



COLLEGE OF ENGINEERING
THE UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN



**THE CRISIS FACING
ENGINEERING EDUCATION
IN MICHIGAN**

A Call for Action

January 15, 1985

1. INTRODUCTION

Among the priorities faced by the Michigan State Legislature, there could be none more critical for the future of our state than the crisis facing engineering education in Michigan's universities. For over a decade, Michigan has systematically dismantled its public support for engineering education. As a result, our state's public engineering schools have been forced literally to the brink. They are struggling to respond to the urgent needs of Michigan industry for talented engineering graduates and technological innovation while crippled by overburdened faculty, obsolete laboratories, and seriously deficient physical facilities.

Despite urgent pleas for assistance, state government has failed to respond to initiatives such as the Engineering Laboratory Equipment proposal and the numerous State Budget Program Revision Requests aimed at restoring adequate instructional staffing in the face of surging engineering enrollment with targeted (i.e., line-itemed) state support for engineering. This has forced several of Michigan's engineering schools to the point where they will soon be forced to eliminate programs of critical importance to our state and drastically reduce enrollments.

There is a sense of extraordinary irony in this situation. Throughout this nation, most other states have already taken strong action to strengthen their engineering programs because of the obvious importance of the role they will play in economic development. They have focused resources to respond to the challenge of re-equipping laboratories and rebuilding the faculty of their key engineering schools.

Yet our state, in response to this challenge, has taken just the opposite approach. Not only has Michigan ignored the urgent pleas for assistance from its engineering schools, but beyond that, it has chosen to respond instead by dissipating limited resources still further in misguided efforts to proliferate new engineering programs of clearly marginal quality and capability. Experience elsewhere has demonstrated convincingly that efforts to build such fledgling programs in regional state colleges or general state universities will never be able to achieve the critical mass of faculty and facilities necessary to achieve national accreditation (far less quality). But even more seriously, it seems obvious that such attempts to proliferate new programs in the face of the limited and inadequate resources presently allocated to engineering education in our state can only cripple still further Michigan's existing engineering schools.

In this document, we have attempted to summarize the concerns of the deans of Michigan's public engineering schools (MSU, WSU, MTU, UM, UMD, OU, WMU) on these matters.

THE IMPORTANCE OF ENGINEERING EDUCATION IN MICHIGAN

In recent months, numerous state commissions and task groups have pointed to the importance of increased public support for Michigan engineering schools as a key component in our state's long term economic strategy:

- Putting Our Minds Together: New Directions for Michigan Higher Education, The Governor's Commission on the Future of Higher Education in Michigan
- The Path to Prosperity, Findings and Recommendations of the Task Force for a Long-Term Economic Strategy for Michigan
- Preliminary Recommendations, Governor's Commission on Entrepreneurship and Small Business Development
- Silicon Valley and Route 128: Two Case Studies, Peter Eckstein, Director, Governor's Commission on Jobs and Economic Development

In this section we have summarized the principal conclusions reached by each of these groups regarding the importance of engineering education for economic development in Michigan.

"High-Tech" in Michigan

There is growing recognition that the key to the long-term economic prosperity of Michigan will involve a major transition from "experience-based" to "knowledge-based" activities, relying less on physical capital and more upon intellectual capital. This shift will require a massive infusion of technology, both to revitalize and diversify existing Michigan industry in the near term and to spawn and attract new industries over the longer term.

The "engine" driving Michigan's economy is durable-goods manufacturing, corresponding to 90% of the jobs in our state's economic base. Hence it is particularly important that Michigan take strong actions to assist the transition of this industry to complex manufacturing processes that are less vulnerable to low-wage competition because of their dependence on human skills. Michigan must become America's "factory of the future". And it must become a world center for the export of new industrial technologies and manufacturing machinery that will form the basis of the factory of the future. In Michigan's emergence as a center of complex manufacturing, new technology will not be a separate industrial sector; it will be at the heart of every industrial sector.

However, there is another equally important aspect of technology-based economic development for our state. Experience has shown that a primary source of new jobs is the creation of new companies and industries. And while industries such as retail trade and medical

services are among the fastest growing in our state, it is also clear that these activities do not contribute to Michigan's economic base by bringing in new resources; rather they simply shift existing resources among various sectors within our state. It is clear that Michigan can become prosperous in one way only: by increasing the value of the goods and services that its industries sell outside the state. Since Michigan's economy is based on technology-intensive manufacturing industries, it is logical to expect that advanced technology and innovation will play the key role in building new companies and creating new jobs.

In summary, then, Michigan faces two major challenges: First, our state must take actions to protect its present economic base by strengthening the competitiveness of existing industries such as the automobile and automotive supplier industry. Second, it must establish an environment capable of attracting or stimulating the growth of technology-based industries that can provide new jobs for Michigan citizens.

Key in this effort will be the availability of technological innovation, technical manpower, and the entrepreneurs capable of exploiting these resources. Experience in other regions suggests that Michigan's success in achieving this rebirth in its industrial base and competing effectively with other states and nations will depend on its ability to build and sustain high quality engineering schools. Such schools play a vital role in economic development since they provide the intellectual creativity fundamental to technological innovation and the talented, broadly-educated engineers and entrepreneurs capable of understanding and implementing this technology.

Furthermore, when coupled with appropriate technology-transfer mechanisms, there is little doubt that quality engineering schools at the cutting edge of research and development can have a major impact on both technological innovation and implementation in the private sector. They provide, through their faculty, students, and graduates, the mechanism for transferring research from the campus into the private sector for commercial exploitation. Finally, such schools are usually a key factor in attracting the "risk capital" represented by massive federal R&D contracts.

There are already strong signs that Michigan industry has recognized and responded to this increased dependence upon technological innovation and the importance of engineers. The recent announcement by General Motors of its intent to establish a new company to produce the Saturn product line based on advanced manufacturing technology has set off an intense competition to attract these facilities. In sharp contrast to earlier industrial siting decisions, GM management has stated that a key factor in the Saturn project will be a site in close proximity to one of this nation's leading engineering schools. The very high skill levels required for the success of the Saturn venture, GM's "factory of the future", will demand large numbers of outstanding engineering graduates and access to the faculty and resources of a world-class engineering school.

Experiences Elsewhere

Other regions have long recognized the important roles that institutions with leading programs in science and engineering play in economic development. California has benefited enormously from the impact of key institutions such as Stanford and UC-Berkeley (electronics and biotechnology) and Caltech and UCLA (aerospace and defense).

A similar pattern is found in the economic revitalization of New England. Indeed, when asked to summarize the key to the economic growth in Massachusetts, a Harvard Business School professor responded with the reply, "Simple,...MIT!"

The dominant role played by world-class engineering schools in economic development has been identified in study after study. In the instances of California and New England, most of the significant technological innovations behind industrial growth originated in key local engineering schools and their associated research laboratories (e.g., MIT, Stanford, UC-Berkeley, and Caltech). These innovations were typically exploited by new firms established by faculty, staff, and graduates of these schools. Companies with origins in these schools subsequently formed the basis of powerful agglomerations of new industries. Furthermore, these schools attracted the massive federal research contracts which played the key role of "risk capital" in building new industries such as electronics and aerospace.

In each case, the key engineering schools involved were top-flight institutions conducting research at the cutting edge of new technology. Furthermore, these schools were oriented to the commercial applications of their innovations, provided the entrepreneurial environment necessary for technology transfer, and in many cases attracted the federal funding necessary to stimulate such industrial development.

Similarities and Differences

There are both similarities and differences between Michigan and these regions. Like New England, Michigan faces the challenge of strengthening and diversifying its industrial base if it is to stabilize and sustain economic prosperity. As a highly industrialized state, Michigan is heavily dependent upon technology and therefore quite sensitive to technological change and international competition. Although Michigan has traditionally been characterized by a highly-skilled labor force, those skills are becoming of diminishing relevance as new technologies such as robotics, artificial intelligence, and computer-integrated-manufacturing are introduced. Michigan industry will, of necessity, become less capital- and labor-intensive and become increasingly "knowledge-intensive".

There are important differences as well. The economic bases of California and New England are heavily dependent upon federal contracts (particularly R&D and defense activities). Furthermore, each region had ready availability of venture capital to spawn new industrial growth. However, it should also be noted that each of these factors was stimulated and enhanced to a major extent by the key engineering schools of these regions.

There is also an important difference in the manner in which these regions have approached the long-term investments necessary for technological strength. Both California and New England have invested heavily through public and private mechanisms in building the leading engineering schools in this nation.

At one time Michigan also recognized the importance of such investments. In the years following World War II, this state made the commitments necessary to build high quality engineering schools at its leading universities. And over the years, these schools have played major roles in providing the research and engineering graduates to strengthen and diversify Michigan industry.

Yet, roughly 20 years ago, Michigan took a dramatically different turn from other states by throttling back its support for engineering education. Despite the obvious importance of world-class programs in science and engineering for economic development, our state pursued a course precisely opposite to those taken by other states. Because of neglect and inaction at the state level, engineering education in Michigan now faces the most serious crisis in its history.

THE CRISIS IN ENGINEERING EDUCATION IN MICHIGAN

The importance of world-class engineering programs to economic development has been recognized by state after state. One by one, states such as Illinois, Ohio, Pennsylvania, Minnesota, Texas, Arizona, New York -- indeed, most states in this nation -- have made massive commitments of public funds in recent years to strengthen their leading engineering schools. They have recognized the critical role that will be played by higher education in general and engineering education in particular as our economy (indeed, our very society) becomes ever more dependent on science and technology and therefore upon engineers.

Unfortunately, Michigan stands alone in its failure to act to restore an adequate level of support to its public engineering schools. Despite the obvious importance of world-class programs in science and engineering for economic development, over the past decade Michigan has pursued a course precisely opposite to those taken by other states. It has responded to the challenge of high technology, the intense competition presented by other states attempting to attract or spawn such industry -- our industry in many cases -- by drastically cutting public support for engineering education.

The State of Michigan has long been renowned for its system of higher education. Yet over the past decade, public support of higher education in Michigan dropped to the point where it ranked 42nd in the nation in its level of state support per student. Furthermore, over this period Michigan ranked 49th in the level of new support provided to higher education. In a period of less than ten years, this state has dropped from a leader in its support of higher education to one of the lowest levels in the nation.

To provide a more specific example, consider the alarming situation which has arisen at Michigan's flagship institution, the University of Michigan. From 1981 to 1984, the University reeled from \$45 million in state budget cuts (roughly 35% of its state funding). During this period it was forced to close programs, lay off faculty and staff, and deny admission to large numbers of Michigan students. It was forced to the brink -- to the horror and dismay of those in this state who depended on its graduates and our research.

Even during more recent and prosperous times this erosion in state support has continued. In FY1984-85 our state responded to the urgent needs of higher education with an across-the-board increase of 10% in state appropriations to all public institutions. However, by coupling this increase with a tuition freeze, the state caused even further deterioration in the base support of the University which relies on tuition and fees for almost 60% of its General Fund budget. (In this sense, the 10% increase in state appropriation coupled with a tuition freeze amounted, in reality, to a 4% increase in effective support -- behind the inflation rate.)

The decline in state funding of higher education in recent years has fallen with particular harshness on Michigan's engineering colleges. Throughout most of the past twenty years, the major share of new state support for education went to the health sciences (e.g., medicine, dentistry, nursing, and public health) and the startup of new institutions. By the mid-1970s, when engineering enrollments began to swell, the state began to encounter its serious economic difficulties, due both to the collapse of the automobile industry and to an over-commitment 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 our engineering schools grew by 50%, the level of state funding for engineering education, in effect, declined sharply.

Indeed, in some institutions such as the University of Michigan, state support of engineering effectively vanished over this period. Today, for example, the UM College of Engineering finds that it must support its instructional and research programs almost entirely from private sources: the tuition charged to its students, the research contract funds attracted by its faculty, and the private gifts provided by its alumni and friends. It has essentially ceased to benefit from state support.

The impact of this decade of underfunding has been very serious. It has resulted in a seriously overloaded faculty, overcrowded classes, and a dramatic increase in the use of teaching assistants. Indeed, current staffing is at roughly half the level suggested by State formula funding models (the Owen-Huffman Investment Needs Model) or national accreditation models (the Accreditation Board for Engineering and Technology) for the present level of engineering enrollments.

The past decade of erosion in state support has forced Michigan's engineering schools to cannibalize resources for equipment and technical support staff. As a result, both instructional and research laboratories have deteriorated to alarming levels. Recent studies by the Michigan Society of Professional Engineers have clearly documented the deplorable condition of our schools' obsolete and inadequate engineering laboratories. The engineering laboratory equipment backlog is a major factor contributing to the crisis facing engineering education in Michigan today.

As a consequence of this loss of state support, most of Michigan's engineering colleges have been forced to limit their enrollments for several years -- despite the enormous demand for engineering graduates and the surging numbers and outstanding quality of students seeking admission to engineering programs. Even more serious is the very real possibility that several institutions may be forced to cut enrollments by as much as 50% over the next several years if this chronic degree of underfunding cannot be reversed.

This crisis situation is most ironic, frustrating, and alarming. For at just that point in time when Michigan and its industries are becoming increasingly dependent on technology and therefore upon engineers, just when every other state in the nation is making a strong commitment to build world-class programs in science and engineering, Michigan has turned its back on its leading engineering colleges. Our capacity for responding to the needs of this state for technological innovation and the talented, broadly-educated engineers to apply this technology, has been seriously jeopardized.

This situation has been complicated by recent political attempts to proliferate engineering education in Michigan, thereby dispersing still further the limited resources available for this critical component of higher education. Michigan's failure to respond to the urgent pleas for assistance of its engineering schools has already taken a dreadful toll on their capacity. It is both ironic and disturbing that there have been misguided efforts to use the crippled capacity of our existing engineering schools caused by inadequate state support as an excuse to attempt to build new engineering programs at institutions which are clearly unqualified to conduct quality engineering education.

SOME FACTS OF LIFE IN ENGINEERING EDUCATION

Fact 1: The Importance of Focusing Resources: If Michigan is to maintain quality engineering education, it has no choice but to focus its resources on a few established programs.

It should be recognized that each of Michigan's existing engineering schools has a somewhat different character and a correspondingly different mission. Several institutions have acquired the reputation, faculty, and facilities necessary to compete with the leading research universities in the world. Others have chosen to focus primarily on undergraduate education. Still others have specialized in programs of particular importance to industry in their region. However each of our state's established engineering schools has required a major investment over many years to build the resources and reputation necessary to conduct quality engineering education.

The investments required for quality engineering education must not be underestimated. The difficulties in assembling the critical mass of faculty, physical facilities, and talented students necessary for engineering education are considerable. It was for this reason that the Governor's Task Force on the Future of Higher Education in Michigan concluded:

"The existence of high-quality engineering programs is critical to Michigan's economic future; they are extremely costly and are being offered by an increasing number of institutions. The Commission feels it makes little sense, for example, to purchase the equipment necessary to produce a combined total of 20 engineering doctorates at two institutions located in adjoining counties or to support more than 5 or 6 engineering programs. The Commission recommends that state funds be focused on the few high-quality engineering programs consistent with institutional roles and missions."

This recommendation follows not only from a consideration of the most efficient use of state resources in the support of higher education. There is an even more fundamental concern here: the importance of quality in education.

Fact 2: Program Quality: Quality must be the overriding factor in determining public investments in higher education.

The importance of quality to our economy has become all too painfully apparent in recent years. Only a few years ago an automobile executive boasted that "Our industry will always be on top as long as we can put a car on the showroom floor for less money per pound than anyone else in the world." And so they could. The only problem was that nobody wanted to buy automobiles by the pound. Indeed, our preoccupation with mass production economies -- with quantity at the expense of quality -- nearly destroyed several of our major industries.

Unfortunately, this same inattention to quality has propagated to other areas of our society. Last year the National Commission on Excellence in Education released a landmark report which noted:

"Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world..."

While we can take justifiable pride in what our schools and colleges have historically accomplished and contributed to the United States and the well-being of its people, the educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a nation and as a people. What was unimaginable a generation ago has begun to occur -- others are matching and surpassing our educational attainments.

If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed this as an act of war. As it stands, we have allowed this to happen to ourselves."

This criticism applies particularly strongly to our state. We have lost our commitment, our dedication, to excellence in education. We no longer seem willing to demand excellence in the performance of our teachers, our students, and our institutions. Instead, we tolerate, indeed, we almost demand mediocrity.

This philosophy of mediocrity is also present in the manner in which we proliferate and fund higher education in this state. Most states have recognized the importance of world-class institutions and attempt to focus resources accordingly. In Michigan we seem to have what Dr. William Hubbard, president of Upjohn, refers to as "an extraordinary intolerance of extreme excellence". Far from focusing resources to achieve excellence, we almost seem to approach higher education as if we had a social responsibility to "level out the peaks of excellence" -- to eliminate those world-class programs we have been able to build over the years in favor of the proliferation programs of mediocre quality in higher education.

Let there be no doubt about it. The simple fact of the matter is that only engineering programs at the cutting edge of technology that are clearly capable of ranking among the nation's leaders are going to have a major impact on economic development in this state. Only such world-class programs are capable of attracting the outstanding faculty, students, and resources necessary to stimulate the growth of new industry. Michigan must come to grips with this fact and develop the capacity not just to tolerate excellence, but to focus its resources to achieve it in selected programs of critical importance to this state.

Fact 3: The Dangers -- and Folly -- of Proliferating Engineering Education: There are strong political pressures driving (and supporting) attempts by several of Michigan's regional state colleges and general state universities to proliferate new engineering programs, despite the almost certainty that such fledgling programs will be of marginal quality and draw badly needed resources away from established engineering schools at Michigan's research universities.

There are strong pressures on many of Michigan's regional state colleges and general state universities to establish new programs in engineering. We are all aware of the intense demand on the part of our state's best high school graduates to pursue studies in engineering. Yet this demand is occurring in the face of a sharp decline in the number of high school graduates, in some regions projected to be as large as 25% by the early 1990s. It is understandable, therefore, that many of Michigan's academic institutions are now drawn to engineering education -- like a moth to a flame -- in their efforts to sustain enrollments in the decade ahead.

Despite the difficulties in assembling the critical mass of faculty, physical facilities, and talented students necessary for quality engineering education -- not to mention meeting those requirements necessary to qualify for national accreditation -- there remains the temptation to cut corners and build new engineering programs with inadequate resources and marginal faculty in the face of almost certain enrollment declines which will occur in other academic programs. Institutions attempting to justify the introduction of new engineering programs can always point to the apparent need of local industry for engineering graduates and continuing engineering education (although such "regional" arguments are of doubtful validity in view of the well-known mobility of engineering manpower and the development of sophisticated telecommunications technology for delivering instruction to remote sites).

Indeed, the serious erosion in public support for established engineering schools has added fuel to the arguments of those attempting to justify new engineering programs. This decline in support has struck hard at those institutions which have traditionally produced the bulk of the high quality engineering graduates in our state. In the face of limited or declining resources, most of our established engineering schools have been forced to freeze or even reduce enrollments to maintain the quality of their programs. The large numbers of applicants denied admission to these engineering programs have intensified the pressures from those institutions attempting to enter engineering education for the first time. It is both ironic and tragic that in many cases this proliferation of new engineering programs will be funded from the same limited public sources which undermined the capacity of established institutions, thereby siphoning still further resources from these schools.

Fact 4: The Challenge of Accreditation: Attempts to begin new engineering schools in Michigan are unlikely to succeed in the face of ever more demanding national accreditation criteria.

The difficulties in introducing new engineering programs becomes all the more apparent when recent actions of the Accreditation Board for Engineering and Technology (ABET) are reviewed. The accreditation experiences of ABET, the primary body governing engineering education, make it apparent that few institutions in this nation have the capacity to begin new engineering programs capable of meeting the requirements necessary for national accreditation.

A number of factors contribute to the difficulty in achieving accreditation of engineering programs these days:

- i) In a world of ever-accelerating technological change, it has become extremely difficult -- if not impossible -- to conduct undergraduate engineering education in the absence of strong graduate and research programs. Indeed, in some fields such as electrical engineering and computer engineering, graduates are obsolete within 5 years of graduation without post-graduate education. It is clearly impossible for engineering faculty in such fields to remain technically relevant without strong research interests. For this reason, ABET has tended in recent years not to accredit new programs formed in institutions without strong graduate programs and research quality faculty.
- ii) There is a serious shortage of engineering faculty in our nation today. Indeed, at last count, over 10% of the budgeted faculty positions in engineering schools (2,000 positions) are vacant. Experience has shown that new programs are forced to turn to foreign nationals with marginal credentials to staff their faculties, thereby further damaging their chances for accreditation.
- iii) Engineering education is quite expensive. The models adopted both by ABET and the National Deans Institute demand a student-to-faculty ratio of 12 to 1. These models also require an investment of \$2,000 per engineering graduate per year for base equipment support. Studies have estimated the cost of an engineering education at both public and private institutions in the range of \$10,000 to \$25,000 per student-year. Since few institutions are able to levy tuition charges (or attract public support) at this level, engineering schools must depend on externally sponsored contract research to support a significant fraction of their educational costs. Needless to say, institutions without high quality faculty or a proven track record of successful competition for federally-sponsored research stand little chance of being able to generate the resources necessary to meet the standards necessary for accreditation.

In this regard, it is essential to keep in mind the importance of such accreditation. Engineering (unlike engineering technology or science degree programs) is a profession, subject to stringent state and federal laws requiring both accreditation of degree programs and licensing of practicing engineers. To attempt to launch a new engineering program without strong assurances of rapid accreditation is not only a foolish waste of resources. It is also a serious injustice to students enrolling in such programs (who will never be able to practice as professional engineers).

Fact 5: Engineering Technology Programs: In considering the future of engineering education in Michigan, it is essential not to confuse engineering with engineering technology programs.

It is important to keep in mind the distinction between engineering programs (such as those offered by UM, MSU, WSU, and MTU) and engineering technology programs (such as those offered by Ferris State and EMU). Programs in engineering technology differ significantly from engineering programs in the degree to which they emphasize the application rather than the development of engineering knowledge and methods. Graduates of engineering technology programs generally move into areas of hardware design using proven concepts, product analysis and development, construction and production management.

Engineering technology programs differ very significantly from engineering programs, both in academic content and requirements (faculty, facilities, and cost). Engineering technology programs are generally conducted by two-year and four-year institutions without extensive graduate/research programs, using faculty with strong practical experience. They can be mounted with modest expense. In sharp contrast, engineering programs demand the environment provided by major universities with strong graduate/research programs in the sciences.

Fact 6: Allocation of State Resources: The "trickle-down theory" simply does not apply in state support of higher education.

Michigan has long prided itself on the autonomy it has granted its institutions of higher education. It has relied on the wisdom of these institutions in the deployment of state resources for the support of programs of higher priority to Michigan citizens. In a sense, it has adopted the "trickle-down" theory of funding academic programs: The state provides a general, undesignated allocation to each institution, and then depends upon that institution to channel these resources to programs of most critical importance.

Unfortunately, the present crisis in engineering education provides strong evidence that such a trickle-down process simply does not work to

target state priorities. Not only have this state's engineering schools not received their fair share of state resources for higher education (whether based on their enrollment levels or their critical importance to Michigan's future). Beyond that, our engineering schools have frequently been used as the "lure" to attract state resources which were then diverted to other uses by their host institution.

An excellent case in point is the allocation of \$4 million in last year's state appropriation for the augmentation of laboratory equipment. Although the primary intent of this additional appropriation was to respond to the crisis in engineering laboratory equipment, in actual fact, only two of the engineering schools in this state (Michigan Tech and UM-Dearborn) saw any of these funds. In most cases, these funds were utilized by the parent institutions to offset the loss in revenue caused by the tuition freeze which accompanied last year's state appropriation.

The experience of the past decade underscores a very important conclusion: The traditional methods of funding higher education in Michigan are simply not adequate to channel resources to the programs of most critical importance to our state's future, its engineering schools. If Michigan is to provide these programs with the capacity to participate in Michigan's long term economic prosperity -- as study after study has indicated they must -- special actions must be taken by our elected public officials.

A CALL FOR SPECIAL ACTION

Now is the time for Michigan to invest in engineering excellence, before our state's engineering schools decay into mediocrity through neglect. If Michigan is to preserve the quality of its engineering schools -- if it is to compete for the technology-based industry of the 21st century -- it must take special action to restore its investments in these critical institutions before it is too late.

In taking such actions, three recommendations are of particular importance:

1. We are in strong agreement with the recommendations of the Task Force on the Future of Higher Education in Michigan that "state funds be focused on the few high-quality engineering programs consistent with institutional roles and missions".
2. The state must not rely on traditional mechanisms of funding higher education to "trickle-down" the necessary degree of support for these programs. Rather it should take special action to see that resources allocated for the support of engineering education are channeled to these units and not diverted to other institutional priorities.
3. It must give the highest priority to the two most urgent needs of engineering schools in Michigan:

- i) To adopt the "Engineering Excellence Fund" or some similar measure to address the engineering laboratory crisis that is crippling both instruction and research in Michigan's engineering programs.
- ii) To take special action to restore a level of staffing consistent with enrollments in Michigan's engineering schools before they are forced to implement drastic enrollment reductions. (In this regard, providing a level of staffing called for by the Owen-Huffman Investment Needs model would be an appropriate goal.)

CONCLUDING REMARKS

While it is true that the blueprint for economic development will be somewhat different for Michigan than in other parts of the nation, it is also clear that a key component in any strategy must be strong public support for the state's leading engineering schools. Indeed, it will be these schools which will provide the technological innovation and talented engineers necessary for long-term economic prosperity. Moreover, it is now painfully clear that in a future increasingly dominated by science and technology, states which are unable or unwilling to make the long-term investments necessary to develop and sustain such institutions simply will be unable to compete for the economic prosperity of tomorrow.

It has become apparent that our state faces a serious challenge in restoring the capacity of its major engineering schools to participate in the long-term industrial and economic development of Michigan. The past decade of neglect has already taken its toll and caused crippling damage to these institutions.

The time for procrastination and inaction has long since passed. Engineering education in Michigan has reached a crisis state. Without prompt and effective action, Michigan will complete the dismantling of one of its most critical resources for the future. And in the process, it will have sent out a strong signal to industry both within and outside our state that we have lost both the foresight and the will necessary to make those investments in engineering education necessary for Michigan's future.

Quite frankly, unless Michigan takes prompt action, it will almost certainly forfeit whatever capacity it has acquired through the quality engineering schools developed and supported by past generations of Michigan citizens. And in so doing, it will lose its ability to sustain the type of technology-based industry that has been and must continue to be the cornerstone of our state's prosperity.

The time has arrived to lay aside Michigan's traditional intolerance of excellence -- its penchant for distributing limited

resources "across-the-board" to achieve mediocrity at the expense of quality in higher education. We simply must begin today to take actions to lay a firm foundation for future economic development in our state. The necessary steps are obvious. All it will take is determination and courage to propose and implement them.

Time is running out for engineering education in Michigan.

