

FROM THE

COLLEGE OF ENGINEERING
UNIVERSITY OF MICHIGAN

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A SPECIAL REPORT FROM
THE DEAN

ENGINEERING EDUCATION
AT MICHIGAN—
CHALLENGE, OPPORTUNITY,
AND RESPONSIBILITY

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THE SITUATION

The College of Engineering at The University of Michigan is a national resource. Its role becomes more crucial day by day as our society becomes ever more dependent upon science and technology and therefore upon the availability of talented, broadly-educated engineers. The degree to which all sectors of our society band together to support the educational and research activities of premier engineering schools such as the College will in large measure establish the level of economic and military security of this nation. This degree of support will also be a determining factor in the quality of American life.

As one of the leading engineering schools in the nation, the College of Engineering has long been distinguished for its ability to integrate outstanding undergraduate, graduate, and research programs to achieve extraordinary breadth and depth across the full spectrum of engineering disciplines. Graduates of the College are widely known for their strong background in fundamental science, their ability to apply this knowledge in engineering practice, and for the ease with which they move rapidly into positions of leadership in industry, government, and academe.

Industry and government are turning increasingly to the College in their efforts to rebuild American productivity and provide for the security of our nation. They seek both the talented engineering graduates so critical to our society and the intellectual creativity of engineering faculty essential to technological innovation. Of even more significance is the degree to which they have turned to the College for the leaders of tomorrow.

Yet at just this moment, when the College of Engineering faces these unprecedented responsibilities and opportunities, it also faces the most critical challenge in its history. Despite the importance of its role for Michigan and the nation, the College finds itself seriously hampered in its efforts to respond to the urgent needs for its graduates and its research. Indeed, it is accurate to state that the College today faces a *crisis* of major proportions in its efforts to maintain its tradition of excellence in engineering education.

At the heart of this crisis is a decade of deterioration in public support of the College. During the 1970s State support of the College effectively vanished. Today the College finds itself operating essentially as a "private" institution. It now must cover the operating and capital costs of its academic programs from one of three sources: tuition, sponsored-research grants and contracts, and private support. In effect, it no longer benefits from State tax revenues. This deterioration in public support has occurred so abruptly that the College has had neither the time nor the opportunity to replace dwindling public support with a comparable level of support from the private sector. As a result, it now finds itself struggling

to meet the intense needs for its graduates and its research in the face of inadequate funding, obsolete laboratories, decaying physical facilities, and a badly overloaded faculty.

In the past the outstanding quality of the College's instructional and research programs was achieved in large measure because of strong private support from alumni and friends, industry and foundations. Private contributions provided the critical margin of support beyond that received from public sources which is so essential for excellence in engineering education. Today, however, the College faces its future from the perspective of a privately-funded institution. It now must rely on such support to the same degree as the other leading *private* engineering schools. Only in this way can the College respond to the needs of Michigan and the nation for its graduates and the intellectual achievements of its faculty, provide the best of our high school graduates with the opportunity for an engineering education of exceptional quality, and sustain its distinguished tradition of excellence in instruction and research.

Over the next decade the College's primary objective will be to continue and strengthen its position of leadership in engineering education, research, and the professional activities of its graduates and faculty. However it has become apparent that the College will be able to respond to the *challenges* and *opportunities* before it only if its alumni and friends, private industry, and private foundations recognize *their responsibilities* to respond *now* to the needs of the College. They must step forward now to assist it in making the painful transition to the status of a privately-funded institution.

This report is intended to document the present challenges, opportunities, and responsibilities that lie before the College of Engineering at The University of Michigan. It traces the alarming deterioration in public support of the College over the past decade. It stresses our belief that a major increase in the support of the College by the private sector will be essential if the College is to remain one of the nation's leading institutions of engineering education, and if it is to respond to the critical needs for its graduates and its research.

THE NEED

There is a growing recognition that the United States faces a technical manpower crisis of unprecedented proportions, a crisis that poses the most serious implications for industrial productivity and national security. The present shortages of engineers in critical fields such as microelectronics, manufacturing engineering, and chemical engineering have been widely publicized. This nation's per capita production of engineers has dropped to the lowest among industrialized nations and is now several times less than that characterizing nations such as Japan, West Germany, and the Soviet Union. The grave shortage of doctoral-level engineers already has had a serious impact on the staffing of research and educational institutions.

Despite the recent economic recession, there continues to be a strong demand for engineering graduates, as evidenced by the number of recruiters that crowd the corridors of the College's Placement Center and the starting salaries they offer to our graduates. Indeed, this past year over 80% of *all* job interviews conducted on The University of Michigan campus were for engineers.

Students are not insensitive to this demand, or to the needs of this nation for engineers. For the past several years the number of applications for admission to the College has been growing at a rate of 10% to 15% each year. There has been a similar upward trend in the quality of students seeking careers in engineering.

The academic ability, enthusiasm, and commitment of undergraduate engineering students enrolling in the College today are extraordinary by any measure.

The College of Engineering represents a critical resource to this nation in its efforts to meet its urgent technical manpower needs. It provides opportunities for engineering careers to the best of our high school graduates and develops talented, broadly educated engineers for leadership roles in science and technology.

There is yet another important dimension to the College's role. As our society has become ever more dependent on science and technology, it must turn increasingly to great research universities such as The University of Michigan for the intellectual creativity so fundamental to technological innovation. Perhaps nowhere is the need for innovation more apparent than in American industry's efforts to remain competitive in the world marketplace. One need look no further than the State of Michigan to see vivid evidence of this intense struggle for industrial survival and its impact on our society.

One of the keys to the "reindustrialization" of America will be a rapid transition from experience-based to knowledge-based activities. This will require a massive infusion of high technology into all aspects of industrial activities, ranging from product design to production to

management and marketing. Technological innovation and technical manpower will be critical in this effort. These, of course, are the principal products of institutions such as the College of Engineering.

There is ample evidence to suggest that prestigious engineering institutions which combine high-quality undergraduate education with strong research and graduate programs have played a critical role in revitalizing and strengthening American industry. One need only consider examples such as Silicon Valley (surrounding Stanford and Berkeley), Route 128 (MIT and Harvard), and the Research Triangle (North Carolina, North Carolina State, and Duke) as evidence of the impact that high-quality engineering programs can have on industrial and economic development.

These models are of particular importance to Michigan. This state stands today in a unique position to integrate advanced technology with its traditionally preeminent, but currently floundering, heavy manufacturing industry. This stance is due in part to the fact that in the College of Engineering, the State has one of the leading engineering schools in the nation. One of the major challenges before the College in the decade ahead will be to establish the strong interactions with industry so necessary for stimulating economic development.

TABLE I 1980 GORMAN RANKINGS OF ENGINEERING PROGRAMS

	U.G.	GRAD		U.G.	GRAD		
AEROSPACE	MIT Michigan Princeton Minnesota Illinois Stanford Brown Ohio State Iowa State Kansas	MIT Caltech Michigan Princeton Stanford Cornell Illinois Purdue Minnesota Georgia Tech	CHEMICAL	Princeton Wisconsin Cal/Berkeley Minnesota MIT Stanford Illinois Caltech Michigan Delaware	Wisconsin Princeton Cal/Berkeley Minnesota MIT Illinois Stanford Caltech Michigan Delaware		
CIVIL	Cal/Berkeley Illinois MIT Stanford Cornell Purdue Michigan Columbia Northwestern Carnegie	Cal/Berkeley Illinois MIT Stanford Cornell Caltech Purdue Michigan Columbia Wisconsin	ELECTRICAL	MIT Stanford Cal/Berkeley Illinois Michigan Princeton Purdue Cornell Minnesota Wisconsin	MIT Cal/Berkeley Stanford Illinois Michigan Princeton Caltech Purdue Cornell UCLA		
INDUSTRIAL	Michigan Stanford Cal/Berkeley Purdue Northwestern Georgia Tech Cornell Ohio State Columbia Texas A&M	Michigan Cal/Berkeley Stanford Purdue Wisconsin Cornell Georgia Tech Northwestern Columbia Ohio State	MECHANICAL	MIT Stanford Cal/Berkeley Michigan Brown Minnesota Illinois Purdue Cornell Princeton	MIT Stanford Cal/Berkeley Caltech Michigan Minnesota Illinois Purdue Princeton UCLA		
METALLURGICAL	Illinois Colorado Missouri Columbia Minnesota Penn State Carnegie Case Michigan Ohio State	Illinois Columbia Pittsburgh MIT Carnegie Colorado Penn Minnesota Michigan Lehigh	NUCLEAR	Columbia Michigan Wisconsin Virginia Penn State RPI Texas A&M Arizona Illinois Cal/Berkeley	MIT Michigan Wisconsin Cal/Berkeley Georgia Tech Virginia Columbia Illinois RPI Texas A&M		
NAVAL (U.G. only)	MIT Michigan Webb Institute	ENG SCI (U.G. only)	Caltech Harvard Michigan Georgia Tech Penn State Iowa State Yale	MATERIALS (U.G. only)	Cornell Northwestern Michigan Cal/Berkeley MIT Brown RPI Vanderbilt Case Carnegie	ENVIRONMENTAL (U.G. only)	Caltech Harvard Michigan Northwestern Penn State RPI Texas Florida

THE POTENTIAL

For over a century the College of Engineering at The University of Michigan has ranked among the leading engineering schools in the world, with claims to unusual strength across the full spectrum of technical interest. Founded in 1853, the College is the seventh oldest engineering school in the nation. It ranks third among all engineering schools in the total number of degrees awarded and claims more than 38,000 alumni throughout the world.

The College has long been a leader in the development of new academic programs at the very forefront of technology. It pioneered in introducing metallurgical engineering (1854), naval architecture and marine engineering (1881), chemical engineering (1901), aeronautical engineering (1916), nuclear engineering (1953), and computer engineering (1965). This tradition of leadership continues today, as evidenced by the College's thrusts into new areas such as robotics and computer-integrated manufacturing, thermonuclear fusion, ergonomics, and biotechnology.

Today each of the 19 academic programs offered by the College is ranked among the leading programs in the nation, whether evaluated with respect to the quality of undergraduate instruction, graduate instruction, or research accomplishment. In a survey conducted in 1980 (see Table 1), 13 of the College's degree programs ranked among the top five in the nation. Nine of these programs ranked first nationally among public universities. This degree of both breadth of disciplines and depth of quality is unmatched by any other engineering school in this nation.

The reputation of the College can be attributed in large measure to the quality of its students and the outstanding achievements of its alumni. Students

presently enrolled in the College have continued this tradition of excellence. Over 25% of the freshmen entering the College this fall were straight 4.0 students in high school; over 80% ranked in the top 10% of their high school graduating class. Furthermore, the average Scholastic Aptitude Test scores of entering freshmen (580 verbal, 670 math) are comparable to those in Ivy League institutions (and the highest among all of The University of Michigan's schools and colleges):

Other statistics of the College are similarly impressive. The College presently enrolls 5518 students, of whom 4259 are undergraduates, 867 are MS students, and 392 are PhD students. Last year the College graduated 1515 engineers including 997 BS, 464 MS, and 54 PhD engineers. (See Table 2.)

This extraordinary productivity is achieved by a faculty of 258 professors and a total staff of 525. To complete the statistics, the College has roughly 1,000,000 net square feet of facilities, 75% of which has been provided by private support. (See Figure 1.) The annual operating budget of the College amounts to \$45 million provided from tuition revenue, research contracts, and private support (though, unfortunately, not from State support).

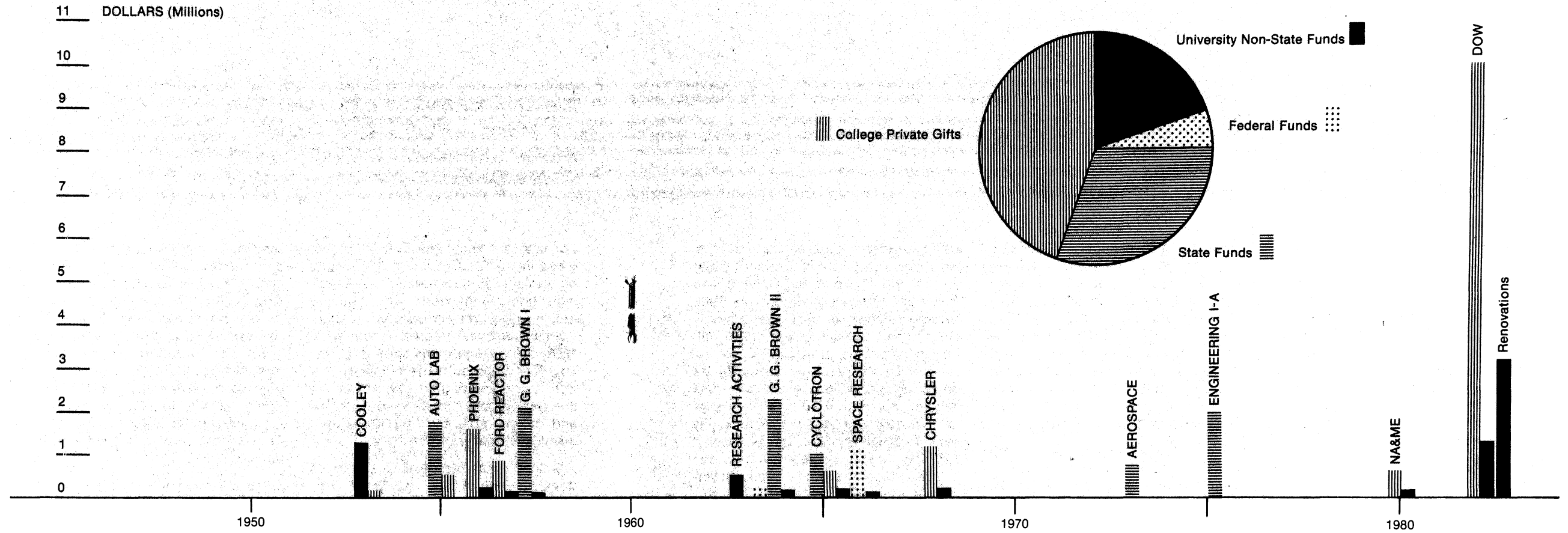
These statistics suggest that the College of Engineering represents an important resource, both to the State of Michigan and to the nation. Furthermore they suggest that the College is a resource that can and should play a major role in revitalizing and diversifying industry through the creative activities of its faculty and the ability of its graduates.

TABLE 2 DATA SUMMARY
FOR THE COLLEGE OF ENGINEERING

STUDENTS		
Enrollment (Fall-82)	4,259 867 392 5,518	Undergraduates (20% women, 5% minority) M.S. Ph.D. (growth of 48% since 1975)
Degrees Conferred (1980-81)	997 464 54 1,515	B.S. (up by 50% since 1975) M.S. Ph.D.
Student Quality	SAT: 1250 24% in 99% 81% in 90%	

(In 1981-82 a typical B.S. graduate received 3-4 job offers at \$24-\$30 K.)

FIGURE 1 UM COLLEGE OF ENGINEERING FUNDING HISTORY OF NORTH CAMPUS CONSTRUCTION (1953-1982)



THE COMMITMENT

As a public institution (in fact, if not in funding), the College of Engineering believes it has a major responsibility to respond to the needs of Michigan and the nation. Of particular importance in this regard is its commitment to respond to the needs of American industry.

This mission is quite natural for an engineering college. In a very real sense industry represents a major reason for the existence of the College. If one recognizes that engineering is the application of science and technology to meet the needs of society, then it is apparent that industry is the manifestation of this

activity. Moreover, the students and research provided by the College can be viewed as the lifeblood of industry and the key to the future of American productivity.

A major thrust of the College over the decade ahead will involve a refocusing of its efforts toward the needs of industry. The College intends to work closely with industry, to learn of its needs and concerns, and then to develop academic and research programs to respond to these needs.

The College is moving rapidly to develop and apply its strong capabilities in areas

that respond directly to these needs:

- 1) computer integrated manufacturing (including computer-aided design and manufacturing, robotics and flexible automation, and management systems)
- 2) microelectronics
- 3) materials development and processing
- 4) biotechnology
- 5) computer science and engineering
- 6) surface science

- 7) applied areas such as aerospace, naval, and nuclear engineering

The College is also expanding its efforts to interact more effectively with industry through other mechanisms:

- 1) continuing engineering education (through its Engineering Summer Conference programs and its Instructional Television System)
- 2) co-operative engineering education programs
- 3) faculty/industry exchange programs

As just one example of this commitment to respond to the needs of American industry, we would note the formation of the Center for Robotics & Integrated Manufacturing (CRIM). The Center was designed to coordinate and expand the ongoing research activities of the College in areas concerned with the computer-based automation of the functions of industrial production including conceptual design, production design, testing, manufacturing, delivery, and management—the so-called “factory of the future.” The Center consists of three divisions: Robotics Systems, Integrated Design & Manufacturing, and Manage-

ment Systems. It involves the efforts of 43 faculty members across six departments (with several more faculty members to be added during the next year). In less than one year of operation, the Center has managed to achieve a sustained level of funding from both private and federal sources in excess of \$2 million per year for the next several years. It is but one example of the potential of the College to respond effectively and rapidly to meet the needs of the State and the nation.

THE CRISIS

Yet, despite the central role that the College plays in meeting the critical needs of this nation for talented engineers and technological innovation, it now faces probably the most serious challenge in its long and distinguished history. A decade of deteriorating public support now threatens not only the quality and capacity of the academic programs conducted by the College, but also its capacity to respond effectively to the needs of both Michigan and the nation.

The State of Michigan has long been renowned for its system of higher education. The flagship of this system (and of public universities throughout the nation) is The University of Michigan. Yet over the past decade, public support of higher education in Michigan has dropped to the point today where the State currently ranks 42nd in its level of state support per student. As yet another indication of the abrupt and serious nature of this drop, it should be noted that Michigan ranks 48th nationally in the level of new support provided to higher education over the past decade. During this brief period Michigan has dropped from a leader in its support of higher education to one of the lowest levels of support in the nation.

This decline in State funding has fallen with particular harshness on the College of Engineering. Throughout most of the past twenty years, the major share of new State support for education went to the health sciences (e.g., schools of medicine, dentistry, nursing, and public health) or to other professions (law and education). By the mid-1970s, when engineering enrollments began to swell, the State of Michigan began to en-

counter its serious economic difficulties, due both to the collapse of the automobile industry and to an overcommitment to social services (particularly entitlement programs). The State lost both its capacity and its will to respond to these engineering enrollment increases. As a result, during a period in which enrollment in the College grew by 45%, the level of State funding for engineering education dropped sharply.

More specifically, State funding of the College of Engineering declined at an average rate of 7% each year during the decade of the 1970s. This sustained erosion in public support, coupled with dramatic increases in tuition charges

and sponsored research support, has led to the ironic (and distressing) situation in 1982 in which the College now finds itself effectively without any State support whatsoever. That is, the recovered income of the College (\$46.5 million) from tuition, private gifts, and research contracts now exceeds its operating and capital expenditures (\$45 million). Far from receiving State support, in effect the College now must pay back to the State (i.e., the University) \$257 per enrolled student just for the privilege of being part of a public university. [A more detailed analysis of this shocking financial situation is provided in Table 3 and Figure 2.]

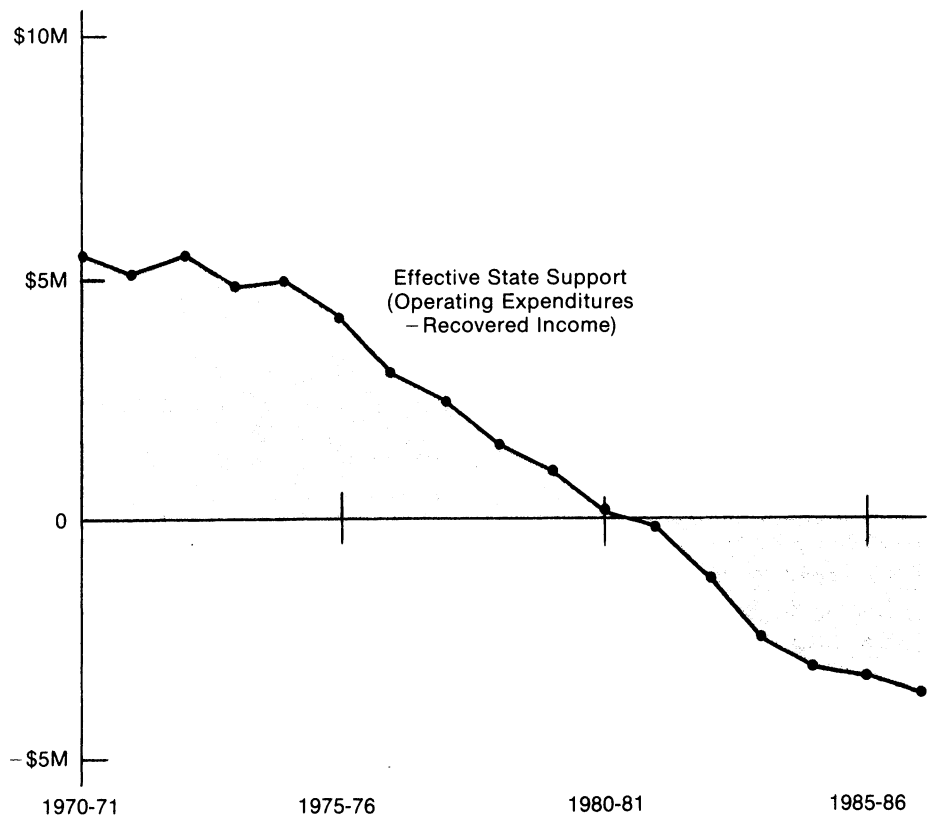


FIGURE 2 STATE SUPPORT FOR THE COLLEGE OF ENGINEERING

TABLE 3 THE COLLEGE OF ENGINEERING
ANALYSIS OF OPERATING COSTS AND REVENUES

BUDGET EXPENDITURES	1980-81	1981-82	1982-83
Direct Costs			
... Gen Fund budgeted expenditures	\$11,275,105	\$12,513,635	\$15,125,437
... Sponsored Research (DC)	11,321,570	12,453,727	14,321,786
Indirect Costs (To Univ.)			
... Instruction from other units	1,897,580	1,954,507	2,110,868
... Instruction to other units	- 336,655	- 373,687	- 418,529
... Sponsored Research (IC)			
..... Research Administration	1,272,453	1,383,793	1,609,653
..... Equip, Rehab, Overruns	404,871	447,700	80,000
..... Cost Sharing	80,000	88,000	101,200
... Plant (Utilities & Main)	2,368,896	2,724,230	3,269,076
... Computer Center	498,000	540,000	583,200
... Eng/Trans Library	345,000	380,000	410,400
... Financial Aid (University sources)	260,000	286,000	314,600
... Staff Benefits	1,887,598	1,859,000	2,044,900
Other			
... State PRR		750,000	250,000
... Service (Designated Funds)	2,085,331	2,293,864	2,293,864
... Financial Aid (College sources)	705,000	775,500	891,825
... Expenditures from College Discretionary Fund	1,690,000	1,859,000	2,044,900
Total Expenditures	\$35,754,749	\$39,935,270	\$45,033,180
RECOVERED INCOME			
Student Tuition and Fees	\$12,245,000	\$15,455,826	\$18,449,593
Sponsored Research (DC)	11,321,570	12,453,727	14,321,786
Sponsored Research (IC)	4,819,897	5,301,887	6,097,170
Service (Designated Funds)	2,085,331	2,293,864	2,293,864
Private Support			
... Gifts (inc capital)	3,486,800	4,184,160	4,602,576
... Earnings	567,700	624,470	686,917
Total Income	\$34,526,298	\$40,313,934	\$46,451,906
NET COST TO UNIVERSITY	\$ 1,228,451	-378,664	\$- 1,418,726
... Net Cost/Student	\$ 231	-69	\$ -257
... UM State appropriation/student	\$ 3,887	3747	\$ 3,901

In effect, a decade of neglect has forced the College to the stance of a private institution—in funding, at least—and has seriously damaged its capacity to respond to the needs of Michigan and the nation. The simple fact of the matter is that NONE of the State tax dollars paid by Michigan residents today go to the support of the College of Engineering. They go instead to pay for social services, for welfare, unemployment compensation—or if they go to education at all, they go to produce even more doctors, dentists, teachers, and lawyers, not more engineers.

To be sure, this situation is both ironic and alarming. For at just that moment in time when Michigan and the nation are becoming increasingly dependent on technology and therefore on engineers, just when there is an unprecedented demand on the part of our best high school graduates to become engineers, the College of Engineering, one of the leading engineering colleges in the nation, finds itself effectively without any public support whatsoever.

The impact of the past decade of underfunding has been very serious indeed. During a period of staggering enrollment growth (45%), the College has been forced to reduce the size of its faculty by 45 positions (–15%). This has resulted in a seriously overloaded faculty, overcrowded classes, and a dramatic increase in the use of teaching assistants. Technical support staff and equipment funds have been cannibalized to offset the deterioration in State support. To respond to these difficulties, the College has been forced to limit its enrollment for the past five years—despite the enormous demand and outstanding quality of students applying for admission. Even more serious is the very real possibility that it will be forced to cut enrollments by as much as 40% over the next several years if this chronic degree of underfunding cannot be reversed.

It has become apparent that if the College of Engineering is to respond to the challenges, opportunities, and responsibilities that lie before it, it must regain a level of support commensurate with its serious needs, goals, and responsi-

bilities. Where might this support come from?

It is quite apparent that help will not come from Washington. Indeed, a number of short-sighted actions at the federal level are responsible in part for the present crisis in engineering education. During the 1970s graduate fellowships and traineeships declined from 40,000 to less than 6,000 nationwide. The Reagan administration is continuing to reduce the federal role in engineering education by reducing the National Science Foundation's science and engineering education programs and cutting the support of research programs in engineering and the physical sciences. And on the horizon are catastrophic cuts in federal loan programs for student aid.

Nor is higher tuition the answer. As Michigan lost its will to support engineering education, the College has been forced to implement dramatic tuition increases. At the present time, The University of Michigan has the "distinction" of having the highest tuition level of any public institution in the nation (\$2200 for in-state, \$6600 for out-of-state students). This has had a particularly serious implication for engineering education, since most of our students continue to come from working class families.

So where is the support (inadequate as it may be) for the academic programs conducted by the College coming from if not from State support or tuition? Ironically enough, it is coming from the engineering faculty themselves. For many years the entrepreneurial efforts of our faculty have been directed toward attracting the public and private resources necessary to support the College's research and graduate programs. Today, however, our faculty is being asked to assume the additional burden of attracting the resources necessary to partially offset the disappearance of State support. More specifically, the College now finds that research grants support essentially all of its equipment purchases, graduate student support, travel, and supplies. Beyond this, roughly 35% of faculty salaries are supported by research grants. This growing dependence of our instructional programs on research support is particularly disturb-

ing, since it implies that more and more faculty effort must go into writing research proposals and reports, administering research contracts, and carrying out all of the other "non-scholarly" activities associated with hustling research support—just to maintain the quality of our instructional programs (not to mention the quality of our research programs).

To place this in perspective, the College now estimates that it costs roughly \$8,000 per student per year for an engineering education at Michigan. At the present time the student pays some \$2,200 if in-state (\$6,600 if out-of-state). Since State support has now vanished, the remainder of this cost, some \$5,800 or 75% of the cost of educating engineering students in the College, is now being borne by a combination of sponsored research grants, contracts, and private support.

This precarious situation cannot—and, indeed, *will not*—continue. The faculty of the College simply cannot continue to bear the burden of the cost of educating its students. Furthermore, the socioeconomic background characteristic of most engineering students raises serious doubts as to their ability to support major increases in tuition (e.g., raising tuition levels to private levels) without comparable increases in sources of student financial aid.

It has become painfully clear that if the College of Engineering is to achieve the degree of excellence in engineering education and research expected of a national leader, it must move rapidly to take strong actions. It must replace dwindling sources of public funds with increased support from the private sector. In particular, the College, its alumni and friends, and industry must acknowledge and respond to the fact that it has now made the transition from a publicly-funded to a privately-funded institution. Even beyond that, the College must continue to stress excellence in its academic and research programs, but with a new sense of commitment and dedication which will almost certainly change its very nature over the next decade.

THE RESPONSE

Despite the deterioration in public support which has occurred over the past decade, the College of Engineering remains committed to the achievement of excellence in education, in research, and in the professional activities of its faculty, students, and graduates that have made it a national leader. It fully intends to continue this tradition of excellence. It intends to be the *best*—and nothing less will do.

As a “private” institution, the College firmly believes that its future will depend not on the *capacity* or *breadth* of its academic programs but rather on their *quality*. It refuses to accept the premise that it should maintain its traditional breadth at the expense of quality—that it should attempt to do simply an adequate job across the board. It is committed to being *the best in certain key areas*, and it intends to focus its resources accordingly.

The breadth and present enrollment capacity of academic programs in the College were achieved during a period of exceptionally strong public support. In the absence of that support, it has become apparent that the most critical factor in determining the ability of a given program to attract the resources necessary for excellence will be the national reputation of the parent department. In a very real sense the quality of a program, not its capacity or breadth, will determine its resources.

Therefore the College must achieve the ability to focus its resources to stress those areas in which it has the capacity, the potential, or the mission to be a national leader. To this end, the College has developed administrative structures and policies to facilitate reviews and resource reallocation. Programs that fail to meet the tests of centrality to the mission of the College, quality, and cost-

effectiveness *must* be reduced or eliminated to provide the resources necessary to strengthen existing programs or to initiate new programs of high priority. Furthermore, enrollments must be reduced to levels more compatible with the objectives of achieving outstanding quality in the face of limited resources.

If the College is to achieve excellence in the face of the financial realities that lie before it, it believes it essential to carefully select only a few new areas of major thrust and to target available resources at these. In a sense it must approach its future as if it were a player in a very high-stakes poker game. It must choose its bets carefully. When it has identified an area in which it senses the capacity or potential for excellence, it must then have the courage to push all of its chips into the center of the table—it must make the total commitment necessary to achieve national leadership.

THE RESPONSIBILITY

Over the past decade the College of Engineering at The University of Michigan has been forced to make a painful transition from a publicly to a privately supported institution. Yet its primary goals remain the same. It remains committed to the achievement of excellence in engineering education, research, and service. And as a part of a great public university, the College believes it has a major responsibility to respond to the needs of the State and the nation for the creative activities of its faculty and the

quality, ability, and leadership of its engineering graduates.

But it is also apparent that if the College is to be successful in this extraordinary mission, if it is to respond to the challenges, opportunities, and responsibilities before it, a major change will be necessary in the attitudes of those who identify with, depend upon, or support the College. Alumni and friends of the College must recognize and acknowledge the fact that it has become effec-

tively a private institution—at least to the degree that it no longer benefits from State support. They should sense their new responsibility to respond to the critical needs of the College to the same degree with which they would be expected to respond to the needs of other private institutions.

To be sure, the alumni and friends of the College of Engineering have demonstrated in the past a degree of pride, loyalty, and generosity that was most excep-

tional for a *public* institution. However, this level of support is still far below that experienced by the leading private engineering institutions such as MIT, Stanford, and Caltech. [In this regard it should be noted that presently fewer than 7% of the College's alumni respond to its appeals for financial assistance.]

If alumni value the education they received in the College, if they take pride in its reputation and achievements, then they must also recognize and accept their serious obligation to assist in supporting the College so that others may benefit from this same opportunity. Few students can afford the full costs of an engineering education. During earlier years, State tax dollars supported most of these costs. Today, however, the College must move toward the model of private institutions in which contributions from alumni and friends provide the dominant source of student financial aid at a level sufficient to replace vanishing public support. Only those who have no concern for the College or who discount the value of the education they have received can ignore their responsibilities to provide this support.

There must also be a major change in attitude and commitment on the part of private industry. There is little question that industry must move rapidly to accept a far more significant role in support of engineering education. Without this support, industry's supply of engineering manpower stands in serious jeopardy, since one by one the leading engineering schools—including the College of Engineering—will be forced to implement massive enrollment cuts.

The cost of a BS-level engineering education at The University of Michigan is roughly \$50,000 (\$8,000 instructional cost plus \$4,000 for room, board, books,

etc. each year). Last year almost 1,000 undergraduate and 500 graduate students received engineering degrees from the College. Most of these graduates took jobs in industry. In a sense, then, the College provided industry with roughly \$75 million worth of engineering manpower. And this was provided essentially free of charge since the College did not benefit from State tax dollars. Yet direct industrial support to the College amounted to less than \$2 million—less than 3% of the actual value represented by the education of the graduates of the College provided to these same companies.

It is obvious that this philanthropy on the part of the College cannot—and, indeed, will not—continue. The public is no longer willing to support engineering education; the student can no longer afford the staggering tuition levels; and the faculty has become so overburdened that they can no longer be expected to generate the research funding required to carry the cost of instructional programs.

Private industry must step forward now to shoulder more of the responsibility for supporting engineering education. Indeed, without such support, both the quality and the quantity of this nation's supply of engineering manpower will deteriorate rapidly.

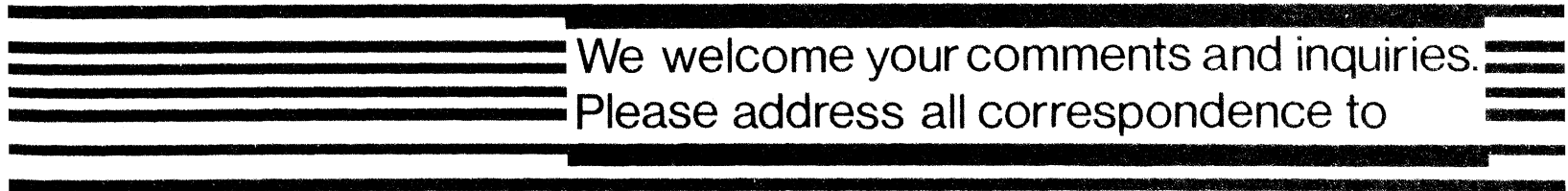
Of course engineering colleges must do their share. They must approach industry with a willingness to respond to its needs, and in so doing, they must develop relationships that will lead to direct support of engineering education by industrial sponsors. They must EARN the support of industry.

It is in this spirit that the College has undertaken bold and exciting initiatives

to refocus its efforts to meet the needs of industry. The recent establishment of the Center for Robotics & Integrated Manufacturing, the Computer-Aided Engineering Laboratory, numerous Industrial Affiliates programs, and the expansion of its Continuing Engineering Education and Co-operative Engineering Education programs are all examples of the sincerity and extent of this new commitment on the part of the College. It has demonstrated its resolve to develop a new partnership with American industry to meet the challenges that lie before this nation in the decade ahead.

The College of Engineering is approaching its future with both optimism and determination. It stands firm in its belief that the key to the achievement of excellence lies with people, with their abilities and commitments. And in the human resources represented by its faculty, students, and alumni, the College continues to benefit from a level of quality that is truly extraordinary. These critical ingredients are certainly consistent with the College's objectives to sustain and strengthen its tradition of excellence in the decade ahead—to be the *best* in whatever it chooses to do.

But more will be required if these objectives are to be achieved. The College must now acknowledge that it has made the transition to the brave new world of a privately-supported institution. It must take the necessary actions to refocus its resources to stress the *quality* of its academic programs at the almost certain expense of breadth and capacity. And it must ask its alumni, its friends, and private industry to accept their new responsibility to provide the resources necessary to continue the College's long and distinguished tradition of leadership in engineering education.



We welcome your comments and inquiries.
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