would take almost a decade).

I have already mentioned some of our early steps to build CAEN. We first provided every member of the faculty with a personal computer (a choice of either an IBM PC or an Apple II computer). We next began to acquire several networked clusters of state-of-the-art computer workstations for research (Apollo, Sun, HP, Apple Lisas, Silicon Graphics). We faced a very major challenge in providing adequate computing resources for our students, since our large enrollments (6,000) would require a massive investment. To address this, we took two very important steps: First, as I mentioned in the previous chapter, we persuaded the University to allow us to charge students a special $100 per term computer user fee to help support their computing environment.

This generated $1.5 million each year that we then could use to buy (or even debt-finance) computer equipment. We made absolutely certain that every penny of these fees (along with significant contributions from the College) went entirely to equip numerous student computing clusters around the College that would be restricted solely for the use of engineering students. To provide a vivid demonstration of just what the students were getting for their fees, we converted two large lecture rooms on the first floor of the Chrysler Center into a gigantic computer cluster, equipped with over 100 of the new Apple Lisa workstations. This was quite a sight—probably the largest collection of Apple Lisas that ever existed—and it really impressed the students.[1] We adopted the philosophy that these were the students' computers, without any constraints on how they could use them. Similar computer clusters were built around the College.[2]



The Apple Lisa Lab in the Chrysler Center

The second element of our plan for students involved developing a mechanism to help them purchase their own personal computers, since we realized that the College would never have sufficient assets to equip all 6,000 students. We explored the possibility of negotiating very deep discounts (60% or more off list price) with key vendors such as Apple and IBM. They were quite willing to do this, but the principal hangup was with the University, nervous that the local computer stores might complain to the state legislature that we were undercutting their business. After considerable effort, we finally managed to convince Shapiro and Brinkerhoff that the leading universities would be achieving massive deployment of personal computers to students through such bulk discounts, and that Michigan would rapidly fall behind if we did not do the same. Since I suspected that the impact on local retailers would be very positive from the secondary hardware and software sales stimulated by the student program, we negotiated a separate agreement with them to sell their wares when the students picked up their computers through the University. Since the first major deliveries occurred early in the fall, we began to call these events the Fall Computer Kickoff Sale. It was quite a hit with the students, particularly when new systems such as the Macintosh appeared. The number of University students acquiring their own computers began to rise rapidly, stimulating both the College and the University to install appropriate networking capability in the residence halls and University buildings. (The Fall Computer Kickoff Sales continue to this day.)

The final step in bringing CAEN to the level of sophistication we had envisioned was made possible by a $2 million gift from General Motors that allowed us to acquire over 350 high-end computer workstations, connected with high speed networks, to serve the advanced needs of students and faculty. Our philosophy was simple: We were determined to stay always at the cutting edge, but with a very strong service focus. We sought to remove all constraints on computing, with no limit whatsoever on student and faculty use. We went with a multivendor environment, moving with whatever technology was most powerful.

Needless to say, these were highly controversial issues in the early 1980s, particularly at the University of Michigan. But as a result, by the mid-1980s the College could boast one of the most sophisticated computing environments of any University in the world, a fact of major importance to recruiting outstanding faculty and students.

The launch of the Computer Aided Engineering Network (with Bill Poduska of Apollo Computers and Steve Jobs of Apple Computer)

Completion of the North Campus Move

As we discussed in the previous chapter, all of the key steps necessary to complete the long-sought (and endured) move of the College to the North Campus were in place by mid-1983. We needed only to finish the construction of the massive Engineering Building I (now the Electrical Engineering and Computer Science Building), and this would occur in spring of 1996.[3]

Of course, although the move of all of our faculty, students, and programs was complete, there was still more to do to improve the quality of the North Campus environment. We invested heavily in building an instructional center (library, computer center, instructional television) in the unfinished basement of the Dow Building (with only a minor setback when the underground facility for the HVAC equipment collapsed from faulty materials and design midway through the project). Chuck Vest pushed for more student facilities, including a small vending/study area next to the EECS Building (we all called it Chuck's Bar and Grill although it was later named as a memorial to one of our young faculty, Jonathan Laitone, who was lost in a climbing accident on Mt. Ranier my first year as dean). A connector laboratory was built between the Dow and G.G. Brown Laboratories for bioengineering, a major addition was built for the North Campus Commons (later named the Pierpont Commons), and the Space Physics Research Laboratory was doubled and then tripled in size.

The Dow-GGBL Connector

The new EECS building

Lurie Engineering Center

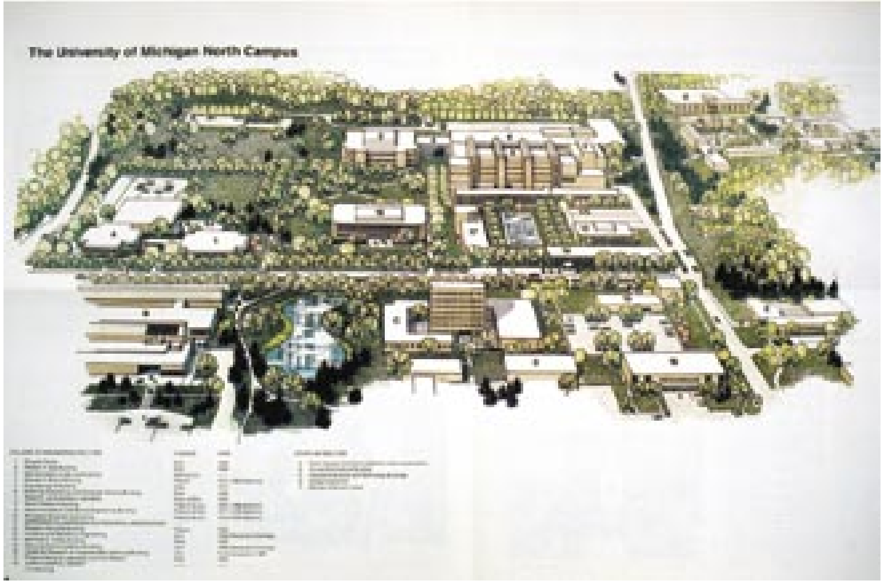
The Media Union

Chuck Vest (as Dean) dedicating the new Space Physics Research Laboratory addition

There were several major additions to the North Campus in the years after I left as dean, including the FXB Building for Aerospace Engineering, the Lurie Engineering Building and Bell Tower, and the Media Union.

Françios-Xavier Bagnoud Aerospace Building

Since I had a hand in all of these projects (rather, an invisible hand, since I was provost and then president at the time), I'll return to discuss these in a later chapter. Finally, in my last years as president, I commissioned a major new master plan for the North Campus (the so-called "North Woods" project), designed to add much of the human experience of the Central Campus. Unfortunately my successor in the presidency, Lee Bollinger, decided to halt these projects and largely ignored the further needs of the North Campus, but that is a story for Chapter 8.



The completed North Campus (circa 1986)

The "new" West Hall (no longer the home of Engineering)

Intellectual Thrusts

With much of the effort to restore the support, environment, and morale of the College now underway, we had the luxury to begin to think more deeply about its intellectual thrusts in teaching and research. My own thinking had been heavily influenced both by discussions with thought leaders like Carver Mead of Caltech and Lynn Conway of Xerox PARC (later to join Michigan as an associate dean) and writings of science philosophers such as Thomas Kuhn. Some background on these evolving ideas is useful here.

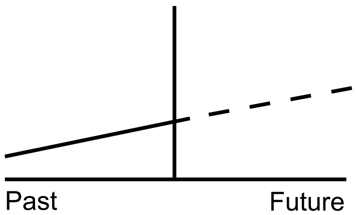
It is important to recognize the dynamic nature of that intellectual character of scholarship. What we regard as entrenched disciplines have changed considerably in the past and continue to do so today. During our lives we have experienced a period of great intellectual change and ferment. New ideas and concepts are exploding forth at ever-increasing rates. We have ceased to accept that there is any coherent or unique form of wisdom that serves as the basis for new knowledge. We have simply seen too many instances in which a new concept has blown apart our traditional views of the field. For example, in my own area of physics, Einstein's theory of relativity and the introduction of quantum mechanics totally revolutionized the way that we thought of the physical world. The molecular foundations of life have done the same to the biomedical sciences. We are increasingly surrounded by radical critiques of fundamental premises and scholarship, collisions between different cultures and perspectives.

Hence the capacity for intellectual change and renewal has become increasingly important to us as individuals and to our institutions. As the pace of new knowledge accelerates, it seems apparent that we are entering a period in which permanence and stability have become less valued than flexibility and creativity, in which the only certainty will be the presence of continual change. The capacity to relish, stimulate, and manage change will be one of the most important abilities of all.

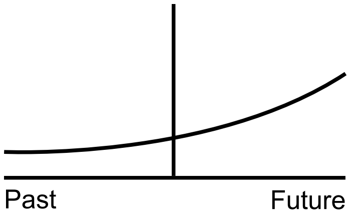
But here we face a major challenge because most of us have been trained to think in terms of change as a linear, causal, and rational process. We have been taught that by looking at the past, we can extrapolate into the future. Yet, because of my background as a physicist, I have become increasingly convinced that the change in most complex systems, organizations, or indeed, even fields of knowledge, is: i) highly non-linear, ii) frequently discontinuous, and iii) usually stochastic or random in nature. Let me expand on this theme for a moment.

Intellectual Change

Most of us have been trained to think in terms of the change process as linear. In a sense, we have been taught that by looking back to the past, we can simply extrapolate linearly to predict the future.

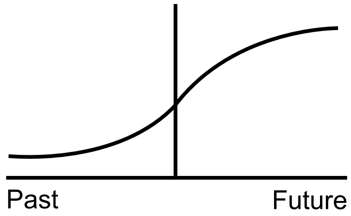


Of course, the scientist has a much different view of change, a view that in many ways in much more disturbing. The scientist notes that most change in our natural world does not occur linearly with time but rather exponentially at ever-increasing rates.



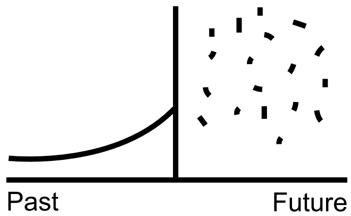
From this view, the challenges that face us, challenges such as the growth in the world's population, or the consumption of our natural resources, or the pollution of our planet, are growing ever more serious at exponential rates. Fortunately, the same is true of the growth in knowledge, since the rate of change in our reservoir of understanding and insight is proportional to the amount of understanding and insight we already have, the basic exponential condition. However, since we are attempting to apply an exponentially growing knowledge base to exponentially growing problems, any imbalance could lead to catastrophe, since we would be overtaken before we could learn how to cope with the problem.

Enter the economist who says not to worry. Sooner or later every exponential phenomenon eventually reaches a limit, a saturation, as the law of diminishing returns sets in. Sooner or later we run out of necessary resources to sustain exponential growth, and the process of change slows to a halt.



The bacterial colony on the petri dish runs out of nutrient. The world population will run out of land surface—although perhaps this will not occur until the year 2500 when there are forty trillion people on the face of the earth with only one square yard per person!

Ah, but we have learned in recent years that the world really doesn't work like this either! Instead, we have learned that even the simplest systems in nature tend to behave in a far more complex and unpredictable fashion. They follow a change process known in today's popular lexicon as "chaos." While the early stages of change are linear, exponential, or perhaps even saturating, at later stages change frequently occurs in a far more dramatic and unpredictable way.



In this view of the world, systems become unstable and undergo dramatic and often chaotic change to create new levels of order and complexity. Here we need only witness the complex evolution of clouds in the sky or the complexity of flowing water or the extraordinary complexity and diversity of living creatures.

To put it in a somewhat different perspective, we now know that most complex systems that may at first appear to be stable and unchanging are, in reality, comprised of components that are continually fluctuating or changing. In these systems a situation sometimes occurs in which a single fluctuation becomes so large, as a result of feedback and non-linearities, that it shatters the stability of the system. At this singular point, called in the language of physics a bifurcation point, it becomes quite impossible to predict in advance which direction change will take—whether the system will disintegrate into a highly disordered or chaotic state or leap to a new higher level of order or organization.

Of course, such bifurcation instabilities cannot be triggered by just any old fluctuation, but only by those that are particularly "dangerous" — those that can exploit to their advantage the nonlinear relations that can trigger the instability of the existing state. The more complex the system is, the more numerous are the types of fluctuations that can threaten instability.

There are several particular features of this modern view of change that have major implications for the world in which we live. First, from this modern view, change is not simple and gradual. It is not linear. Rather, it is characterized by nonlinearities that lead to complex behavior, frequently to dramatic rather than gradual change, to revolution rather than evolution.

But that's not all. Change is also not predictable and deterministic, but rather random and stochastic in nature. The real world works in sharp contrast to the deterministic views of classical science of Newton or such modern determinists as Freud or Marx or Skinner. That is the bad news.

Now for the good news! Chaotic change depends far more sensitively on small disturbances than we had ever thought possible. This is in sharp contrast to the basic idea in western science that you don't have to take into account the falling of a leaf on some planet in another galaxy when you are trying to account for the motion of a billiard ball on a pool table on earth. Usually, we neglect very small influences. There is a convergence in the way things work, and arbitrarily small influences don't blow up to have arbitrarily large effects. The situation is quite the opposite in chaotic systems. These behave in what mathematicians would refer to as an "ill-posed" manner. But the popular press has a far more picturesque term, known as the "butterfly effect," which arises from the suggestion that even the disturbance in the air caused by a butterfly's wings could cause major changes in weather half-way around the globe because of the chaotic nature of weather patterns.

Translated into more human terms, dramatic change is frequently triggered by a few extraordinary people with extraordinary ideas—or by the young or newly initiated—people who haven't had the time yet to become trapped in the same ruts as the more experienced of us.

If we take the viewpoint that most organizations—or even most fields of knowledge—are examples of such complex systems, then this view of change is remarkably similar to that in the philosopher Thomas Kuhn's thesis concerning the way that scientific knowledge evolves[4]. In essence, it says that a single individual, or idea, can create dramatic change, a revolution, if you will, in the traditional way that we look at a field. Kuhn uses the term "paradigm" to refer to the body of knowledge, in essence the way that one is accustomed to look at a field, the accepted practices or perspectives. In a sense then, a paradigm is what the members of a community of scholars share; and conversely, a scholarly community consists of people who share the same paradigm. One must take care here, however, because in contrast with the standard usage, a knowledge paradigm is not really a model for application; rather it is a subject for further study and articulation. In this sense, then, most research consists not of seeking major novelties, but rather polishing up existing paradigms, essentially mopping up, or "sweating the details."

In Kuhn's view, major progress does not occur through the gradual evolution of an existing paradigm, but rather through a revolutionary process in which an existing paradigm is replaced by an entirely new paradigm. The transformations of paradigms are revolutionary in nature, and the successive transition from one paradigm to another via revolution is the usual developmental pattern of a mature field of knowledge.

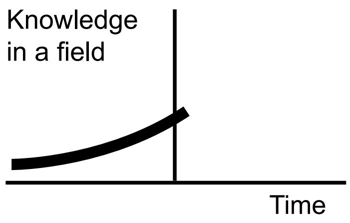
Kuhn also observes that those who achieve the fundamental invention of a new paradigm are usually either very young or very new to the field whose paradigm they change. These are the individuals, who, being little committed by prior practice to the traditional rules of the discipline, are particularly likely to see that those rules no longer define a playable game and conceive another set that can replace them. They can make contributions of unusual importance since they haven't had the time yet to fall into the same old ruts that have trapped more experienced scholars.

In summary then, the Kuhnian view of intellectual change, in which one knowledge paradigm is replaced through revolution by another knowledge paradigm, is remarkably similar to the nonlinear evolution of complex systems that we discussed earlier. So far, so good. What is the implication of this modern view of change for our institutions and our scholars?

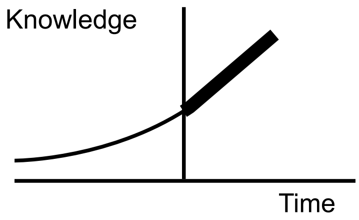
If our future is indeed one in which the capacity to stimulate and manage intellectual change becomes important and in which change is also viewed as a highly nonlinear, occasionally dramatic, and usually unpredictable process triggered by extraordinary people and their ideas, then this suggests that academic institutions may well wish to reconsider carefully how they go about their business of teaching and research. In this future, renewal and change will become essential for both the achievement and the sustaining of excellence.

It seems critical that academic institutions respond not just grudgingly to change. Rather, they must relish and stimulate and manage the process of continual change and renewal if they are to achieve excellence in leadership. Further, we must encourage faculty members, on occasion, to take the risks necessary for major impact. As Lynn Conway puts it, after faculty have progressed through the traditional promotional ranks, demonstrating their potential for tenure and then the achievement to become full professors, there is still something more: the goal of doing work that will shape or even create a field.

All too often academic institution—and academicians—tend to regard their role more as keepers and transmitters of existing knowledge than as the creators of new knowledge. Here it is useful to think of the growth of knowledge in the field as an S-shaped or sigmoid curve. In the early stages, the growth of knowledge in a field is exponential with time, since the more you learn, the more rapidly the rate of knowledge increases.

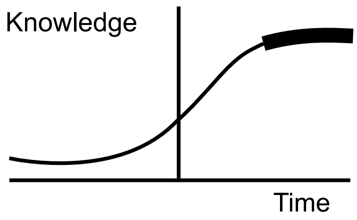


At this early stage, a few individuals of exceptional ability and great intellectual span can have a truly extraordinary impact, essentially stimulating and defining entirely new fields of knowledge. This is the "high risk" area, since it can frequently take years (in addition to great talent) to achieve something.



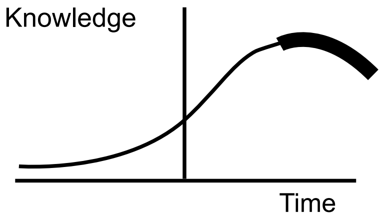
As the field matures, the growth in knowledge becomes linear with time. In this stage, the more resources you throw at an area, the more people or dollars, the more you learn. This is where it is "safest" to work, easiest to get grants, and to achieve tenure.

As the field matures still further, the growth and knowledge trails off, it saturates, a law of diminishing return sets in as one mines most of the new knowledge out of a field.



All too often, much of our work drifts into this saturation regime and becomes essentially trapped in a rut.

Some of my colleagues suggest there may be a fourth phase—they have referred to it as intellectual senility—where continuing to work in a field is counterproductive and actually reduces its knowledge content.



(Actually, there have been times recently when I have begun to wonder if my old field, nuclear fusion, hasn’t entered this final phase of intellectual evolution as of late with the controversy over “cold” fusion.)

One of the great challenges of research universities is how to encourage more people to work down in the high-risk, exponential part of the knowledge curve without unduly jeopardizing their academic careers. We must stimulate more of a risk-taking intellectual culture in which people are encouraged to take bold initiatives. From this perspective, it is important to jar as many people as possible out of “conventional wisdom” by fostering experiments, recruiting restive people from outside of the university and turning them loose, “causing trouble” by making conventional paths more trouble than unconventional ones.

And, here once again, we must consider carefully the degree to which the disciplines should be allowed to constrain truly innovative scholarship and teaching. While we always take care to understand and appreciate the tradition of the disciplines, we must also recognize the degree to which they can exclude or punish those who take risks.

To this end, we launched a series of major research projects and centers that would draw faculty members together from across the departments of the College and beyond and encourage high risk research ”on the exponential part of the knowledge curve.” Examples of such efforts included the following.

- Center for Research on Integrated Manufacturing
- AFOSR Center for Excellence in Robotics
- Computer Aided Engineering Network
- SRC Center for Excellence in Microelectronics
- Center for Ultrafast Optics
- Computer Enhanced Productivity Project (EPIC)
- Center for Advanced Electronics and Optics Technology
- Center for Scientific Computation
- Center for Machine Intelligence

There were many other such efforts launched and supported during my last years in the deans’ office. To help us in this effort, we recruited Lynn Conway, who was then head of the artificial intelligence program at Xerox PARC, to join the College. Her role was to “launch rockets,” which she did almost immediately in a spectacular fashion by forming a partnership with EDS and the College to build the “capture lab,” a multimedia brainstorming laboratory that functioned as part of the Center for Machine Intelligence.

Associate Dean Lynn Conway

Technology Transfer and Intellectual Property

One of our key goals was to provide strong incentives and support for technology transfer. Key in this was modifying the existing University policies on intellectual property. At the time, the University not only held ownership of all intellectual property produced by faculty and staff in research activities, but retained as well essentially most of the royalties under the control of the vice president for research. There was very little incentive for intellectual property disclosure or patent development, and even less support for these activities from the University, whose activities were largely staffed by lawyers with the primary mission of keeping the cork in the bottle so that the "big one" would not get away.

It was our belief that income from technology transfer should be determined on the basis of who earned it and not under the control of the vice president for research. The key issue in royalty distribution should involve effort, risk sharing, and equity, with the goal of providing strong incentives to faculty and staff to become engaged in these activities. To respond to these pressures from the College and others, the University established an external organization, the Michigan Research Corporation, with the mission of intellectual property development from University research. Unfortunately, however, MRC could only work with those technologies that were released to it by the Intellectual Property Office of the vice president for research, and the lawyers running that office were determined not to let MRC have any intellectual property with potential value. (In fact, there were strong signs that the IPO felt threatened by MRC and wanted it to fail.)

Despite our best efforts, the University was just not ready to move on any significant modification of intellectual property policies for much the same reason that they were unwilling to address the University-wide issue of indirect cost recovery and research incentives. These matters would have to wait until I moved into the provost office.

Changing the Culture

Throughout these chapters we have stressed the importance of the goal of changing the culture of the College, creating an environment in which excellence and innovation were not only encouraged and supported but, indeed, expected. We have discussed the many steps we took not simply to put into place strong incentives for achievement, but also to raise the morale and confidence of the faculty.

But changing the culture involved many other elements. For example, we believed it very important to put into place rational, transparent, and need- and performance-based mechanisms for allocating resources. We worked closely with the department chairs and Executive Committee to develop these budget allocation processes. We have already discussed several aspects in earlier chapters, for example, how funding for flexible instructional or support staff or permanent faculty positions were allocated to the departments. We believed it very important to share with all of the departments the total resource allocations of the College, so that each could assess whether they were getting their fair share relative to other units. We believed the deans should be held accountable for these decisions.

Beyond the faculty and the administration, we also faced a challenge in changing the student culture. Not that the students lacked talent, energy, and commitment, since even during the early 1980s, we were attracting the best students in the University, as measured by their entering qualifications. But the rapid growth in University enrollments during the decades following WWII had largely lost the identification of students with graduating classes or academic programs.

We attempted to restore this *esprit de corps* by assisting students in creating once more a graduating class identity, complete with elected

Addressing the Engineering Class of 1983 class officers, and then organizing a separate Engineering Commencement Exercise each spring. (This Engineering Commencement was held in addition to the University-wide commencement exercises, so that engineering students could participate in both.) The first Engineering Commencement was held in Chrisler Arena in spring of 1983, and it was a rousing success, giving students, parents, and the faculty both ownership of and identification with their own graduation celebration. It created an important tradition that continues today.

Strengthening the Bonds with LS&A

One of the themes of our leadership was to rebuild the bonds between the College of Engineering and the rest of the University, particularly the College of Literature, Science, and the Arts. In earlier chapters we discussed how the College had increasingly isolated itself from the University during the 1960s and 1970s, requiring its students to take courses in humanities and social sciences from its own faculty. With the move to North Campus, there was a risk that the College would become even more isolated. I was determined not to let this happen, both because of my commitment to the goal of a liberal education for our students, and moreover because I believed the College would draw much of its strength from the science and mathematics programs in LS&A. I was convinced that in the long run, the College could never rise to a position of true national leadership without strong University programs in areas such as physics, chemistry, biology, and mathematics.

But here we faced a major challenge, since although the University of Michigan had been a leader in science and mathematics during the 1930s and 1940s, these programs had lost much of the leadership during the post-war decades. This was a period in which the LS&A leadership was dominated by the social sciences, and laboratory-intensive programs such as physics, chemistry, and biology suffered greatly. Although the decline in the quality of these programs had become a concern to the University, with the release of the rankings of graduate program quality in the early 1980s, it would take a significant commitment to rebuild them, which was unlikely during a period of financial retrenchment.

Hence we made a conscious decision to do what we could to help build the quality of the sciences through the creation of a series of joint programs. The first of these efforts involved building new interdisciplinary programs in applied physics and applied mathematics, managed jointly by Engineering and LS&A. In each case, we worked closely with our colleagues in the LS&A departments of physics and mathematics to design these new programs. The College compensated for LS&A's reluctance to invest substantial new resources in these programs by taking the lead in allocating new faculty positions and facilities to these joint efforts, even in those instances in which LS&A was unable (or unwilling) to make a matching contribution. In some cases the College took the lead in obtaining additional funds to support LS&A's participation, such as when we built into the Research Excellence Fund an additional $500,000 per year in base support for Applied Physics. In other cases we made massive commitments in funding and facilities to recruit new superstar faculty to build the programs, as we did when we lured Gerard Mourou's group in ultrafast lasers from the University of Rochester to Michigan. We also worked closely with the science faculty in LS&A to build and operate special-purpose facilities such as a materials characterization laboratory (e.g., electron microscropy, electron beam epitaxy).

There was also an effort to build bridges between Engineering and LS&A that reflected the changing nature of scientific programs. For example, Dan Atkins led the effort to merge computer science and engineering on the campus, by guiding a faculty process that eventually led to the merger of the Computer and Communications Science Department in LS&A into the Electrical and Computer Engineering Department in Engineering. This new super department became the primary tenant of the new Electrical Engineering and Computer Science Building (formerly

Engineering Building I). A parallel process in the reverse direction occurred when the oceanographers in our Department of Atmospheric and Oceanic Sciences were transferred into the Geology Department of LS&A, leaving the College with a Department of Atmospheric and Space Sciences.

Although most of these efforts demonstrated a growing spirit of cooperation between Engineering and LS&A, there were a few bumps on the road. The LS&A deans occasionally exhibited a touch of paranoia, suspecting that Engineering's increasingly strong engagement with the sciences might be part of a power play to eventually take them over. Not that this was a new idea. Frequently, we would be approached quietly by faculty members in departments such as physics, chemistry, and mathematics, frustrated by years of neglect within LS&A, and pleading with us to bring these departments into Engineering. Actually, this was not so far-fetched, since several of the top universities in the nation did merge their sciences into engineering, notably the Universities of Illinois, Minnesota, and Caltech. Although I had great sympathy for the plight of the sciences, the geographical separation of the sciences on the Central Campus and Engineering on the North Campus would have been just to difficult to overcome. The thought of raising the $100 million or more it would have taken to move the sciences to the North Campus was simply too formidable at the time (although had I remained as dean another five years, it would almost have certainly come on the radar scope). As it was, I would turn my attention to rebuilding the sciences when I became provost of the University.

Development

In my later years as dean, more and more of my time would be spent in fundraising, traveling to visit donor prospects, whether individuals, companies, or foundations. We rebuilt the old Industry Committee of the College as a new National Advisory Committee, comprised of leaders from both our alumni and industry. This served not only as an advisory group to the College, but also as one of our primary fund-raising groups. I challenged the NAC at one of its early meetings by observing:

> *As an increasingly privately financed institution, the College firmly believes that its future will depend not on the capacity nor breadth but rather the quality of its academic programs. The breadth of academic programs in the College was achieved during a period of exceptionally strong public support. In the absence of that support, the College must achieve the capacity to focus its resources to stress those areas in which it has the capacity, potential, or mission to be a national leaders. To this end, the College has developed administrative structures and policies to facilitate reviews and tests of centrality to its mission, quality, and cost-effectiveness. It must approach its future as if it were a player in a very high-stakes poker game. It must choose its bets carefully and courageously.*

More and more effort was spent identifying and cultivating major donor prospects. During the early stages this was more like a scavenger hunt, in the sense that our development staff would set up a series of appointments in a given region, say Florida or southern California, and off I would go by myself, map in hand, trying to find my next meeting with a prospect. In retrospect, it was a bit crazy, since I was usually in a panic to find the prospect's house or office in a strange city in time for a scheduled meeting. But the effort did pay off, since many of our most generous donors came from these early meetings (including Reid Anderson, Ralph Colton, Carl Gerstacker, Earl Hoover, Goff Smith, Ame Vennema, Milo Oliphant, and Bob and Anne Lurie). And over time we built very significant private support.

But, as most deans soon find, the fund-raising activities of their school or college occasionally run into complications with the central University development function. In our case, it was made more difficult because the University had launched a major fund-raising campaign during the 1980s without including the College in the planning process (both because Ragone had completed a College-specific campaign in the 1970s and because we had had interim leadership until I came on board). The key priorities of this campaign had already been set, including several real dogs like the chemical sciences complex (for which they never were able to raise any money, and which I would eventually build as provost and president with state money). Not surprisingly, Chuck Vest and I would occasionally have to fall into our “good cop/bad cop” routine in which I would pound the table when central development screwed up (for example, in allowing Ford’s gift to the University to go to UM-Dearborn Engineering rather than us). Then Chuck would come in with a calm, relaxed proposal designed to address the concern. In the end, we found that we were best off when we kept the central development operation out of our hair, since it was usually the case that they were more of a hindrance than a help.

The Forces of Darkness

Although we tried to eliminate the defensiveness and insularity that had built up in the College over the years of budget deprivation during the 1960s and 1970s, we recognized that amidst all of the good will, encouragement, and support we had been receiving from State Street, there were, in fact, some serious threats buried in the central administration. Most of these related to the empire that had evolved under the vice president for research. As we noted earlier, during the 1960s, this office was frequently in direct competition with the College for resources, both from within and without the University. Perhaps the most striking example was the building of the Institute of Science and Technology, which not only diverted state capital funding from the College’s North Campus moving needs, but created programs in engineering and applied science that competed directly with those in the College for University and federal funding.

But there were other examples. Van Wylen had strongly opposed the creation of the Highway Safety Research Institute, believing that those activities should be conducted within the College of Engineering. One could well have made the case that the reporting line for the Phoenix Laboratory should also have been in the College, since it was most closely related to the Department of Nuclear Engineering. Beyond this, there was an ongoing effort by the vice president for research to take over other activities in direct competition with the College that were only thwarted by our direct approach to Harold Shapiro and Bill Frye. A good example was the aggressive effort to wrest the robotics institute (later the Industrial Technology Institute) away from Engineering.

Perhaps our greatest frustration with the vice president involved a series of policy issues. During my tenure as chair of the Academic Affairs Advisory Committee we had already identified faculty concerns ranging from the highly centralized and unresponsive nature of the vp-research units to inadequate support and incentives for sponsored research development. To this list, the College added other concerns such as the policies governing intellectual property and indirect cost recovery. We had learned that within the Executive Officer discussions, Overberger would generally be the one to argue against supporting the College. Yet our concerns did not rest alone with a single individual, but rather with the office itself and the empire it had spawned. And, sure enough, when Overberger was eventually succeeded by a new vice president for research, Linda Wilson, from the University of Illinois, we continued to have problems—although, in fairness, I always felt these arose primarily from the bureaucracy that had built up over the years rather than Wilson herself, who seemed basically supportive of Engineering.

And, for Our Next Act...

As I entered my fifth year in the dean’s office, most of the initial planning objectives had been achieved. With the construction of Engineering Building I, the North Campus move was assured. The Research Excellence Fund erased the Engineering Gap and put the College on a secure financial footing for the foreseeable future. We were attracting outstanding new faculty members at all levels, and as a result, our success in winning major national research competitions was improving rapidly. All of the indicators such as the national ranking of our academic programs, our sponsored research volume, and Ph.D. production were headed up toward national leadership.

Of course, my notebook continued to have long "To Do" lists, since no matter how far we had come, there were always roads ahead yet to travel. The North Campus still needed a major library facility which we envisioned as supporting all of its academic units (including Music, Art, and Architecture). We were in the process of negotiating with the state legislature a statewide instructional television network (MITN: the Michigan Instructional Television Network). And the North Campus still fell short of the quality of life for faculty and students that characterized the Central Campus (although Chuck Vest's addition to the North Campus (Pierpont) Commons would help).

As was customary at the time, Bill Frye had touched bases with the College Executive Committee concerning my reappointment for another five-year term, and they had enthusiastically supported it. But, as usual, I was beginning to have my own doubts. Although I was confident that we had moved far enough along our agenda to rebuild the College that backsliding was unlikely, even in the event of shifting University priorities or eroding state support, I was less certain that I was the appropriate leader for the College's future. After all, I had been brought in as a change agent, to rebuild and reshape the College, restoring its quality and its reputation. Now that the College had rocketed to cruising altitude, perhaps it needed another style of leadership.

Of course, during the years I served as dean, I had been probed about other opportunities. My alma mater, Caltech, had tried to talk me into becoming the Executive of their Division of Engineering and Applied Science, with the understanding that I would be a lead candidate to succeed its president, Murph Goldberger in two years when he was intending to step down. The University of Virginia had approached me about their provost position. Ford Motor Company had probed about the possibility of becoming their chief technical officer. And, as I was to learn later, I was even on the Yale presidency list (although, I suspect, only at a very early stage). But Anne and I were not ready to leave Ann Arbor and the University just yet.

As fate would have it, we really did not have to leave, since the provost position at Michigan opened up. Bill Frye decided in fall of 1985 to return the following spring to his native Georgia as provost at Emory University. Harold Shapiro launched a long and quite involved search for Bill's replacement, in which it was clear that the leading internal candidates were three deans: John D'Arms, dean of the graduate school, Gil Whitaker, dean of the business school, and me. On the positive side, Michigan had never selected a provost from outside the University (in part because of the concern that the learning curve was simply too steep and unforgiving in a university of its size and complexity). However, it was also the case that in over 175 years of Michigan history, the University had never selected anybody from Engineering for a senior University position.[5]

Yet, sometimes the impossible happens, and in March, while I was in Washington at a National Science Board meeting, I received a call from Susan Lipschutz, assistant to the president, asking me to come back to Ann Arbor to discuss the provost position with Harold Shapiro. (Actually, I had been intending to fly on to Walt Disney World to meet Anne and our daughters for our spring break week, but I called and told them I would catch up with them the next day.)

In a brief meeting at the President's House, Harold Shapiro offered me the position, with the hope I would stay in it for at least five years. After all, Michigan provosts frequently have been lured into university presidencies (e.g., Roger Heyns to UC-Berkeley, Frank Rhodes to Cornell, Harold Shapiro to Michigan and Princeton, Chuck Vest to MIT, Bernie Machen to Utah, and Nancy Cantor to Illinois). I agreed, but with the understanding that Shapiro would also stay for that period. (Unfortunately, Harold would leave for the presidency at Princeton the following year, and soon after I would be sucked into the vortex of a presidential search.) As in my earlier "negotiations," I said that since our relationship would depend on a very high level of trust and confidence, I would be comfortable with whatever arrangement he decided on. My only request was that I continue my service on the National Science Board, since I believed this to be of major importance to the University (and the nation, of course). We also agreed that Chuck Vest would not only succeed me as acting dean, but that we both would develop a process that would quickly result in his appointment as my permanent successor as dean of engineering. (As usual in a University, process was everything, so we could not immediately just announce him as the next dean.) It is worth noting that I have scribbled in my notes on this brief meeting with Shapiro the concluding phrase:

"And Faust signed on the dotted line..."

With this midcourse maneuver completed, I then caught the next plane for Florida to join my family. On the way I made quick phone calls to Chuck and Dan to let them know, and then while in Disney World, I made calls to Bill Frye and several of the key staff and deans to let them know before it hit the wires. Since I would not be back in Ann Arbor for a week, I also sent the following electronic mail message to the department chairmen and senior staff:

The time has come, the walrus said, to speak of many things...
Of sailing ships and sealing wax, of cabbages and deans...
...and provosts too...

Last Friday President Shapiro called me back from Washington to ask if I would take on the provost assignment. Since the search/decision process to select Bill Frye's successor had been a rather lengthy and extensive affair, I had had plenty of time to consider carefully the pros and cons of leaping from the frying pan into the fire.

During the past five years I have enjoyed immensely the opportunity to work with you and your faculty colleagues in our efforts to rebuild the College into one of the leading engineering schools in the nation. However in recent months I have become more and more convinced that the first phase of this work was nearing an end, and perhaps it was time for a change in College leadership. While my "damn the torpedoes, full speed ahead" style was probably necessary to get us moving once again after the doldrums of the 1970s, I believe that the College might now benefit more from a dean who can provide the vision, wisdom, and considered reflection to lead the College to new levels of excellence.

I am also convinced that, at this point in the University's history, it desperately needs a scientist/engineer in a top leadership position—not simply to maintain and enhance the momentum the College has achieved over the past several years, but to rebuild the quality of the basic and applied sciences at Michigan to a level befitting a great university.

To maintain the momentum of the College, I believe it essential that the torch of leadership be passed as rapidly as possible. When I return next week, I will meet both with the Chairman's Advisory Council and the Executive Committee to discuss this process. While there will certainly be a short period of time during which an Acting Dean will be necessary, I am confident that the selection of my permanent successor can be completed by this summer (i.e., before the key budget decisions for FY86-87 are made).

Let me apologize for this rather cold style of communicating my decision (via e-mail). (Although I am sure that many would characterize an e-mail message from Walt Disney World as perfectly consistent with the Duderstadt style...high tech, with a dash of Mickey Mouse).

Because of your support and effort, the College has been a very exciting place during the past several years. I can assure you that I will continue to do everything possible to provide you with the support you need on your continued climb to the top of engineering education.

See you next week!

A farewell address to the College

The New Provost

A "moving on" picnic for the dean

The new provost and provostess

The transition from dean to provost was about as rapid as that from faculty member to dean. My meeting with Shapiro was on March 22, and I moved into the provost office on May 1. As with my transition into the dean's role, I spent most of that six-week period meeting with people (particularly the deans) while working with Chuck and Dan to ensure a smooth transition in Engineering. Dan and Chuck arranged a going-away party-most fittingly, a German picnic complete with a German band, bratwurst, sauerkraut, and lots of beer. They presented us with "Provost" and "Provostess" T-shirts and a brass plaque containing the famous charts documenting the progress to erase the Engineering Gap.

We had fun at the farewell, but both Anne and I would miss Engineering a great deal. We would look back on those five years as perhaps our most enjoyable at the University. While Anne and I were able to accomplish more of lasting value to the University in the roles of provost (and provostess) and president (and first lady), the "go for it" spirit of our deans, chairs, and faculty team as we rebuilt the College was an experience we would never forget. Besides, being dean is probably the best job at the University of Michigan. (It certainly beats being provost or president, as we were to learn!)

Chapter 8

The Invisible Hand

The New Provost Team

The story of my involvement with the College of Engineering does not end in 1986, however. As both provost and president, I had many opportunities to help sustain the momentum established during the early 1980s. To be sure, the provost of the University, as both chief academic officer and chief budget officer, must take great care not to play favorites among the academic units. Furthermore, it is important to stay out of the way of one's successors so that they can set their own goals and style of academic leadership. But loyalty lingers. After spending almost two decades in the College of Engineering, including five intense years in rebuilding it, I was not about to tolerate any backsliding in University priority or support.

But, before continuing on with my personal history of the College of Engineering, it is useful to first take another detour to describe a few of our adventures in the roles of provost and president of the University. This book is not the place for a detailed narrative of my presidency. But it is probably appropriate to convey a brief summary of that period before returning to discuss the progress of the College of Engineering during that period.

As I have stressed, the fate of the College has depended as much upon the leadership of the University as that in the engineering dean's office. Since I was the first engineering faculty member ever elevated to the rarefied heights of the central administration of the University, it is useful—or at least amusing—to understand how an engineer approached the roles of provosting and presiding.

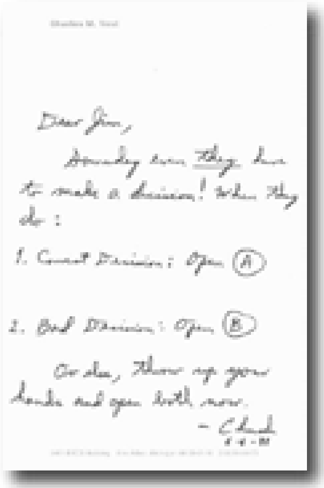
Both Anne and I tried to bring the same energy, excitement, and confidence about the future to our new roles in the provost's role that we had brought to leadership in the College of Engineering.

Within a few months I had not only launched a major set of planning activities involving every school and college of the University, but I had also launched many of the initiatives that would later define my presidency: a major effort to increase the racial diversity of the campus community (the Michigan Mandate), a series of initiatives designed to improve the undergraduate experience, an aggressive plan to improve the capital facilities of the University, a far-reaching effort to achieve leadership in the use of information technology, efforts to rebuild the natural sciences, and the restructuring of several key professional schools (including Dentistry, Library Science, and Education).

As the activities of the Provost Office accelerated, we were also asked to take on additional responsibilities. Even during normal times, the provost position at Michigan was a particularly challenging one because of its broad range of responsibilities since the provost not only serves as the chief academic officer of the University but also as the University's chief budget officer. The provost was also second-in-command and thereby empowered to serve as acting president in the event of the president's absence. Such a situation arose late in 1986 when Harold Shapiro took a brief sabbatical leave, spent partly in England and partly in New York, working at the Ford Foundation. During this period, I served as Acting President in addition to my role as Provost.

While on sabbatical leave, Harold Shapiro was approached by Princeton University concerning its presidency. Although he declined the initial approach, the wear and tear of returning to winter in Ann Arbor took its toll, and he eventually agreed and announced his intention to accept the Princeton offer in early May. Needless to say, Anne and I found our roles in the Provost's Office even more difficult, since not only did we have to assume the responsibility of guiding the University through a difficult period of transition in leadership, but as second-in-command, I was immediately identified as the most visible internal candidate to succeed Shapiro at Michigan.

The presidential search was long and wearing—as Anne put it, like a 14-month pregnancy. During the latter stages of the search, Chuck Vest, then serving as Dean of Engineering, dropped off two bottles of wine with the accompanying note:


Dear Jim,
Someday soon they have to make a decision! When they do:
1. Correct Decision: Open (A)
2. Bad Decision: Open (B)
Or else, throw up your hands and open both now.
— Chuck

Chuck Vest's Advice

Others can debate whether the Regents made the correct decision or not, but as fate would have it, in June of 1988 I was elected the 11th president of the University at a public meeting of the Board of Regents. Since the Regents' meeting was public, there were enough folks in attendance to require the use of the anteroom. In addition to our daughters, Susan and Kathy, there were a number of our friends on the faculty. There were also a number of University personalities, such as Bo Schembechler. (Needless to say, Bo stole the headlines with statements like, "He was my choice!")

My public interview with the Regents

Introducing the new first family

In general, there was a very positive reception to the selection, both on the campus and in the media. Our family was well known to the University community, and there seemed to be a sense of confidence in the direction that we would lead.

Since my old dean's office in the Chrysler Center—consisting of two small rooms and access to a conference room—was now vacant with the opening of the new dean's office in EBI, I persuaded Chuck Vest to let me continue to use this space as my


The University Record

Duderstadt named to lead the U-M into 21st century

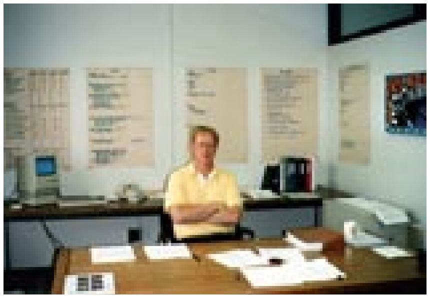

Presidential family works as a team

The announcement of a new president in the University Record

"faculty office" in Engineering. Since the office was adjacent to the College of Engineering computing center (CAEN), it had very strong computer support and network connectivity. This office was to prove invaluable as backup command center when the Fleming Building was under siege, e.g., from student protests or media attention. It provided the perfect retreat for my effort to plan the early stages of my presidency. During August, I disappeared back to my old North Campus office to begin to put together my strategy for the University.

There I wrote the key speeches I would be making during the year ahead to introduce my agenda, including my inauguration address. The walls of my old office were covered with ideas and outlines for the themes for the years ahead and my proposed vision for the future of the University.

Fortunately, much of my activity as provost had involved leading an extensive planning effort within the University. In countless meetings with faculty, students, and staff on campus, augmented by numerous discussions with external constituents, I began to focus on three themes for the future: knowledge, globalization, and diversity. Knowledge was becoming increasingly important as the key to growth and change. Information and communications technologies were quickly breaking down barriers between nations and economies, producing an increasingly interdependent global community. As barriers disappeared and new groups entered the main stream of American life, isolation, intolerance, and separation had to give way to pluralism and diversity. A new, dynamic, and interconnected world was emerging. If the University wanted to maintain the leadership position it had enjoyed for close to two centuries, it had to not only adapt to life in that world, but to lead the effort to define the very nature of the university for the century ahead.



Jim working on his speeches in the dean's office

I was aware of the long-held belief that each of the earlier presidents of the University seemed to have been chosen—or perhaps was molded—by the challenges of the times. The 1950s and 1960s had been a time of dramatic growth, and Harlan Hatcher had led the great expansion of the University as it doubled in size and added two regional campuses. The late 1960s and 1970s were a time of great unrest in America, and Robben Fleming's wise and experienced leadership had protected the University and its fundamental values during these difficult times. While Harold Shapiro had positioned the University to adapt to a future of declining state support,

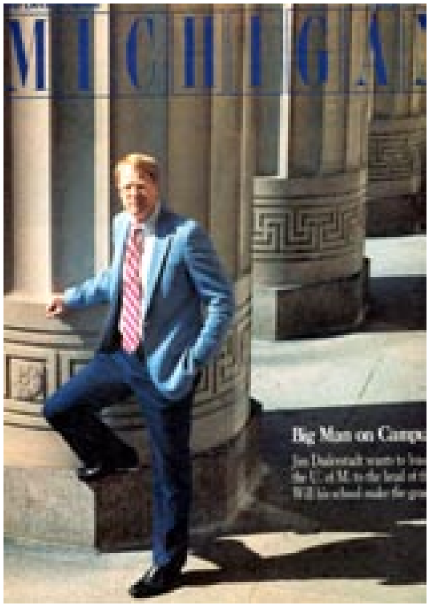
Anne and the Inauguration Committee, Shirley Clarkson, Anita Miller, John D'Arms his most important impact was in a different area. As both Vice President for Academic Affairs and then as President, Shapiro's commitment to academic excellence was intense and unrelenting.

But I sought something beyond excellence. Instead I embraced the University's heritage of leadership, first as it defined the nature of public higher education in the late 19th century, and then again as it evolved into a comprehensive research university to serve the latter 20th century. I became convinced that to pursue a destiny of leadership for the 21st century, academic excellence in traditional terms, while necessary, was not sufficient. Beyond this, true leadership would demand that the University would have to transform itself once again, to serve a rapidly changing society and a dramatically changed world. And it was this combination of leadership and excellence that I placed as a vision and challenge to the University.

I wasted little time in setting out my vision for the University during the week of inauguration activities. My inauguration address set this out as a challenge:

> *The triad mission of the university as we know it today--teaching, research, and service--was shaped by the needs of an America of the past. Since our nation today is changing at an ever-accelerating pace, is it not appropriate to question whether our present concept of the research university, developed largely to serve a homogeneous, domestic, industrial society, must not also evolve rapidly if we are to serve the highly pluralistic, knowledge-intensive world-nation that will be America of the twenty-first century?*
>
> *Of course, there have been many in recent years who have suggested that the traditional paradigm of the public university must evolve to respond to the challenges that will confront our society in the years ahead. But will a gradual evolution of our traditional paradigm be sufficient? Or, will the changes ahead force a more dramatic, indeed revolutionary, shift in the paradigm of the contemporary research university?*
>
> *Just as with other institutions in our society, those universities that will thrive will be those that are capable not only of responding to this future of change, but that have the capacity to relish, stimulate, and manage change. In this perspective it may well be that the continual renewal of the role, mission, values, and goals of our institutions will become the greatest challenge of all!*

Although I had to be discreet in my efforts, I was able to watch out for the College in my roles as provost and president, using an invisible hand to sustain its progress and prevent any backsliding. For example, in an earlier chapter I have already mentioned how I quickly used my position as chief budget officer to quietly lock the Research Excellence Fund into the base budget of the College. Chuck Vest did the same when he later succeeded me as provost. In subsequent years this $8.5 million, increased each year at the same rate as the state appropriation, would lose its identification as a specific fund for research and instead become a part of the College's base budget, under the control of the dean and available for any purpose.



The New Prez

As I will explain later, as President I was also able to use my influence over state appropriations and private fund-raising to quietly acquire several major new facilities for the North Campus, including the Media Union, the Lurie Engineering Building (which, despite portrayals to the contrary, was actually a state-funded building), and an array of other facilities and infrastructure. I was also able to help out the College in other ways, through influence in Washington, Lansing, and with key donors. But my most important role as provost and then president was to make certain that the College continued to benefit from strong leadership.

Transitions in the Dean's Office

My first task as provost was to select a new dean for the College. It was obvious to all that Chuck Vest was the clear choice for this post. Nevertheless, University tradition and process required that we conduct a sufficient search to at least give the faculty a sense that they had had input to the decision. We felt this was important both to the University and to Chuck's credibility as dean. To this end, we appointed a small search committee, and then we retained a search consultant to do a scanning exercise, just to see what other candidates were out there (particularly at other universities) and how they compared with Chuck. The consultant quickly confirmed our belief that Chuck would clearly be the best candidate for the position, and by early summer we were able to name him Dean of Engineering. Dan Atkins and Lynn Conway stayed on as associate deans, along with Hal Harger as business manager. Chuck soon named Erdogan Gulari, one of our strongest younger professors from Chemical Engineering, as his own successor as associate dean of academic affairs.

Dean Chuck Vest dedicating the expansion of the Space Physics Research Laboratory

Chuck's first assignment was to preside over the formal completion of the move of the College to the North Campus by dedicating the new Electrical Engineering and Computer Science Building. This was planned as a champagne gala, complete with laser light show and fireworks and a visit by Governor Blanchard. Unfortunately, a tornado alert kept the Governor in Lansing (although he called both Chuck and me to congratulate us). And, as noted earlier, both Anne and I assumed what would become our increasingly frequent roles as invisible guests at the back of the audience.

Unfortunately, Chuck's tenure as dean of engineering was brief. Shortly after becoming president, I convened a provost search committee dominated by faculty from the humanities, with the assumption that the faculty would be most comfortable with someone from the liberal arts as provost to pair with a president from Engineering. Imagine my surprise when the search committee concluded, unanimously, that Chuck was the most outstanding candidate. Although the idea of two engineers at the helm of the University was a bit unnerving at first, after consultation with a great many faculty members, the belief was that Chuck's exceptional breadth, and the strong difference in our styles, would quickly overcome any concerns.[1]

Daniel Atkins (Interim Dean 1988-89)

Just as during my own days in the provost's office, Chuck's first job was to find his successor as dean of engineering. Since this would be his first search as provost, I felt it important to let him take the lead. Dan Atkins agreed to be Interim Dean during the search process. After a national search, which considered top candidates from Caltech, Berkeley, and MIT, Chuck finally offered the position to Peter Banks, a professor of electrical engineering from Stanford. Banks was both visionary and charismatic, with extensive experience in entrepreneurial activities and federally sponsored research. However, his inexperience in leading a large academic unit, along with his considerable off-campus activities in fund-raising and federal relations, led to a growing gap between his visions for the College and where the faculty wanted to head. Furthermore, the College Executive Committee attempted to fill the growing leadership vacuum and became overly involved in micromanaging the College.

Unfortunately, Chuck remained in the provost role for only a year before he was approached by MIT about their presidency. Although he was very concerned about leaving after such a brief stint, I portrayed the MIT offer as a "call to national service" that left him little choice but to accept.

Peter Banks was successful in continuing to build the reputation of the College, and his fund-raising skills were key in pulling in major gifts to build several important North Campus facilities (including the FXB Building for Aerospace Engineering and the Lurie Engineering Center and Lurie Tower). However after several years, he opted for a new position as the president of the Environmental Research Institute of Michigan. Hence we were back to the search for a new dean.

The prez and provost cooking burgers for the Regents

Two university presidents: MIT and Michigan

Peter and Paulette Banks with John and Susan Ulrich, fund-raising chair

Glenn Knoll (Interim) (1994-1996)

We were able to convince an old friend and colleague, Glenn Knoll, to take the role as Interim Dean in 1994. Knoll had served as chairman of the Department of Nuclear Engineering and was widely regarded as one of our most outstanding faculty members in both teaching and research. Hence his appointment was a popular one to the faculty. The search for his successor, however, took somewhat longer than we had originally planned, in part because of a change in the provost's office followed by my own decision to step down from the presidency and return to the faculty.

I had been playing a personal role in this search in an effort to lure Steve Director, then dean of engineering at Carnegie Mellon and a leading engineering educator, to Michigan. When I announced my decision to return to the faculty, it set the search back several months. There was a brief period when a number of faculty members approached me to see if I would be willing to return to the dean's role myself.[2] Anne and I had long felt that it was a more enjoyable role than serving as provost and president. In the end, however, I decided that after leading the University for 10 years, it would be difficult to return to the role of dean. Been there, done that.

Hence, I resumed negotiations with Steve Director, and he finally agreed to become the next dean of the College. Director brought with him not only a reputation as a national leader in engineering education, but moreover a reputation as a leading computer engineer. He was quickly able to reestablish the linkages between the dean's office and the faculty and continue the momentum of the College. Furthermore, Director provided the strong leadership necessary to protect the College from the dangers posed by a new administration that largely viewed the North Campus as having benefited to an unusual extent during my years of leadership and was determined to push Engineering down the list in priorities once again.

Further Evolution of the North Campus

The North Campus site of the College of Engineering continued to evolve during the years following my tenure as dean. When the College completed its move in 1986, following the opening of the Electrical Engineering and Computer Science Building, it was

The North Campus master plan, circa 1986

already recognized that additional facilities would be necessary, as indicated by this planning map for the North Campus.

In particular, there was a need for a major North Campus library that would serve all academic units, as well as an expansion of the North Campus Commons (later renamed the Pierpont Commons, after Wilbur Pierpont, the former vice president for finance of the University who was the real visionary behind the development of the North Campus site.)

The College of Engineering also had particular needs. As I pointed out in an earlier chapter, the Department of Aerospace Engineering had been housed in an inadequate, concrete block building constructed during the 1970s. Through the efforts of Tom Adamson, chair of the Department of Aerospace Engineering, we were fortunate to receive a major gift from

The François-Xavier Bagnoud (FXB) Building

The Wilbur & Maxine Pierpont Commons

the Countess Albina DuBuousvouvray to build a new building in memory of her son, François-Xavier Bagnoud, a former student in aerospace who was killed in a helicopter accident in Africa. The FXB Building provided superb facilities for this important department. Furthermore, the Countess provided additional funding to commission a major sculpture, "The Wave Field," by Maya Lin.

Maya Lin's "Wave Field"

This blending of major art with the evolution of the North Campus was due in part to the particular interests of Brad Canale, who continued to direct the College's development efforts.

Chuck Vest was instrumental in building a major addition to the North Campus Commons that housed an array of student services activities.

Perhaps the most dramatic new buildings constructed on the North Campus resulted from a unique combination of public and private support: the Media Union, the Lurie Engineering Center, and the Robert and Ann Lurie Tower. During my days as dean, I had become friends with

A sculpture at the Dow Building

Bob Lurie, a former graduate of the College who had built a major financial empire in Chicago with Sam Zell, a graduate of the Business School. Bob was a wonderfully creative person who had long expressed an interest in helping the College. When he died at an early age, his wife Ann picked up the commitment and agreed to fund a major building on the North

The expansion of the North Campus Commons

Campus, commissioning the noted American architect, Charles Moore, for the design.[3] In addition, Ann Lurie provided another gift for a bell tower

The Lurie Engineering Center

and carillon on the North Campus, also designed by Charles Moore.

At roughly the same time, I was guiding through the state capital outlay process for a major appropriation for a North Campus "library." We had long had this project on the drawing boards, including it without success in the Campaign for Michigan of the 1980s, with a vision for building a "library of the future". Two events occurred that provided the University the opportunity to move forward immediately not only with this project, but also the Lurie projects.

In 1992, when a new governor, John Engler, was elected, he learned that he had inherited a $1 billion deficit in the state budget from his predecessor. By taking advantage of an interesting loophole in Medicare reimbursement, we were able to execute an electronic transfer of funds through our medical center that allowed the governor to

The Robert and Ann Lurie Bell Tower

The North Campus, circa 1996

plug the hole in his budget. This not only enabled him to move ahead with a capital outlay program, but in his gratitude, he agreed to let us use our share of these funds (roughly $125 million) in a highly flexible manner. We had included in our package $50 million for a North Campus library, but when we learned that Michigan State University was proposing a $70 million Soil Sciences Laboratory, we decided to jump-start the Lurie projects and add them in the budget request to match Michigan State.

To enable this, we needed a somewhat different concept for the three buildings. Driving to our first hearing before the legislative capital outlay committees, I suggested that we combine the magic words "instruction," "technology," and "center" into a term that sounded high-tech but really meant nothing: "The Integrated Instructional Technology Center" or ITIC. And this is precisely what the state funded: a $70 million complex that included the Lurie Building, Bell Tower, and the library (later to be called the Media Union). Ann Lurie was comfortable with using state funding to start the projects, with the understanding that her gifts, to be paid out over a longer period, would eventually go to help support a new building for the School of Social Work ("all money is green," as they say).

The Lurie Engineering Building and Lurie Tower would turn out to be the very last buildings designed by Charles Moore. Because of the architectural importance of these structures, when cost overruns on the Lurie Tower threatened to cut the original design, I put in $2 million of additional University funding to build it exactly as Moore had designed it.

The Industrial Technology Institute

The Space Physics Research Laboratory

There were several other North Campus building projects during this period, including the Industrial Technology Institute and an expansion of the Space Physics Research Laboratory. Furthermore, the Lurie Engineering Center also provided a significant expansion of the facilities occupied by the Department of Industrial and Operations Engineering.

The Department of Industrial and Operations Engineering

The Media Union

The main structure of the ITIC complex was a $50 million building, originally portrayed as a North Campus library. However, since the governor had given us unusual flexibility in the design of this facility, we assembled a usually creative team of faculty and deans and said: “Here is $50 million. Build us a building for a 21st Century university!” The team included visionaries such as Lynn Conway, Maurita Holland, Dan Atkins, and Randy Frank from the faculty and Deans Peter Banks (Engineering), Paul Boylan (Music), Bob Beckley (Architecture), and Allen Samuels (Art). Together, they came up with a fascinating new concept, best captured by the new name “Media Union,” which was a play on the “Michigan Union” of the Central Campus, but suggested the merging of various media (art, music, architecture, engineering) and senses (sight, hearing, touch, etc.) Randy Frank, then the director of the Computer Aided Engineering Network, took lead responsibility for directing the evolution of the project.

The Media Union (Bonisteel Boulevard side)

The Media Union (campus side)

And what a project it was. When the Media Union finally opened its doors in 1996, there were probably fewer than a dozen people on the campus who understood what it was. But the students rapidly learned, and within a month it became the most popular facility in the University, operating around the clock, seven days a week, populated by thousands of students.

Cutting the ribbon for the Media Union with Governor John Engler

The Media Union was designed to be a testbed for developing, studying, and perhaps implementing the new paradigms of the university enabled by information technology. It would give us the chance to try out different possibilities before they become widespread realities, helping us avoid potentially expensive or even dangerous mistakes while maximizing the extraordinary capacities of our new tools.

The Media Union created an environment where students and faculty could join with colleagues beyond the campus, developing and testing new visions of the university, exploring teaching, research, service, extension, and other areas. Even more importantly, the Media Union fostered a new spirit of excitement and adventure. It provided the foundation for a risk-tolerant culture, where students and faculty were strongly encouraged to “go for it,” accepting failure as a part of the learning process as they reach for ambitious goals. Organized around dynamic, integrative themes, the Media Union worked to break down the compartmentalized nature of the larger university.

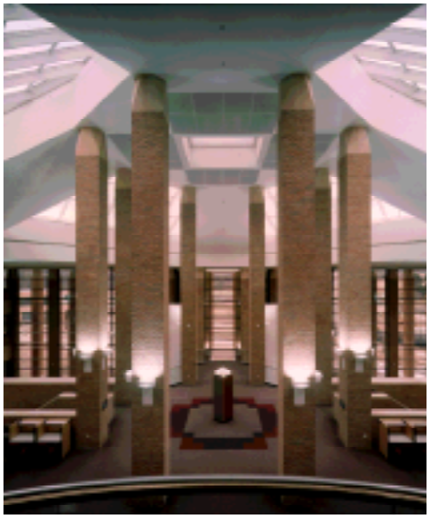
Originally we envisioned the Media Union as a common connecting point among the four schools on the University’s North Campus: Engineering, Architecture and Urban Planning, Music, and Art, all of which are intimately concerned with the act of creation. Although all four facilities operated within close proximity of each other, in the past there had been few collaborations between them. This made little sense. Increasingly society demands designs that combine aesthetics, efficiency, and durability. As engineers become more like artists, artists and musicians have become more interested in new environments for their creations; and architects are increasingly concerned with the structural integrity and beauty of their designs.

The University of Michigan Media Union

We soon realized, however, that the Media Union must be a resource for the entire University. The need for interdisciplinary collaboration extends beyond the North Campus schools, and as a facility designed in part to bridge the limitations of time and distance, what better place to bring the North and Central Campuses together? The Media Union could act as a catalyst, helping faculty and students from different fields realize their similarities while capitalizing on their differences.

More specifically, this 250,000 square foot facility, looking like a modern version of the Temple of Karnak, contains almost 1,000 workstations for student use-including Pentiums and Macs and Unix machines such as Suns and Hewlett Packard workstations.

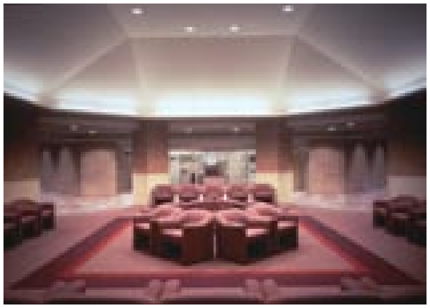
It has thousands of network jacks where students can plug in their laptops, and wireless modems if they wish to work in its surrounding plazas and gardens during the summer. The facility contains a 1.5-million volume library for art, science, and engineering, but perhaps more significantly, it is the site of our major digital library



The atrium of the Media Union

project. There is a sophisticated teleconferencing facility, design studios, visualization laboratories, and a major virtual reality complex. Since art, architecture, and music students work side-by-side with engineering students, the Media Union contains sophisticated recording studios and electronic music studios. It also has a state-of-the-art sound stage for "digitizing" performances, as well as numerous galleries for displaying the results of student creative efforts. The Media Union is open 24 hours a day, seven days a week, so that students have round-the-clock access to its facilities.

The "virtual" nature of the research teams in the Media Union entice not only campus scholars, but exciting thinkers around the world to participate. (For example, we built a relationship with the Schools of Art and Architecture at Yale University.) While groups could meet physically from time to time, many of the members of these project teams participated through interactive technology. Members did not need to leave their home institution or even their homes to join in close collaboration with other scholars who were thousands of miles away.



The design studios in the Media Union

Libraries will always have books, but the Media Union's library will not be judged by its number of volumes. Increasingly, information will be stored electronically, and its data will be dispersed across the globe. We are talking about more than just text; the Internet already contains archives of images and sounds, audio and visual information that scholars can retrieve at the touch of a button. Eventually a researcher will not have to find a DVD to view movies or locate a tape recorder to listen to the score of a symphony. And published "papers" will increasingly include images and sounds as an integral part of their presentation.

The library area in the Media Union

The Media Union libraries eliminate much of the drudgery usually associated with information retrieval. Quasi-intelligent software programs search out data for even the most unique topics, tracing connections within a broad spectrum of research that scholars might have missed using manual techniques. While this will never replace human insight, the wide-ranging character of these searches helps break down the invisible barriers that often separate disciplines today. The most useful resources for a psychologist working on an aspect

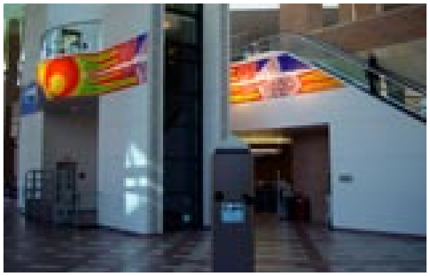
The gallery areas of the Media Union

of "panic" might well turn out to have been written by an anthropologist or an English professor or even an engineer.

Libraries will also increasingly become places where the differences between "researching" and "doing" blur. The new information technology not only supports information retrieval, but also facilitates manipulation of that information. A student could not only read about architecture, but use a computer tool at the same time to try out a design.

For the Media Union to succeed, we realized we had to take risks, accepting that we might stumble before we could walk. When we began the early planning for the project in the 1980s, our challenge was to envision a building that could become a campus "commons," both physically and virtually. We struggled with designing a place that would allow colleagues from very different disciplines and across great distances to collaborate with each other. Ultimately, we had no final answers—just ideas. We realized we probably would not get it all right from the beginning. In fact, it was clear that stagnation will have arrived if the Media Union ever settles comfortably into any single form.

One of the problems in centers like the Media Union at other universities has been that projects often move in when the facility is built—and then never leave. Limited paradigms take hold and then can't be shaken loose. Instead of propagating flexibility within the larger university, the reverse often happens, and these centers find themselves infected by the stolid, incremental "disease" of large institutions. Creating a fluid structure that continually embraces new ideas would be a great struggle. A related challenge would be learning to sustain spaces that are truly neutral in their academic orientation.



The "Comet and Quantum Mechanics" fresco in the Media Union

Another difficulty we grappled with was finding ways to let the energy and enthusiasm from the Center's cutting-edge research projects trickle out into the common areas of the building, and ultimately to the entire University. The new interactive library was open to all members of the Michigan community, but much of the rest of the building would be reserved for a wide spectrum of research projects and groups. Researchers and scholars needed space of their own to work together, but we worried that if they remain isolated behind closed doors (even glass doors), we could lose the opportunity for our students and colleagues to experience their excitement. Even allowing the outside world "virtual" access to the Union's projects would not be enough.

As Architecture Dean Robert Beckley noted, "there are ways in which we would like the building to have the messy, intriguing look of a house for mad scientists." If we expected the Media Union to be a catalyst, changing the common practices of our community, we had to find ways for these new practices to move beyond the building's studios.

The Media Union

The North Campus, circa 1996

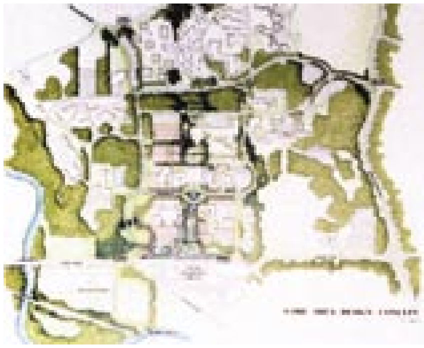
The North Woods Project

With the completion of the Media Union, Lurie Engineering Building, and Lurie Tower in the mid-1990s, the North Campus had taken on a decidedly different look. It was now home to four major schools and over 14,000 students. It made important architectural statements. Its rare blend of creative disciplines began to suggest a new name adopted by several of the deans: "The Renaissance Campus." In many ways, the North Campus had become the laboratory for the University of the 21st Century.

To recognize this broader mission, we launched a major effort to develop a new master plan for the campus. To stimulate creativity, we approached this as a blind competition, inviting the very top architectural planning firms to prepare proposals, with the deans of the North Campus schools forming a committee of judges to select the final design.

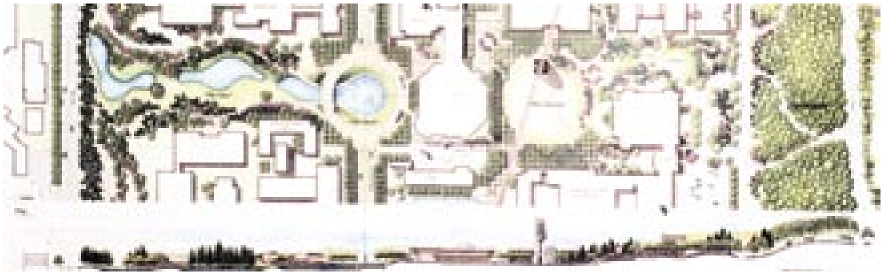
The North Campus "diag"

The competition was intense, and the judges were rigorous. In the end, the competition was won by Johnson, Johnson, and Roy, ironically the creators of earlier master plans for the University, who developed an extraordinary new master plan with the code name "North Woods." This plan created a new North-South axis running through the campus, from the forests to the north down to the Huron River to the south. It made extensive use of the evergreen plantings that had long provided a distinctive character to the North Campus. The deans forming the judging committee were ecstatic about the design, united in their belief that it would make a statement comparable to other important campus designs such as the Jefferson quadrangle at the University of Virginia or the Harvard Yard. Unfortunately, the North Woods design

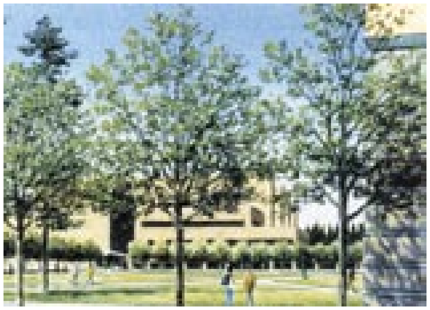


The North Woods master plan

A schematic of the North Woods master plan



A schematic of the north-south axis of the North Woods plan



Artist's conceptions of the North Woods plan

was completed during the last year of my presidency. Although we were able to launch some aspects of the design (such as purchasing a large tree farm to provide new trees, and beginning some of the circular plantings and entrances), the effort was rapidly brought to a halt by my successor, Lee Bollinger, who had become infatuated with the architecture of Robert Venturi (noted for post-modernist design in the Las Vegas style). Bollinger replaced the University's longtime master planner with Venturi, who promptly stopped everything else going on campus, including the North Woods project. The deans who had strongly supported the project were either removed or retired, and Bollinger's new administration attempted to bury the concept (and the North Campus).

We were fortunate, however, in the fact that the new president's lack of interest in the North Campus meant that Venturi's attention was focused elsewhere. Hence, although the North

The Venturi-Bollinger "Halo" on Michigan Stadium

Woods project was suspended, at least we did not suffer from the Venturi architectural touch that humiliated other parts of the campus.

But, as the College has learned throughout its history, if an idea is good, it will eventually return. And the compelling nature of the North Woods plan suggests that in the wake of the unusually brief tenure of the Bollinger administration (the shortest for a president in the University's history), there may be an opportunity to resume the project. Let us all hope!

However, the Bollinger administration was to leave one final legacy for the North Campus. Even as the president was negotiating his next position at Columbia University, he persuaded the Regents to sell 55 acres of the University's North Campus property to the Pfizer Corporation for further expansion of their already massive R&D laboratories, land that had been reserved in the master plan for academic programs. Although this sale brought the administration some $25 million of badly needed cash to dump into the "cat hole" of the Life Sciences Institute, it did so at the expense of land critical to the University's future expansion. It is interesting to compare this short-term opportunism (by a president walking out the door) with the vision of the Regents some 50 years earlier when they purchased the original North Campus site.

The expansion of the Pfizer R&D laboratories on the North Campus

Chapter 9

Lessons for the Future

As this book is written, Anne and I are completing our 33rd year in Ann Arbor and at the University of Michigan. This is not only an unusually long period, as faculty careers go, of serving a single institution, but it also spans most of the half-century period in the history of the College of Engineering. During this period we have had the opportunity—indeed, the privilege—to serve the University and the College in many roles: as a faculty member, teaching and conducting research; as a leader of groups such as the Faculty Women's Club that knit together the campus community; as dean and "deanette", provost and "provostess", and president and first lady, leading the College and the University; and as emeriti, returning to teaching and participating in the University community, almost as ghosts from the past, serving in whatever way we can (and are allowed).

Yet, looking back over these many years of serving the University, the brief five-year period spent in the role of dean of engineering was in many ways the most exciting and rewarding. In part it had to do with the energy and excitement of youth, since we were both in our mid-30s when I was tapped by the University for this role. So, too, it arose from the wonderful experience of working with some remarkably talented and dedicated colleagues in the "calling" of rebuilding the College. And, of course, it was immensely satisfying to play some role in the resurgence of the College, rising like a phoenix bird from the ashes of malaise and neglect of the 1960s and 1970s to a position of national leadership in engineering education once again.

Of course, the sharp acceleration of the College and its rapid rise to prominence had as much to do with how far it had declined in earlier decades as it did with our success in rebuilding an adequate measure of University support and restoring the quality of its faculty and its programs. Peaks always look far higher when viewed from a deep valley.

In this final chapter, it seems appropriate to offer a somewhat broader view of the history of the College and the ebb and flow of its fortunes and fate, dependent mostly upon people, but also upon events. But perhaps more significant is an attempt to draw out some lessons to be learned from the experience of rebuilding an academic unit, both as a dean and then as a university leader. I have also taken the liberty of speculating a bit about the future of engineering education. Hopefully these observations can provide not only some measure of what it takes to achieve excellence in academic programs, but they can also provide guidance for those who will be responsible for sustaining the momentum of the University of Michigan's College of Engineering in the years ahead, enabling it to continue to serve the University, the state, the nation, and the world.

Five Years Before the Mast

As the earlier narrative in this book makes apparent, the list of accomplishments during that brief period in the early 1980s is both significant and lengthy. But, now from the perspective of hindsight, I would suggest that the most important of these achievements were the following: At the top of the list would be restoring the College of Engineering as a top priority of both the University and the State of Michigan, as evidenced by the remarkably strong support of both the College's needs for strong funding (e.g., doubling General Fund support and passing legislation establishing the Research Excellence Fund) and quality facilities (e.g., the North Campus move, Engineering Building I, and the ITIC complex).

Second on the list would be transforming the culture of the College, reestablishing both the commitment to excellence and the confidence that it could be achieved. This required not only the presence of strong rewards and expectation for excellence, but also creating a "go for it" spirit of risk-taking and entrepreneurism through the faculty, students, and staff of the College.

A third area of effort was rebuilding the quality of the faculty in the face of the low morale and apathy that had come to characterize much of the College during the preceding decade. We were able to arrest the departure of our strongest junior faculty while recruiting new faculty members at all levels. In fact, during the five-year period, almost 120 new faculty members were hired, corresponding to roughly 40% of the faculty cadre.

Of course, key in our efforts was the ability to restore adequate support for the College. As we have described in earlier chapters, we were able to triple the University's base support of the College, increasing its General Fund budget from $13.2 million per year in 1980 to $36 million in 1986. This was augmented by similarly large increases in sponsored research support and private giving.

History will probably record the successful move of the College to the North Campus as a major event of the period, since this had been a goal for over three decades. But beyond the success in putting together and executing a plan to accomplish the move in slightly less than four years, we were also able to provide a number of new facilities that gave the College one of the nation's leading environments for engineering education and research (e.g., EECS, Dow, FXB, SPRL, IST, Lurie, and the Media Union). We were also able to build a state-of-the-art computing environment, CAEN that became the envy of the nation.

There were also several subtle but nevertheless important changes. We believed it important to restore the focus of the College on graduate education and research, since these areas provide the measures that would most determine our reputation, national rankings, and ability to attract students and faculty. Investments were made to build world-class programs in hot areas such as manufacturing engineering, microelectronics and advanced optics, computer science and engineering, and bioengineering.

By the mid-1980s, the quantitative measures of College momentum began to surge and continued to do so throughout the 1990s. The volume of sponsored research grants and contracts attracted by our faculty doubled, then doubled again, and has continued to rise. Ph.D. production also has increased by a factor of four since it hit a low point in 1980. In fact, today the College of Engineering has the largest population of graduate students of any school or college in the University. The College has been both a national and University leader in its efforts to diversify its student body and faculty with respect to race and socioeconomic background. Members of the faculty now routinely are recognized with major awards such as election to the National Academy of Engineering. And the reputation of the

College has climbed to new heights, with both the College and most of its departments now ranked among the top five in the nation (alongside MIT, Stanford, UC-Berkeley, and Illinois). More information on these quantitative measures is provided in an appendix.

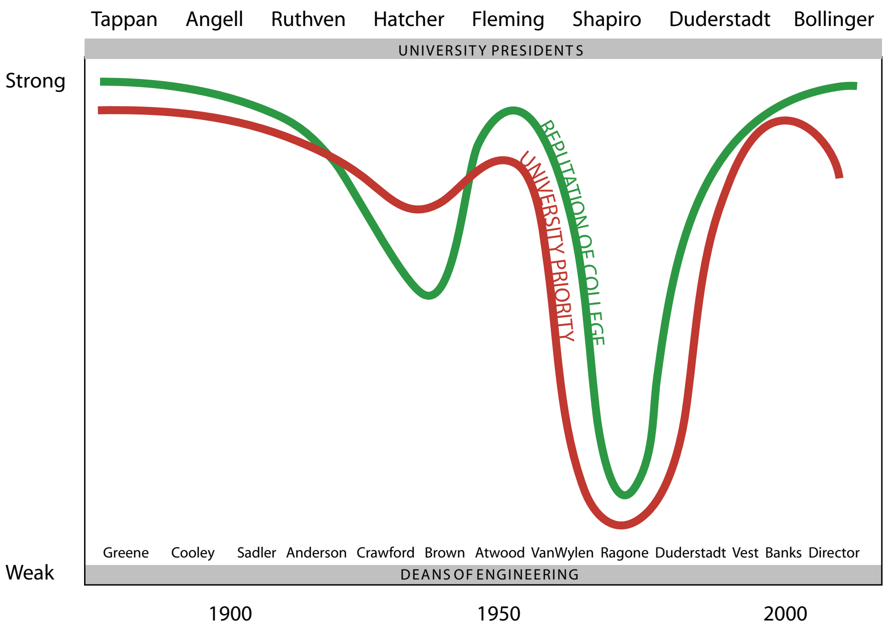
Hence, by any measure, the College of Engineering has come a long ways since the doldrums of the 1970s. Today it is clearly recognized as both one of the strongest academic programs in the University and a leader in engineering education across the nation and throughout the world.

A Broader Historical Context

As we have observed in earlier chapters, the fortunes of the College have waxed and waned over the century and a half of its existence. To a very considerable degree, the strength of the College has depended upon people, both academic leaders such as deans and university presidents, as well as events at the University, state, and national level. To illustrate this, I have attempted to develop a symbolic chart suggesting the correlation between the reputation or strength of the College and its priority within the University for various periods in its history.

Although there may be some risk in doing so, I also feel obliged to relate these trends both to leadership of the College and to historical events of the period. There seems little doubt that the College of Engineering made the most progress during three periods of deans: Mortimer Cooley, G. G. Brown, and finally the team that led the College during the 1980s. In part this had to do with the events of the times. Cooley led the College during the industrialization of America, with great demands for technology and engineering. G. G. Brown benefited from a period of exceptional growth in higher education, with the G.I. Bill and returning veterans from WWII, as well as the developing research partnership between the federal government and the nation's research universities, stimulating massive investments in campus-based research and graduate education as a key factor in achieving national security during the Cold War. During the 1980s we benefited very significantly from the new emphasis on diversifying the state's economy and restoring the competitiveness of Michigan industry.

In contrast, other deans of the College of Engineering have not been so fortunate. Sadler was at the helm during the Great Depression, while Crawford led during WWII, times that made progress very difficult. Attwood, Van Wylen, and Ragone faced shifting University priorities, driven by the Great Society themes, the protest movement, and the recessions of the 1970s. These broader themes explain to some extent the directions in which they attempted to lead the College. For example, Van Wylen responded to the



enrollment growth associated with the post-WWII baby boom by focusing the College on undergraduate education. Faced with declining University support, Ragone focused his efforts on private fund-raising.

So too, there are likely correlations as well with University leadership. For example, Cooley had the support of Angell and Burton; Brown benefited from the arrival of Harlan Hatcher; and I had the exceptionally strong support of both Harold Shapiro and Bill Frye. In contrast, both Sadler and Crawford served under Alexander Ruthven, then in declining health. Van Wylen and Ragone served during the Fleming years, at a time when the priorities were coping with campus unrest, and had to contend with Allen Smith as provost, who had little enthusiasm for supporting engineering. Fortunately, my successors (Vest, Banks, Knoll) could depend upon my strong support as both provost and president. During his early years as dean, Steve Director had to contend with a largely disinterested if not occasionally hostile administration led by Lee Bollinger. Fortunately, the sky appears to be brightening with the arrival of a new president, Mary Sue Coleman.

But although events of the times and University leadership are key in determining the fortunes of the College, we should not underestimate the important role of the dean in exploiting or surmounting these factors. Both Mortimer Cooley and G. G. Brown were not only energetic, forceful, and persuasive, but they also devoted considerable time to making the case for the College to the University and the state. They were active both on the campus and beyond, becoming frequent visitors to the State Legislature and the United States Congress. These two leaders provided excellent role models for our efforts to rebuild the College during the 1980s.

Some Lessons Learned—Revisited

Although we briefly discussed some of the lessons learned during the early stages of our efforts to rebuild the momentum of the College, it is of interest to reconsider this topic from the broader perspective provided by two decades of subsequent reflection. Since I believe these to be key elements of successful academic leadership, it is also appropriate to stress them once again here.

Establishing the Priority of the College within the University

Both the history of the College of Engineering and my own experience suggest that the first and most important objective must be establishing the priority given an academic unit by the central administration. When the visibility of the College of Engineering on State Street has been high, the College has thrived. When the University has neglected–or even, at times, acted against–the College, it declines very rapidly, as it did during the 1960s and 1970s. When our team came into the dean's office in 1981, we realized immediately that until we had re-established the priority of the College with the central administration, the rest of our agenda would simply not be possible. Key in this effort was making the case for the College directly to the top leadership of the University, to the president (Harold Shapiro) and the provost (Bill Frye). Once we had earned their respect, commitment, and support, the other components of our plan began to fall rapidly into place.

This task is clearly the primary responsibility of the dean. There really is nobody else, among the faculty, alumni, or patrons of a college, who can effectively make this case and earn the confidence and support of the university leadership. History has shown time and time again that when the dean is incapable of or ineffective in making the case and establishing a college's priority, it simply cannot prosper.

Consistency and Persistence

Although it can sometimes seem like beating your head against a brick wall, consistency and persistence are everything. Staying on message both to internal constituencies such as the faculty and external patrons such as the central administration, industry, and alumni is essential. Any uncertainty or wavering will rapidly erode the effort to build support. And besides, sometimes a window of opportunity opens in what appears to be an immovable brick wall.

Speed and Timing Are Everything

Today it is sometimes difficult to understand just how rapidly we pushed ahead our *blitzkrieg* to rebuild the College. But it is also my belief that this was, in part, the key to our success. We were able to accelerate, building momentum along a number of fronts. Success in one area propagated to others, almost like a chain reaction. Restructuring the salary program to reward achievement drove faculty effort and morale, which in turn established a credible case for greater University support. The completion of the North Campus move was key in recruiting strong faculty who rapidly established the College as a major player in key national research initiatives.

Our experience clearly indicates that to take advantage of the opportunities, one needs to have the capacity to move very rapidly. Timing is everything. Windows of opportunity open and close very rapidly, whether in the University, Lansing, or Washington.

The Importance of Having a Clear Strategy

Too often academic leaders tend to react to–or even resist–external pressures and opportunities rather than taking strong, decisive actions to determine and pursue their own goals. They frequently become preoccupied with process rather than objectives, with "how" rather than "what." We believed it important to develop a planning process that was not only capable of *adapting* to changing conditions, but to some degree capable of actually *modifying* the environment in which the university would find itself in the decades ahead. We sought a progressive, flexible, and adaptive process, capable of responding to a dynamic environment and an uncertain—indeed, unknowable—future.

To this end, we adopted an opportunistic planning approach. The idea was to develop flexible strategies that took advantage of windows of opportunity, which avoided confining the College to rigid paths, deep ruts. In a sense, this corresponded to an informed dead-reckoning approach, in which one selected strategic objectives—where we wanted to go—and then followed whatever course seemed appropriate at the time, possibly shifting paths as opportunities arose and updating strategic plans with new information and experience, always with the ultimate goal in mind. In such opportunistic planning, we assumed that the planning framework was never rigid. What first appeared to be constraints might, in fact, be transformed into opportunities.

Since I am a scientist-engineer, it is not surprising that as a leader I tended to be comfortable with strategic thinking. Yet it should also be acknowledged that my particular style of planning and decision making was rather unorthodox, sometimes baffling both our university planning staff and my colleagues alike. Once I overheard a colleague describe my style as "fire, ready, aim," as I would launch yet another salvo of agendas and initiatives.

This was not a consequence of impatience or lack of discipline. Rather it grew from my increasing sense that traditional planning approaches were simply ineffective during periods of great change. Far too many leaders, when confronted with uncertainty, tend to fall into a "ready, aim . . . ready, aim . . . ready, aim . . . " mode and never make a decision. By the time they are finally forced to pull the trigger, the target has moved out of their sights. Hence, there was indeed logic to my "anticipatory, scattershot" approach to planning and decision making.[1]

I believed that incremental change based on traditional, well-understood paradigms might be the most dangerous course of all, because those paradigms may simply not be adequate to adapt to a time of very rapid change. If the status quo is no longer an option, if the existing paradigms are no longer valid, then more radical transformation becomes the wisest course.[2] Furthermore, during times of very rapid change and uncertainty, it is sometimes necessary to launch the actions associated with a preliminary strategy long before it is carefully thought through and completely developed.

Always Bet on Your Best People and Strongest Programs

Clearly, academic institutions and programs are intensely people-dependent enterprises. The secret to success is simple: attract the very best people; provide them with the support, encouragement, and opportunity to push to the limits of their talents and dreams; and then get out of their way! Academic leaders should post on their desktops a sign stating: "IT'S THE PEOPLE, STUPID!"

There is a corollary here. If you are going to place a big bet on the future, make certain that you place it on your best people and your best programs. Always invest in areas of strength, and from them, create the momentum to build new areas. It was for this reason that we placed our largest bets (and they were very large, indeed, amounting to many millions of dollars) on programs such as the Center for Integrated Manufacturing, the Solid State Electronics Laboratory, the Center for Ultrafast Optics, and the Computer Aided Engineering Network.

The converse is also true. It is very dangerous to make major investments in areas of weakness in an effort to build new areas of excellence. This almost never succeeds.[3]

Thinking Outside the Box

As we have noted, simply damning the torpedoes and pushing full speed ahead does not always lead to success. The decision process in a university can become overloaded and driven into a state of paralysis. Sometimes it takes a more creative approach.

Our deans' team was particularly fortunate in tapping the creative talent of some truly extraordinary people who have gone on to demonstrate this rare human attribute elsewhere. Chuck Vest's skill in managing the successful North Campus move has been echoed time and time again in his leadership at MIT. Dan Atkins' efforts in building the Computer Aided Engineering Network and stimulating a broad array of leading research initiatives were precursors of the role he would play as the founding dean of our new School of Information. Lynn Conway's creative talents have been demonstrated time and time again through initiatives such as the Center for Machine Intelligence, the UMTV broadband network, and her many efforts in engineering design. We were fortunate in our ability to tap the creative talents of many others among the department chairs, the College Executive Committee, the faculty, and our students.

The Importance of Teamwork

The importance of teamwork runs throughout this period in the College's history. Indeed, the sense of teamwork among our deans' team, department chairs, Executive Committee, and faculty was truly extraordinary. It clearly dominated the usual hierarchy of authority that characterizes administrative organizations.

Not to say that we avoided responsibility. Sooner or later someone had to lead the troops into battle, and suffer the consequences if the battlefield strategy was a failure. I have long become convinced that academic leadership is never effective from far behind the front lines. Truly effective academic leadership occurs on the front lines.

The Future of Engineering Education

All of these lessons are likely to prove valuable in the years ahead as engineering education faces a period of extraordinary change, perhaps too long delayed and today desperately needed. Let me explain.

In rummaging through the historical collections of the University during the research for this book, I was surprised to find how similar the engineering curriculum of a century ago was to today's programs. In 1900 we required students to take 130 credit hours of courses in mathematics, physics, and chemistry with a concentration in applied courses in areas such as mechanical, civil, and chemical engineering, just as we do today. In fact, if one swaps yesterday's requirement for surveying and mechanical drawing for today's courses on computers, the two curricula are almost identical. Of course, the actual content of these courses has changed considerably—or so one would hope.

With one major exception, the actual structure of the engineering curriculum has remained roughly the same over the past century. That exception is an important one. The 1900 curriculum placed far more stress on the importance of a liberal education, with more courses in humanities, arts, and social sciences. In fact, one might even suggest that we have regressed over the past century, overloading our current curriculum with highly specific technical courses at the expense of broader educational opportunities for our students.

Of course, engineering practice today is dramatically different than it was a century ago. Indeed, it is quite different from that of two decades ago, when most of our current faculty members were educated. This raises an important question: Is the education we provide today for technical professions such as engineering adequately preparing our students for a world of practice and citizenship that is quite different from the one that we have known?

Study after study has suggested that dramatic change is necessary in engineering education. From the National Academies to federal agencies such as the National Science Foundation to industrial groups to accreditation agencies there is a growing consensus that engineering education today remains trapped in a mid-20th Century paradigm[4] (or perhaps even a late 19th Century paradigm, if my archeological discoveries about similarity between early engineering curricula and today's offerings are correct). We continue to provide a form of engineering education, which, while familiar from our own educational experiences, is increasingly irrelevant to the changing needs of a profession—not to mention a society—that is already far beyond our universities.

The context for considering the nature of undergraduate education in general and engineering education in particular is provided by the broader challenges of change characterizing our world and impacting higher education. Engineering education will not be exempt from these changes, but may be swept along at the crest of the wave of university change. There is little likelihood that the engineering curriculum will continue to preserve its century-old structure in the century—indeed, in the decade—ahead.

The Challenges

Today, engineering practice is evolving rapidly in response to a rapidly changing world. The shifting nature of national priorities from defense to economic competitiveness, the impact of rapidly evolving information technology, the use of new materials and biological processes—all have had deep impact on engineering practice. The shift of our society from guns to butter, from transportation to communication, from atoms to bits, means that today's engineering students will spend most of their careers coping with challenges and opportunities vastly different from those most currently practicing engineers—or currently teaching faculty—have experienced. While engineers are expected to be well grounded in the fundamentals of science and mathematics, they are increasingly expected to acquire skills in communication, teamwork, adaptation to change, and social and environmental consciousness.

It is also clear from this perspective that engineering education simply has not kept pace with this changing environment. It is only a slight exaggeration to say that our students are currently being prepared to practice engineering in a world that existed when we, as their faculty, were trained a generation or two ago. They are not being prepared for the 21st Century. No doubt that part of this challenge is due to the intellectual organization of the contemporary university in which academic programs are partitioned into increasingly specialized and fragmented disciplines. Perhaps reflecting the startling success of science in the 20th Century, most disciplines are reductionist in nature, focusing teaching and scholarship on increasingly narrow and specialized topics. While this produces graduates of great technical depth, it is at a certain sacrifice of a broader, more integrated education. This is particularly true in science-based disciplines such as engineering. The old saying is not far off the mark, "A Harvard graduate knows absolutely nothing about absolutely everything. An MIT graduate knows absolutely everything about absolutely nothing!"

We must question the value of narrow specialization at a time when engineering practice and engineering systems are becoming large, more complex, and involving components and processes from widely dispersed fields. Many believe that the most important intellectual problems of our time will not be addressed through disciplinary specialization but rather through approaches capable of integrating many different areas of knowledge—through “big think” rather than “small think”.

Ironically enough, the essence of engineering practice is the process of integrating knowledge to some purpose. Unlike the specialized analysis characterizing scientific inquiry, engineers are expected to be society’s master integrators, working across many different disciplines and fields, making the connections that will lead to deeper insights and more creative solutions, and getting things done. Thus, engineering education is under increasing pressure to shift away from specialization to a more comprehensive curriculum and broader educational experience in which topics are better connected and integrated.

As the knowledge base in most engineering fields continues to increase at an ever more rapid rate, the engineering curriculum has become bloated with technical material, much of it already obsolete. Most undergraduate engineering programs have already become almost five years in length for most students. Even with this increasing technical content, most engineers will spend many months if not years in further workplace training before they are ready for practice. Furthermore, the effort to include the new technical knowledge in many fields, while retaining as well much of the old, has squeezed out other important curriculum content in areas. For example, at the University of Michigan, the humanities and social sciences component of the undergraduate engineering curriculum has dropped to less than twenty credit hours, with as low as two credit hours of free electives in some engineering majors.

We simply have to accept the fact that it is no longer possible (if it ever was) for an engineering student to learn all they need to know during their undergraduate studies. Acquiring the array of technical knowledge and experience is a lifetime goal and requires a personal commitment to continual learning. An undergraduate engineering education should be viewed as only the initial launch for a career, designed to place the student in a lifetime orbit of learning.

As the growth of technical knowledge accelerates and the undergraduate engineering curriculum becomes more bloated and strained with new technical content, it becomes ever more apparent that it is simply no longer possible to regard the baccalaureate degree as sufficient for professional practice. Today, engineering is one of the very few professions that require only an undergraduate degree for professional status. Most other knowledge-intensive professions such as law, medicine, and even business, utilize graduate programs built upon a diversity of undergraduate majors. Little wonder that the status of engineers lag somewhat behind those of other professionals with more advanced education.

The inadequacy of the baccalaureate degree for professional practice is becoming apparent to employers as well. There is an increasing trend to hire graduates at the masters or even Ph.D. level for technical work, while relying upon baccalaureate engineering graduates for supporting services such as sales and technical support. Although study after study has recommended that the masters degree become the accepted route into the engineering practice, this continues to be resisted both by the profession and the academy.

There is little doubt that the current sequential approach to engineering education, in which the early years are dominated by science and mathematics courses with engineering content deferred to the upper-class years, discourages many capable students. Students have little opportunity to find out what engineering is all about until late in their undergraduate studies. It is not unusual to find students wandering into our counseling and placement offices in their senior year, still trying to find out what they are majoring in and what they can do with an engineering degree. Compounding this is the fragmentation of the current curriculum, consisting of highly specialized and generally unconnected and uncoordinated courses, whose relationship to one another and to engineering education is rarely explained. Although everyone agrees that the undergraduate curriculum should focus on the fundamentals, few can agree on just what content is truly fundamental.

While the rigor of the scientific and mathematics foundation of modern engineering is important, it must be augmented by the broader contextual and integrative approach characterizing engineering practice. Students must gain experience not only in solitary analysis but also in group work and hands-on "design-build-operate" projects. We must strive to integrate real design and process understanding into the educational system. Above all, we must challenge our students to think, to create, and to understand excellence.

In today's world of change, most graduates will find themselves frequently changing not only jobs, but entire careers. We already find that only about fifty percent of engineering graduates will enter technical careers, and after five years, about half of these will have moved into other areas such as management or sales. Most engineering graduates of today will find themselves in engineering practice for only a relatively short period, if at all.

Yet the increasing importance of technology to our world has made an engineering degree an excellent preparation for many other careers and professions: business, law, medicine, consulting, and government service, to name only a few. This poses a particular challenge to engineering educators, since they still focus primarily on educating students for the engineering profession.

Instead, as Roland Schmitt, former chair of the National Science Board and president of RPI has noted, we must enlarge the very concept of the engineer to cover a wider range of human activities than every before. Engineering educators must begin by realizing that it is their duty to educate the leaders of our society as well as to educate the professional engineer. We should develop and promote a new kind of engineering education as a form of "liberal education" for the 21^{st} Century. This will require new objectives and new curricula, some radically different that those of today because of a radically different objective: educating not simply professional engineers but a new breed of graduates with an engineering-based, liberal education.

Engineering faculties are almost unique among those of professional schools since they generally have little experience or activity in professional practice. The strong research focus of most engineering schools has led to a cadre of strong engineering scientists, able at generating new knowledge but relatively inexperienced in professional practice. Furthermore, engineering faculty are judged and rewarded by criteria appropriate to science faculty. Indeed, professional practice is not only absent in promotion and reward criteria, but frequently discouraged.

The faculty reward system recognizes teaching, research, and service to the profession, but it gives little recognition for developing a marketable product or process or designing an enduring piece of the nation's infrastructure. It would be hard to imagine a medical school faculty comprised only of biological scientists rather than practicing physicians or music school faculty comprised only of musicologists rather than performing artists. Yet such detachment from professional practice and experience is the norm in engineering education.

It Is Time to Stop Talking and Take Action

Engineering educators, professional societies, and federal funding agencies such as the National Science Foundation have not been insensitive to these concerns. All agree that a sea change in engineering education would require a concurrent change from the predominant engineering school academic culture based on compartmentalization of knowledge, individual specialization, and a research-based reward structure to one that values integration as well as specialization, teamwork as well as individual achievement, and educational research and innovation as well as research in the engineering sciences. These studies suggested a new set of goals for engineering education:

1. To offer a broad liberal education that provides the diversity and breadth needed for engineering practice.
2. To prepare graduates for entry into careers and further study in both the engineering and nonengineering marketplace.
3. To develop the motivation, capability, and knowledge base for lifelong learning.

This will require a very major change in the engineering curriculum. To some degree, it will require modernizing the science and mathematics instruction, e.g., recognizing that discrete rather than continuous mathematics is the foundation of the digital age, that biology and chemistry are rapidly becoming more important than physics, that new materials and processes have made obsolete much of the traditional curriculum. Beyond these technical changes, the NSF studies recognized that the new engineering curriculum must reflect a broad range of concerns, including environmental, political, social, international, and legal and ethical ramifications of decisions. Although the technical component would continue to be the core of an engineering education, the economic, political, social, and environmental context of engineering practice needs to be explicitly addressed.

Beyond that, engineering education should move away from the current dominance of classroom-based pedagogy to more active learning approaches that engage problem-solving skills and team building. Joseph Bordogna, Deputy Director of the National Science Foundation and a former engineering dean recalls the old Chinese proverb:

I hear and I forget.
I see and I remember.
I do and I understand. [5]

This is apt indeed for engineering education. As a recent NSF workshop put it, the ubiquitous lecture is the bane of true learning, especially in observation-based, hands-on fields such as engineering. The lecture-dominated system encourages a passive learning environment, a highly compartmentalized (lecture-sized) curriculum, and worst of all, instills neither the motivation nor the skills for life-long learning. The dependence on the standard lecture must be diminished with emphasis given instead to discovery-oriented learning. We must create discovery-oriented learning environments that capitalize on the full power of new communication, information, and visualization technologies.

Undergraduate engineering programs can no longer ignore the fact that they simply cannot provide all the necessary knowledge for graduates to remain competitive throughout their careers. Content-based learning alone must not drive engineering education. The primary aim should be instead to instill a strong knowledge of how to learn, while still producing competent engineers who are well grounded in engineering science and mathematics and have an understanding of design in the social context. Engineering schools must educate the student for a lifetime of learning rather than just for their initial job. Students must learn how to learn, and they must be able to assess their skills and educational needs throughout their many careers. As Peter Drucker puts it, "We are redefining what it means to be an educated person. Traditionally an educated person was someone who had a prescribed stock of formal knowledge. Increasingly an educated person will be someone who has learned how to learn and who continues to learn throughout his or her lifetime."

Despite this broad effort, change in engineering education has been modest, as reflected in the tone of frustration in the recent remarks of Bill Wulf, President of the National Academy of Engineering: "We have studied engineering reform to death. While there are differences among the reports, the differences are not great. Let's get on with it! It is urgent that we do!"

Who is holding back change? Professional societies and accreditation agencies such as ABET? No, we have seen that they have become important forces of change.

What about industry? To be sure there is still a good deal of myopia among the recruiters that visit our placement office, all too often reinforcing very narrow definitions of student majors and abilities. Yet at high levels of management, there is strong awareness of the need for a broader form of engineering education. In a recent survey of CEOs conducted by the Business Higher Education Forum, it was found that the qualities valued most highly in graduates were not specific technical knowledge or skills but rather the ability to communicate clearly, a commitment to lifelong learning, the ability to adapt to an increasingly diverse world, and finally the willingness not only to adapt to change but to actually drive it.

What about the faculty itself? To be sure, change is sometimes a four-letter word on university campuses. It is sometimes said that universities change one grave at a time. Judging from my comparison of the engineering curriculum of a century ago, even this may be too optimistic for engineering education. In fact, engineering educators do tend to be very conservative with regard to pedagogy, curriculum, and institutional attitudes. This conservatism produces a degree of stability (perhaps inflexibility is a more apt term) that results in a relatively slow response to external pressures.

For the past several decades, the emphasis of engineering education has been focused on the scientific foundation of engineering knowledge. In part this had to do with the impact of modern science on technology. But it was also due to the culture of the research university, in which engineering faculty were evaluated based on their performance in fundamental research rather than engineering practice. Many believe this emphasis on research has also eroded the quality of teaching in engineering schools. In fact, a recent conference of young faculty suggested that most engineering schools not only fail to support adequately but also outright discourage faculty achievements in teaching, instructional scholarship, and public service. Tenure and promotion criteria do not encourage faculty to aspire to broad scholarly achievements, especially innovation, nor to contributions to public understanding.

Some Ideas for Accelerating Change

In the spirit of stimulating debate and thought, let me suggest a few more Draconian actions designed both to shake up and transform engineering education. First, it may be time to start with a clean slate by eliminating all specialized engineering majors, particularly at the undergraduate level. The ever more narrow specialization among engineering majors is driven largely by the reductionist approach of scientific analysis rather than the highly integrative character of engineering synthesis. It may be appropriate for basic research, but it is certainly not conducive to the education of contemporary engineers nor to engineering practice. Although students may be stereotyped by faculty and academic programs—and perhaps even campus recruiters—as electrical engineers, aerospace engineers, etc., they rapidly lose this distinction in engineering practice. Today's contemporary engineer must span an array of fields, such as modern technology, systems, and processes.

Perhaps it is time to go even further and simply abandon the concept of an undergraduate engineering major and instead provide a general engineering curriculum, much as in other professions such as medicine, law, and business. Like these professions, one could leave specialization until later, provided either through graduate study or on-the-job training.

In fact, one might conjecture that in a future characterized by lifelong learning, perhaps engineering will rapidly evolve along the lines of other learned professions and shift professional education and training entirely to the graduate level, eliminating the undergraduate engineering degree altogether. There are strong reasons to suspect that a broad, liberal education is just as important for engineering practice as it is for other professions such as medicine and law. (Here one could also make the case for significantly greater technical and scientific content in the contemporary liberal arts curriculum.)

Although science and engineering are heavily based on laboratory methods, in fact they are usually taught through classroom lectures coupled with problem-solving exercises. Contemporary engineering education stresses the analytic approach to solving well-defined problems so familiar from science and mathematics—not surprising, since so many engineering faculty members received their basic training in science rather than engineering. To be sure, design projects required for accreditation of engineering degree programs are introduced into advanced courses at the upper-class level. Yet design and synthesis are quite small components in most engineering programs.

Clearly those intellectual activities associated with engineering design—problem formulation, creativity, innovation—should be introduced throughout the curriculum. This will require a sharp departure from classroom pedagogy and solitary learning methods. Beyond team design projects, engineering educators might consider adopting the case method approaches characterizing business and law education. More use might be made of internships as a formal part of the engineering curriculum, whether in industry or perhaps even in the research laboratories of engineering faculty where engineering design is a common task.

It is absolutely essential to broaden the engineering faculty to include practitioners. One approach would be to work with industry to persuade and allow senior engineering staff to accept faculty appointments. In fact, many retired engineers would make ideal faculty members, bringing their wealth of experience in engineering practice not only to the students but to the reshaping of the current science-driven culture of engineering schools. Of course, this would require a very significant restructuring of the faculty promotion and reward systems. It might even lead to the elimination of tenure, at least in some components of engineering education. But the mix of practitioners and scholars has been both accepted and constructive in most other professional schools—medicine, law, business, architecture, and the fine arts. It seems high time to bring engineering education into line.

As we noted earlier, engineering educators should be challenged to devise an engineering-based "liberal education" for students of the 21st Century. Engineering principles and modes of thought should be the centerpiece of what the liberally educated person should know in the age of knowledge that is our future. We should produce graduates for all careers—from industry to law to government—with an education attuned to the issues and challenges of a knowledge-driven society, many of which have dominant technical themes. The old saying that the purpose of a college education is not to prepare a student for their first job but rather their last job still has a ring of truth.

The Future of the University of Michigan's College of Engineering

Today the College of Engineering enjoys not only a reputation among the top engineering programs in the nation, but it is probably the strongest academic unit in the University of Michigan. This success is due to the efforts of many, many people–faculty and staff, alumni and patrons, and academic leaders at both the College and University level. Beyond skillful leadership and vision, commitment and loyalty to the College and the University were essential.

But it is also due, I believe, to a concerted effort by the College to weave itself into the mainstream of the University. We worked hard during the 1980s not only to build strong relationships with the leadership of the University, but to position the College as an active participant in University-wide priorities (e.g., working with LS&A to strengthen the sciences, building interdisciplinary programs with numerous schools and colleges, pulling back from efforts to duplicate instruction in areas such as mathematics and the humanities). In the process, the College of Engineering was able to build a political base of support across the University that enabled the strong support provided by the central administration and the State of Michigan.

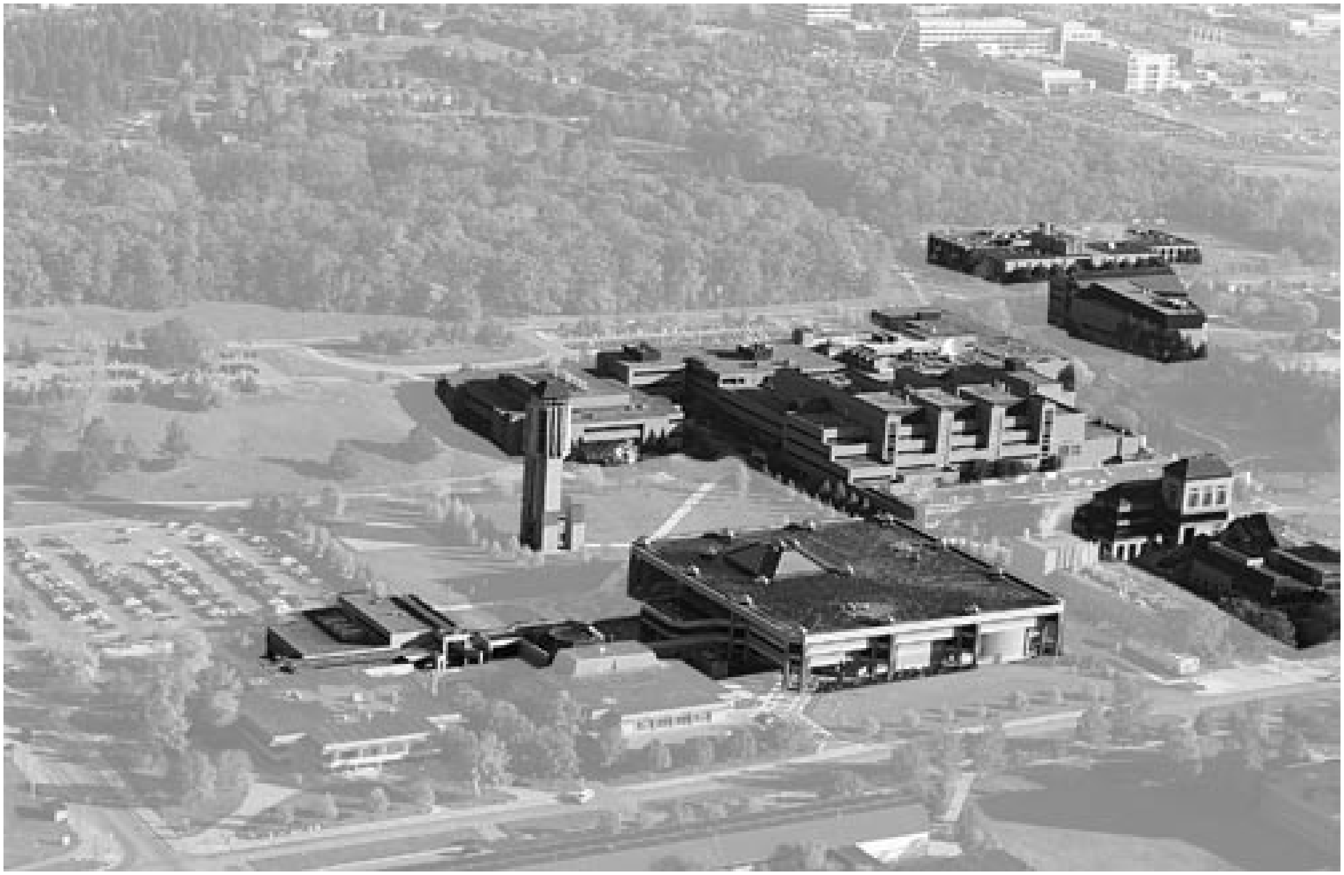
The lesson of history seems clear. The College of Engineering tends to thrive when it is at the center of University activities. It invariably suffers when it attempts to go it alone, to follow its own agenda, to decouple from the University leadership. One must never forget that the College of Engineering draws its strength and its reputation from the University of Michigan. It is a great engineering school because it is an integral part of a great university!

Appendices

Appendix A

List of the College of Engineering Buildings

1854: South College
1881: Scientific Blacksmith Shop
1882: Carpenter's Shop
1885: Brick Engineering Shop
1891: Old Dental School
1904: West Engineering
1908: Old Hospital structure for surveying added on one end
1916: Old Power Plant
1922: East Hall (Old Tappan Elementary School)
1923: East Engineering
1947: East Engineering Addition
1950: Cooley Laboratory, Phoenix Laboratory (North Campus)
1952: Fluids Laboratory (now G. G. Brown Laboratory) (North Campus)
1954: Automotive Laboratory (North Campus)
1964: Institute of Science and Technology (North Campus – UM)
North Campus Commons (North Campus – UM)
Chrysler Center for Continuing Engineering Education (NC)
1968: Space Physics Research Laboratory (North Campus)
1970: Building 1-A (addition to GGBL for water resources)
1970: Aerospace Engineering Building
1981: Dow Building (North Campus)
1981: Accelerator Laboratory (Naval Architecture)
1983: DRDA (Industrial Engineering), Cooley Laboratory (Nuclear Engineering)
GGBL High Bay Area (Civil Engineering)
GGBL and Auto Lab renovated for Mechanical Engineering
Stearns Building (Engineering Placement)
1985: Electrical Engineering and Computer Science Building
1985: Addition doubling (then tripling) Space Physics Research Building
1985: Connector between Dow and GGBL
1986: Addition to North Campus Commons (Chuck's Bar & Grill)
1986: IST reassigned to Engineering
1990: FXB Building for Aerospace Engineering
1996: Media Union
1996: Lurie Administration Building and Lurie Tower
2002: Addition to IST
2003: Carl Gerstacker Laboratory



North Campus buildings constructed after 1980.

Appendix B

Introductory Address to the Faculty, March 17, 1981

Thank you, Dr. Frye. It is certainly a privilege—and certainly also, I might add, a challenge—to be offered the opportunity to serve as dean of the College of Engineering. The College has a distinguished history, ranking among the leading engineering programs in the United States for many years. It has played an essential, indeed, a vital, role within the University, the state, and the nation. And I believe the College will play an even more important role during the next decade, as the state and the nation become ever more dependent on engineering to revitalize industry and the economy.

To be sure, the College faces serious challenges at the present moment, including inadequate funding, decaying physical facilities, obsolete equipment, and an overloaded faculty. But it also faces a time of great opportunity. Never before has the demand for engineers, and the demand on the part of students to become engineers, been more intense. Furthermore, I believe that the central administration, President Shapiro and Vice-President Frye, understand well the present difficulties faced by the College and are seriously committed to working with us to overcome these difficulties. But we must go beyond that, to develop our own goals for the long term—to determine where we are today, where we want to be in five or ten years, and what we need to do to get there—and the faculty must play an essential role in this activity.

I would suggest that the most important of our goals for the long term should be a rededication, a commitment, to the achievement of excellence, in education, scholarship and research, and in the professional achievements of faculty and students. All too often we have been distracted by more immediate goals such as the North Campus move or improving instructional efficiency than focusing on the quality of the College's research and instructional programs. The key to quality lies not with physical facilities nor clever administration—it is with people, their abilities, their attitudes, and their commitment.

I would hope to work with you to establish an environment within the College that not only allows for excellence, creativity, and innovation, but actively stimulates and rewards—indeed, demands—such efforts. To do this will require your cooperation. It will also require resources, both from traditional sources such as University support, state funding, and federal research grants as well as new and innovative relationships with industry. But I am confident that with the proper incentives, such resources can be acquired.

As a dean I will be dedicated and committed to the achievement of excellence. I would hope that I can exhibit the energy and enthusiasm to stimulate and achieve this. I assure you that I intend to be a full-time dean, receptive and responsive to student and faculty needs and concerns and totally dedicated to working with you to see that these needs are met. It is my intent to open up new lines of communication to the faculty, to reinvolve you in the governance of this College. To this end, I would hope to have the opportunity to meet with most of you, either as individuals or members of your department or research groups during the next month, to learn your needs and concerns and to seek your advice and suggestions.

In conclusion, I am very optimistic about the future of the College. I look forward to working closely with you to meet the challenges, the opportunities, and the responsibilities that face the College during the years ahead.

Appendix C

The "MIT of the Midwest" Plan (1985)

Stage I: The Restoration Phase

The College sought a base budget increase of $8.5 million to restore state support of the College to a level comparable to that presently received by other peer public engineering schools (Illinois, Purdue, Texas). Additional one-time support of $20 million was sought to support major initiatives in the critical areas of complex manufacturing technology, advanced electronics and optical devices, and advanced materials.

Stage II: The Leadership Phase

A sequence of additional state investments were sought to bring the support of UM Engineering to a level comparable to that of leading engineering schools (e.g., UC- Berkeley, MIT, Stanford). This would require an additional increase in base appropriations of $9.5 million and one-time equipment support of an additional $20 million to restore the College's laboratory equipment inventory to competitive levels. In addition, two new facilities were sought: a $20 million building to contain laboratories for rapidly changing areas of technology, and a $20 million facility to serve as an incubation center for bring together startup company and satellite corporate R&D laboratories with College faculty, students, and staff.

Policy Matters

- College control over all contract research funding (both direct and indirect cost recovery via an Engineering Research Institute model).
- Some degree of control over other College-generated resources and expenditures (e.g., tuition revenue and patent and royalty income).
- Modification of University conflict-of-interest and patent policies.

Other Sources of Support

The College would use the additional state funding to generate an additional $70 million per year in revenues from:

- $30 million per year of federal and industrial research contracts
- $25 million per year of tuition and fee income
- $15 million per year of private gifts

(It should be noted that over the next decade, the College achieved most of these goals. Phase I was, of course, the Research Excellence Fund. The policy changes, including control of all revenues was achieved through the Responsibility Center Management program implemented during my presidency. Although we did not achieve the additional state support in Phase II, we did achieve $70 million of additional state capital outlay for the Media Union and the Lurie Engineering Center. Finally, the goals of sponsored research volume, tuition and fee income, and private support were all achieved within a few years.)

A Personal History of the College of Engineering

Notes

Chapter 1

[1] Emerson, George S., *Engineering Education: A Social History* (David & Charles: Crane, Rujsak & Company: New York, 1973).

[2.] Howard H. Peckham, *The Making of the University of Michigan*, 1817 - 1992, edited and updated by Margaret L. Steneck and Nicholas H. Steneck (University of Michigan Bentley Historical Library: Ann Arbor, Michigan 1997) pp, 1-15; Wilfred B. Shaw, editor, The University of Michigan, An Encyclopedic Survey (University of Michigan Press: Ann Arbor, 1941-)

[3] Paul E. Lingenfelter, The Firing of Henry Philip Tappan, University Builder, M.S. Dissertation, University of Michigan, 1970.

[4] Henry Philip Tappan was quite an unusual leader for a 19th Century university. Unlike most university presidents of this period, Tappan was a broadly educated philosopher rather than a clergyman by training. He conceived of the university as a capstone of civilization, a repository for the accumulated knowledge of mankind, and the home of scholars dedicated to the expansion of human understanding. Among his many accomplishments as University president was the establishment of the traditions of emphasis on research, graduate education, student autonomy and freedom, and active faculty governance.

Yet both his vision and his personality stimulated considerable opposition. Led by the editor of the Detroit Free Press, the state's newspapers were strongly opposed to his goal of building a true "university" in the European sense, but instead believed that a "high school" was the only goal deserving of state support. Within a few months after arriving on campus, Alexander Winchell developed a strong dislike for Tappan, both because of his personal assignments to various academic programs that he detested (civil engineering, mathematics) as well as to Tappan's refusal to countersign an order for a microscope he wanted. Working closely with his close friend Erastus Haven, Winchell sent a private communication to the Regents claiming that Tappan had assailed his professional character. He then began to write letters under the anonymous name of "Scholastus" to the Detroit newspapers criticizing Tappan and his ideas. He also encouraged a resolution at the state Methodist convention questioning the moral conditions at the University. It was clear that by 1857 Tappan had made a profound enemy in Winchell, and that Winchell had a strong ally E. O. Haven. Both men believed Tappan must go, and Haven was toying with the idea of someday replacing him (as indicated in his letters).

When the new Board of Regents was elected, both men began to work with a new Detroit Regent, Levi Bishop, who also began to write hostile anonymous letters concerning Tappan to the Detroit papers. Most of the other Regents were not initially hostile to Tappan, but Bishop soon found a way to drive a wedge between them by being appointed chair of a committee to report on rules and regulations. His report recommended a committee structure that would assume most of the executive function of the President and the faculty. Tappan fought against this, noting that not only was this unconstitutional, but that the "president and the faculty are not mere "employees" but are, in fact, THE university. Bishop launched a counter attack, with vicious diatribes against Tappan's "bundle of nonsense." Winchell continued to ingratiate himself with the Regents to lobby against Tappan.

Finally, as the Regents approached the end of their tenure, they quietly moved to replace Tappan. Haven wrote to tell Alexander Winchell that he had been asked whether he would accept the presidency if it were open, and he replied that he would probably accept an offer. He let his Michigan friends know that he was "profoundly interested in educational matters." On June 25, 1863, the Regents passed a motion to remove Tappan both as president and as Professor of Philosophy. They then unanimously elected E. O. Haven as president. Tappan was offered the opportunity to resign the morning of the motion but refused. The same day Haven wrote a letter to Winchell conveying his "surprise" and pleasure at the action of the Board and asking for Winchell's assistance in preparing for the fall. Winchell wrote that "my worst enemy has been displaced and my best friend put in his stead."

But years later, James Burrill Angel was to have the last word on the sordid incident: "Tappan was the largest figure of a man that ever appeared on the Michigan campus. And he was stung to death by gnats!"

[5] Mortimer E. Cooley, Scientific Blacksmith (University of Michigan Press: Ann Arbor, 1947).

[6] Mortimer E. Cooley was the first officer detailed to the University of Michigan from the United States Navy as Professor of Steam Engineering and Iron Shipbuilding in 1881 to establish courses in mechanical engineering in the Department of Civil Engineering. However his title was quickly changed to Professor of Mechanical Engineering, since he was, in fact, the only mechanical engineer in the state.

[7] Charles Adams, then professor of History and later to become president of Cornell, used to stop by the little building to greet

Cooley with "And how is the scientific blacksmith shop doing this morning".

[8] The Regents adopted the practice that all academic units enrolling first-year students (e.g., LS&A) were named "college," while those enrolling only upper division or graduate students (e.g., Medicine, Law) were named "school." Architecture would remain a department in Engineering until 1931, when it was spun off as a separate school with Emil Lorch as its first dean.

[9] Wilfred B. Shaw, editor, *The University of Michigan, An Encyclopedic Survey* (University of Michigan Press: Ann Arbor, 1941 -)

[10] Mortimer E. Cooley, Scientific Blacksmith (University of Michigan Press: Ann Arbor, 1947).

[11] Personal communication, Mike Wallace to J. Duderstadt, 1992.

Chapter 2

[1]Here I might note my own connection to Saarinen's architecture. When I arrived at Yale in 1960, the university had just finished construction of two of Saarinen's boldest designs, Stiles and Morse College. These massive stone structures, more reminiscent of the Neolithic stone monuments scattered about England than Yale's traditional gothic architecture, were infamous because they avoided 90-degree corners in any of its rooms. Later, during a summer job in 1963 with an architect-engineering firm, I was to work on another Saarinen design, Dulles International Airport in Washington, yet another project somewhat ahead of its time with its soaring architecture and mobile airport lounges.

[2] *The Michigan Alumnus*, October, 1949, p.93

[3] *The Michigan Alumnus*, December, 1950, p.15

Chapter 3

[1] In an interview with the Michigan Technic, Ragone observed, "The decision to move the College was made before I arrived on campus in 1953. The decision was already made before then, when we built the Mortimer Cooley building out there in 1953-54. We were committed right then. The Mechanical Engineering Department is split. We've now half out there and half in here. I think that's more serious than worrying whether you're going to talk to the philosophers. But, having the Mechanical Engineering Department split in two, and the Civil Engineering Department split, and the Water Resources Department split—I think that's more serious intellectually than worry about whether you're going to talk to the rest of the campus."

Chapter 4

[1] The Academic Affairs Advisory Committee of the Senate Assembly was sometimes known as the "little aaac" to distinguish it from the Academic Affairs Advisory Council (the big "AAAC") comprised of the deans. Much later this confusion was rectified by renaming the AAAC the Provost's Advisory Group or PAG. However to keep things simple, I will use AAAC instead of aaac in this book.

[2] My paths would cross frequently in later years with those of Frank Rhodes, with whom I worked closely on an array of higher education issues as a university president and then who succeeded me in 1994 as chairman of the National Science Board.

[3] Actually, since the West Engineering Building had originally been constructed in 1904, I suppose it would be more correct to classify it as Edwardian in era. Whatever. It was still almost a century out of date with contemporary engineering needs.

Chapter 5

[1] There is an interesting sidebar here: Since engineers think quantitatively, we developed a rather complex formula to allocate budget resources according to several key performance indicators such as instructional load, Ph.D. enrollments, sponsored research activity, and so on. We distributed this formula to all of the department chairs, along with tables showing the allocation to each department, in an effort both to stress openness and clearly indicate the priorities we used for resource allocation. After a couple of years of using this formula, one of our department chairs, Steve Pollock, cornered me one day and said, "Say, do you guys know that if you simplify the algebra in the formula, all of the terms cancel out?!" Actually, we had realized that early on, but since no one questioned the algorithm and it seemed to be doing the job in sending out the right message concerning priorities and incentives, we decided to leave it alone.

[2] Our development people were horrified that I might make GM mad.

Chapter 7

[1] There are many stories about our use of the Apple Lisa to launch CAEN. We negotiated a very special arrangement with Apple, with deep discounts and special hardware and software support. Several large trucks arrived from California two weeks before the fall term started with the first delivery, and with great effort, we managed to get all of the computers operating before the students arrived. Although the Apple Lisa was never a major commercial success, for many years it remained the state-of-the-art. Even when it became obsolete it had a use. The College presented Chuck Vest with an Apple Lisa converted into a planter when he left to become president at MIT!

[2] One piece of evidence of just how receptive the students were to this plan was an editorial in the Michigan Daily that concluded: "The University's engineering school has tried something different. It is purchasing a new, sophisticated computer network, and giving engineering students unlimited access to it. The system has its price-an extra $100 per term-but it is worth it. The school could have forced all students to buy their own computers. But this will provide a far more sophisticated system. And financial aid can cover the tuition hike in some cases."

[3] Ironically, the completion of the EECS Building and its dedication in September of 1986, which marked the official completion of the North Campus move, occurred just after I had moved over to the provost's office on State Street. Chuck Vest was the new dean, and he had the honor of presiding at the EECS dedication and hosting the celebration of the completion of the move. Anne and I stood in the back of the audience at the dedication (an experience that would become even more common when we stepped out of the presidency ten years later

Chapter 8

[1] Interestingly enough, a similar situation arose in the late 1960s when two law faculty members, Robben Fleming and Allen Smith, were president and provost. Fleming always delights in telling the story of being introduced by the dean to the LS&A faculty, who told them not to worry, since although Fleming was also a lawyer, like Smith, he wasn't a very good lawyer.

[2] At the time, not only was Glenn Knoll Interim Dean, but Bill Martin, another faculty member from nuclear engineering, was associate dean. When rumors about the possibility of my returning to the role began to circulate, the running joke was "Question: How many nuclear engineers does it take to lead the College? Answer: Three ...and still counting!"

[3] Charles Moore was not only the most distinguished graduate of the University's School of Architecture, but was important to the University in other ways as well. When we awarded him an honorary degree in 1994, he noted that his great-great grandfather had been the Regent of the University who had made the formal motion to admit women.

Chapter 9

[1] Larry Downs and Chunka Mui, *Killer App* (Cambridge: Harvard Business School Press, 1998).

[2] Thomas S. Kuhn, *The Nature of Scientific Revolution* (Chicago: The University of Chicago Press, 1962)

[3] An unfortunate example of the latter approach is the massive investment the University made in recent years to build a new Life Sciences Institute. Although this is an important area, and although the University investment has been massive (largely depleting the reserves of the University Hospital), this is not an investment in strength. In fact, many other institutions with clear advantages (including Nobel Prize winning faculty) are investing far greater sums, making it highly unlikely that the effort will succeed. The University would have been far wiser to invest in areas of existing strength such as the clinical sciences, and then to evolve from these into broader areas of the life sciences.

[4] Morgan, Robert P., Proctor P. Reid, Wm. A. Wulf, "The Changing Nature of Engineering", ASEE Prism, May-June, 1998, pp. 13-17.

[5] Bordogna, Joseph, Eli Fromm, Edward W. Ernst, "Engineering Education: Innovation Through Integration", *Journal of Engineering Education*, January, 1993, pp. 38.

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