HIGH TECHNOLOGY IN MICHIGAN:

SILICON VALLEY OR APPALACHIA?

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Ann Arbor, Michigan

October, 1983

1. INTRODUCTION

Today we hear frequent claims that high technology will play a key role in the future of our State. We're promised that Michigan will be the next scene of the high-technology renaissance--that within a few years our economy will be dominated by robotics factories and computer software houses. Visions of Silicon Valley and Route 128 dance in our heads.

Yet at the same time we also hear fears that high technology will displace our labor force. There are calls for a national industrial policy to shift emphasis away from "smokestack" to "sunrise" industries--from the industrial Midwest to the Sunbelt. From this perspective, Michigan's high-tech future may not be a Silicon Valley utopia but rather the despair and poverty of Appalachia.

Just what is Michigan's "high technology future"? Which of these two paths will we take -- Silicon Valley or Appalachia?

As Dean of the College of Engineering at the University of Michigan, I would like to share with you our perspective of the role that technology will play in Michigan's future. In the College we presently conduct world-class research and instructional programs in all of the areas commonly identified with high technology, ranging from robotics and automation, to microelectronics and computer technology, to laser systems and holography, biotechnology, and even more exotic areas such as controlled thermonuclear fusion and supercomputer development.

We too would like to grasp the high technology ring on the merry-go-round as it swings by, to use high-tech to revitalize Michigan's industrial base. Indeed, the College is totally committed to focusing its resources to rebuilding the economy of this State. But as engineers, we also tend to be rather pragmatic and realistic about the impact of such technology.

To assess the role of high technology in Michigan's future, let me first remind you of the challenges that face our State today. Then I'll survey the resources Michigan can draw upon to rebuild its economy on a solid technological base. Finally I will attempt to identify the investments -- indeed, the commitments -- that will be necessary if Michigan is to rise once again to economic and industrial leadership in this nation.

2. THE CHALLENGE

It is certainly no secret that American industry faces formidable competition in the world marketplace. We need look no further than our own industries in Michigan to see vivid evidence of this intense struggle for industrial survival. And we need look no further than this state to see the impact of this struggle on our society. Over the past several years almost one

million Michigan citizens were out of work. Our State has struggled to maintain badly needed social services while avoiding the catastrophic dismantling of distinguished institutions such as its universities.

There is a growing recognition that the key to the economic recovery of this state and the survival of the Michigan economy will involve a major transition from "experience-based" to "knowledge-based" activities. This will require a massive infusion of high technology, both to revitalize existing Michigan industry in the short term and to attract new industry into this State over the longer term.

The Impact of High Technology

This point is important. In the short term, the primary impact of high technology on Michigan will not be to build or attract new industries into the State, but rather to enable existing industries to survive in the face of intense competition from abroad. The initial impact of high technology will be job protection, not job creation. Quite frankly, without high technology--without robotics, automation, and the "factory of the future" -- there won't be much industry left in Michigan by the end of the decade.

To be sure, over the longer term Michigan must seize the opportunity to diversify and strengthen its economy with new, high technology industries. It is important, however, that in our haste to climb aboard the high-tech bandwagon, we not forget the needs of our existing industry.

The winds of changing technology will almost certainly have other types of impact on our State. The explosion in modern computer technology, telecommunications, and manufacturing will revolutionize the nature of employment in both the industrial and service sectors of our State's economy. Flexible automation and computer-integrated manufacturing will allow small, flexible manufacturing facilities to be dispersed across the State.

Furthermore, the revolution in office and professional automation ("white-collar productivity") will eliminate the need to cluster such activities in large urban complexes. Rather, both manufacturing and service activities will spread out across the State, their location being determined primarily by living conditions, educational and cultural opportunities, and costs -- the "quality of life" -- offered by a region, bringing new types of economic development to regions which have traditionally been based on agriculture and forestry.

Hence we all have a stake in Michigan's high technology future -- whether we live in Detroit or Grand Rapids -- or Menomonee or Petosky. High technology is absolutely vital for the survival of industry in this State. It will be the key to diversifying Michigan's economy. It will also certainly revolutionize the

nature and distribution of employment in Michigan, distributing industrial, service, and professional activities throughout our State.

The Key Ingredients to the Development of High Technology

As the hard lessons of the past several years have struck home, and industry has searched for ways to regain competiveness, it has begin to recognize the importance of two critical factors in this task:

i) technological innovation

ii) technical manpower

To put it more simply, the keys to regaining competitiveness will be IDEAS and PEOPLE. In their search for these essential ingredients, both state government and private industry have turned increasingly to the primary source of these critical ingredients, to this nation's great research universities, seeking their help to provide the intellectual creativity so fundamental to technological innovation and the talented, broadly-educated scientists and engineers who can understand and implement this technology.

Of course, others have long recognized the importance that institutions with world-class programs in science and engineering play in economic development for many years. My colleagues and I have spent a great deal of time wandering around the high-tech meccas in California and New England trying to identify the keys to the phenomenal economic success of these regions.

Time and time again, we heard one response that dominated all others. It was not a more favorable tax structure (taxes in California or Massachusetts are higher than even in Michigan). It was also not the quality of life -- the smog-filled basins in southern California and the real estate prices in Silicon Valley quickly convince you of that. Nor was it the difference in wage-rates (although certainly Michigan's image as a high labor cost state has hurt it severely in attacting new industry.)

What we heard mentioned most frequently as the key to successful high technology companies in California was access to the faculty and students of four extraordinary institutions: Stanford and Berkeley in the north, and Caltech and UCLA in the south. Over the past 20 years California has invested heavily in making these institutions among the leading engineering schools in the nation. And the payoff has been enormous. Caltech spawned the California aerospace industry. Stanford and Berkeley triggered the Silicon Valley economic explosion. And these institutions continue to sustain these active and aggressive industries.

A similar story is told in New England. When asked to

describe in a few sentences the key to the economic renaissance in Massachusetts, a Harvard professor responded with one word: "MIT".

The dominant role played by world-class engineering schools in economic development has been identified in study after study. For example, in a comprehensive survey of technology-based companies conducted by the Joint Economic Committee of the United States Congress, the access to skilled technicians and engineers and to world-class engineering schools were listed as the leading factors in choice of location. This study noted:

> "The role of the university is important because universities are the major suppliers of technicians, engineers, and scientists. They are also a major source of new ideas upon which high technology companies so heavily depend to remain competitive. Universities also add to the recreational and intellectual opportunities of a region."

In a very real sense, the technological thrust of this nation is carried by a handful of such institutions, characterized by extraordinary excellence in science and engineering. We can easily identify them: MIT, Caltech, Stanford, Berkeley, Michigan, Illinois, ... perhaps no more than 10 to 20 at the most. These are the institutions that have provided -- and will continue to provide -- the technological leadership that is the key to the industrial and economic strength of this nation.

3. MICHIGAN'S RESOURCES

The College of Engineering of the University of Michigan is just such a world-class institution. The College has consistently ranked among the leading engineering schools in the nation and the world. It has been able to integrate outstanding undergraduate, graduate, and research programs to achieve a degree of breadth of disciplines and depth of quality matched by few other engineering schools in this nation. Furthermore it ranks third among all engineering schools in the total number of degrees awarded and claims more than 40,000 alumni throughout the world.

The Tradition of Leadership

The College has long been a leader in the development of new academic programs at the very forefront of technology. It pioneered in the introduction of metallurgical engineering (1854), naval architecture (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.

The Statistics

The basic statistics characterizing the capacity, breadth, and quality of the programs offered by the College are impressive:

CAPACITY:

Enrollment:

4,259	undergraduates (20% women, 7% minority)
867	M.S.
392	Ph.D.
5,518	total (growth of 48% since 1975)

Degrees:

997	B.S.
464	M.S.
95	Ph.D.
1,556	total graduates

Staffing and Facilities:

Faculty		301
Staff		650
Physical Plant		1,000,000 nsf
Operating Budget		$45 million
Revenue		
	Tuition	$18.4 M
	Research	20.4 M
	Private	7.5 M
		$46.3 million

QUALITY:

PROGRAMS:

- All 19 of its academic programs are ranked in top 10 nationally; 13 are ranked in top five.
- 9 are ranked first nationally among public institutions
- 3 rank first in nation among all institutions; 4 more are ranked second overall.

STUDENTS:

- 3200 applications for 750 positions
- Average entering freshman graduated in 97 percentile.
- SAT scores: 1250 (580 verbal, 670 math)

- o 25% were straight 4.0 GPAs in high school.
- o Attrition rate: < 15%

These statistics suggest that the College of Engineering represents an important resource, both to the State of Michigan and the nation. For the moment, at least, the College continues to have the capacity, the reputation, and the commitment to respond to the needs of Michigan in its efforts to revitalize and diversify its industry.

History would tend to confirm this role. Many companies have been attracted to Michigan principally because of the reputation and capacity of the College. Furthermore, graduates of the College have spread out to all corners of the State to establish and build new companies and industries. Beyond that, since most of the almost 1600 engineering graduates produced by the College each year seek employment in Michigan or the Great Lakes area, the impact of the College on the State is enormous.

The Commitment

For the decade ahead, the College has set as its primary objective the focussing of its efforts and resources to respond forcefully to address the needs of Michigan. Of particular concern will be the needs of Michigan 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 manifestitation 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.

Recent Initiatives of the College

To better illustrate the impact of the College on economic development in Michigan, let me list several examples of recent initiatives in this area:

1. The Center for Robotics and Integrated Manufacturing was established to conduct research and instruction in areas concerned with the computer-based automation of the functions of industrial production -- from product design to manufacturing to management, sales, service, and upgrading -- all of the activities of the so-called "factory of the future". It is just this technology that will be the key to the survival of industry in Michigan. The Center currently involves the efforts of 43 faculty and 100 graduate students

across 6 academic departments. In less than 18 months of operation, the Center has received international recognition and managed to achieve a sustained level of funding from both industrial and federal sources in excess of $3 million per year.

2. The College has played a key role in the development of the Industrial Technology Institute of Michigan. This Institute will be a world-class center for research and development in a variety of areas related to manufacturing, ranging from automation and manufacturing processes to technology transfer and the social implications of industrial technology.

3. In parallel with these major thrusts into industrial technology and manufacturing engineering, we have begun an exciting new program in what might be called "white collar" or "professional" productivity. In collaboration with several Michigan companies, we are working to apply modern computer and communications technology to develop a prototype computer network of tomorrow that will support industry and business.

4. For many years we have conducted Industrial Affiliates programs in which companies collaborate with us in a variety of areas of mutual interest. However now we are negotiating more extensive interactions with key companies in which we place faculty-graduate student teams into their facilities to identify and develop joint research projects, and then these teams return to campus, along with their industrial colleagues, to continue the interaction.

5. The College of Engineering conducts the leading program in the nation in occupational health and safety through its Center for Ergonomics. Recently the Center has played a key role in analyzing and restructuring the workplace environment of the factories of one of Michigan's leading companies, in order to address the concerns both of organized labor and management. Of particular concern has been the development of an effective "man-machine interface" between workers and automated machinery.

6. We have taken very seriously our obligations to transfer the fruits of our research activities into the private sector to stimulate economic growth. During the past month we have completed an extensive negotiation in which a $2 million software R&D program will be transferred outside the University to be formed into a private corporation. Furthermore, the University has recently founded the Michigan Research Corporation, a for-profit corporation in which the University holds minority equity interest, with the mission of identifying intellectual properties developed on campus and providing the guidance and resources necessary to bring these to commercial application. Once again the intent is to spawn new companies and economic growth in

Michigan.

7. The College is taking steps to expand its delivery of instruction in engineering to industry through a variety of mechanisms, including its Instructional Television Network, tutored-videotape instruction (similar to that provided by Stanford and MIT), and engineering short courses and conferences held both in our oncampus facilities and at widely-scattered industrial sites. We are also participating with industry through cooperative education programs.

8. We have taken very seriously our responsibility to participate in economic development activities, in close cooperation with State and community groups. For example, we were a founding member of the Michigan Technology Council. Furthermore, we have participated with the Governor's Office in its attempts to attract new organizations such as the Semiconductor Research Corporation and the Microelectronics and Computer Corporation.

In summary, our philosophy has been to accept the responsibility to go out to Michigan industry across this State, to learn their needs and concerns, and then to develop programs which address these needs. These brief examples provide strong evidence of our commitments to focus our considerable resources toward the assistance of Michigan industry.

4. DARK CLOUDS ON THE HORIZON

The importance of technology in Michigan's future is obvious. Furthermore, the key ingredients necessary to build a solid technological base for future economic development have been underscored time and time again by our competitors both in this nation and abroad.

Yet there are dark clouds on the horizon -- actions taken by our State in recent years -- which cast long shadows over Michigan's economic future. Let me identify several of these serious concerns.

Is Michigan Eating Its Seed Corn?

It has become apparent to most states in this nation that world-class engineering colleges can play a critical role in economic development. State after state -- Arizona, Texas, Minnesota, North Carolina, Florida, Louisiana, Wisconsin, California, New York, and so on -- are making massive commitments of public funds to build the Caltechs, the Berkeleys, the Stanfords, the MITs, -- and yes, the Michigans -- of tomorrow because 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.

Interesting enough, at one time Michigan also recognized this importance. In the years following World War II, this State made the major investment of public funds necessary to build one of the most distinguished institutions in the world, the University of Michigan. The University's engineering programs became widely regarded as national leaders. And this investment led to an impact by the University on industry in Michigan and across the nation which was just as dramatic in years past as that seen today in California and New England.

But then something went wrong. Roughly 15 years ago the State of Michigan began to throttle back its investments in the University of Michigan -- and in a very real sense ceased making these investments in its future. Indeed, 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 its competitors. 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 its major research universities, the very institutions which must play the key role in rebuilding and diversifying industry in this State.

Let me be more specific: 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 has dropped to the point today where the State currently ranks 42nd in the nation in its level of state support per student. Michigan ranks 49th in the level of new support provided to higher education over the past decade. 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.

In particular, over the past three years, the University of Michigan, the flagship of public higher education in this nation, has reeled from $45 million in permanent State budget cuts (roughly 35% of its state funding). It has been forced to close programs, lay off faculty and staff, and deny admission to large numbers of Michigan students. It has been forced to the brink -- to the horror and dismay of our colleagues across the nation -- and to those who depend on our graduates and our research -- and to prospective students who now must face the highest tuition level of any public university in the nation.

The 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., medicine, dentistry, nursing, and public health). 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 the College grew by 45%, the level of State funding for engineering education in effect has vanished.

The College today finds itself forced to support its programs 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. The impact of this decade of underfunding has been very serious indeed. It 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, resulting in obsolete and inadequate laboratories. Furthermore, the College has been forced to conduct its programs in deteriorating buildings (most of these from 50 to 70 years old) scattered over two widely-separated campuses.

As a consequence of this loss of State support, the College has been forced to limit its enrollment for several years -- despite the enormous demand for engineering graduates and the surging numbers and outstanding quality of students seeking admission to the College these days. Even more serious is the very real possibility that we 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.

We find this situation most ironic, frustrating, and alarming. For just at 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 one of the leading engineering colleges in the nation, the College of Engineering at the University of Michigan. We are now struggling valiantly to fund our programs almost entirely from private sources. 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.

The Growing Obsolescence of Michigan's Labor Force

A second concern involves the fact that the labor force of Michigan is rapidly becoming obsolete -- unable to cope with the technology of the future that will be necessary to keep our industries competitive. It is not surprising that unskilled labor will lose its relevance in a world dominated by microelectronics, computers, and automation. But, beyond even that, the type of skilled labor that has been Michigan's strength in the past, the machine-tool operators, draftsmen, machinists,

etc., may well be obsolete before the end of this decade. Instead we will require individuals skilled in electronics, computer software and hardware, and all of the other activities of the factory of the future.

There are serious concerns that our present labor force simply may not have the fundamental educational level in science and mathematics to allow them to be retrained for this future. And yet I see little sign that our educational system is responding to this challenge by strengthening the basic level of education in science and mathematics required of all students (as almost every other industrialized nation in the world has done). It is bad enough to face the prospect of a significant fraction of our labor force becoming unable to cope with the technology of the future because of an inadequate education. Do we want to condemn our children to a similar fate? Can we afford it?

A Compulsion Toward Mediocrity

The importance of quality to our economy has become all too painfully apparent in recent years. Only a few years ago a GM executive bragged to me that "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 such a product. 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 propagated to other areas of our society. Recently 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 education 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."

These criticisms apply all too precisely 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 teachers and students. 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 in our research universities over the years in favor of the support of mediocrity in higher education.

The simple fact of the matter is that only programs at the cutting-edge of technology which are capable of clearly 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 capability not just to tolerate excellence, but to focus its resources to achieve it in selected programs of critical importance to this State.

5. AN INVESTMENT IN THE FUTURE

The root causes of this crisis in the support of higher education in general and engineering education in particular lie very deep. Over the years this State has ceased investing in its future. It has chosen instead to mortgage its future to pay for the mistakes made in its past. Let me explain.

Frequently these days one hears reference to the "six-month planning horizon syndrome" which threatens to destroy American industry -- the inability to look into the future to identify the investments which must be made now if one is to achieve long term objectives. It seems evident that the State of Michigan has been infected with this same malady for many years.

In particular, I find the attitude we have toward our most precious natural resource, the youth of this State, both callous and alarming. Over the past 10 years, this State has methodically dismantled what was once the finest system of public education in the world. Michigan, a state with one of the highest per capita income in the nation, has turned its back on public education.

I simply will not accept the excuse that "we can no longer afford this investment in the educational opportunities we offer the youth of this State". Rather, I would suggest that, for whatever reason, we have chosen instead to cannibalize Michigan's system of higher education, to mortgage the real future of this State, to meet short-term needs that are the direct result of our own shortsightedness, selfishness, and lack of resolve.

To be sure, the immense social needs for welfare assistance, medical care, and all of the other programs that have drained our State treasury are compelling. However by choosing to meet these needs with resources taken away from our educational institutions rather than through reforms in our tax structure and political system, we have in reality mortgaged the future of this State by withdrawing the educational opportunities from its youth. We have forgotten the commitments that past generations of Michigan citizens have made to build educational institutions of exceptional quality -- institutions that have provided Michigan residents -- including many of the readers of these remarks -- for years with the unsurpassed educational opportunities.

Public support of higher education represents an important investment in the future. For it will be the great research universities of this nation which will provide the technological innovation and talented, broadly-educated scientists and engineers needed to rebuild America. Those states which cannot develop or sustain such world-class institutions will be unable to compete for the new prosperity of the 80s and 90s.

The writing on the wall could not be clearer. Michigan simply has no future -- at least a future that you or I would be willing to be a part of -- if we continue down this path. No State that is unable to recognize and sustain quality, that mortgages its future at the expense of the educational opportunities offered to its youth can expect -- or deserve -- the position of leadership to which we have been accustomed in the past.

There are no magic solutions, no high tech quick fixes to Michigan's present economic problems. It is only by investing in our future today -- that we can rebuild Michigan for tomorrow. Universities, industry, state government -- and, indeed, you as a citizen of this State -- all make a renewed commitment to working together to revitalize industry in this State. Speaking both for the College of Engineering and the University of Michigan, I can assure you that we have made that commitment.

Despite the challenges before us and the handicaps leveled upon us in recent years by this State, I assure you that the College of Engineering of the University of Michigan intends to do its best to meet its responsibilities to Michigan and to its industry. We have undertaken new and exciting initiatives to refocus our efforts to meet these particular needs. We have renewed our dedication to building and sustaining world-class programs in areas of key importance to this State. We have

signed our part of the agreement, and we have the will and determination to play the major role expected of us.

But it is also clear that without a comparable commitment from Michigan citizens and their elected public officials, we simply will not have the capacity to fulfill such urgent responsibilities. We will be forced to drastically cut our enrollments and dismantle key programs urgently needed by this state. We will cease to be a world-class engineering institution.

Fortunately, today for the first time in many years, there are strong signs that Lansing has awakened to the importance of higher education in general and world-class engineering programs in particular to Michigan's future economic development. In recent months our State leaders have shown the foresight, the courage, and the resolve to take action to reverse the slide in public support which has crippled our leading institutions over the past decade. There is renewed hope that by working together, our State government, industry, and leading institutions of higher education can rebuild the economy of Michigan.

What is Michigan's high technology future? Silicon Valley or Appalachia?

The choice is ours. We certainly have the capacity to rebuild Michigan, to restore our State to a position of industrial and economic leadership.

The more serious question is whether we have the foresight and the resolve to make the investments today, to make the total commitment to excellence -- to quality over quantity -- that will lead to prosperity and economic strength for tomorrow.

APPENDIX

TAKEN FROM:

"LOCATION OF HIGH TECHNOLOGY FIRMS AND REGIONAL ECONOMIC DEVELOPMENT"

A Staff Study prepared for the use of the Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee, Congress of the United States, June 1, 1982.

LOCATIONAL DETERMINANTS OF HIGH TECHNOLOGY COMPANIES: A MICROVIEW

The historical overview of the development of high technology centers in the Silicon Valley, Highway 128, and the Research Triangle reveals the complex, dynamic nature of the growth process. This section expands on the historical overview by taking a microview of the development process. In particular, the literature on the role of universities, skilled labor, State and local taxes, quality of life factors (including climate, housing costs, and the environment), and State and local development initiatives to the development of the three high technology centers is examined in more detail.

Universities. A recurrent theme in the literature on the growth of the three high technology centers is the central role of the university system as providers of basic research and as suppliers of trained personnel.20/ Nowhere is the linkage between the university system and the high technology community stressed more in promotional efforts than in the Research Triangle. In particular, the Research Triangle Foundation stressses the importance of a close relationship between the park occupants and Duke University (8 miles away in Durham), North Carolina State University (14 miles away in Raleigh), and the University of North Carolina (12 miles away in Chapel Hill).21/

> Our cluster of three great university campuses is a powerful incentive to new industry. It is their existence within a single, close-knit regional community, the challenging intellectual environment they foster, and their receptiveness to innovation and new ideas that have been the most compelling factors in bringing new industry to the area.22/

Ned Huffman invites prospective park occupants to meet university deans, department heads, and professors in their areas of interest.23/ Through their location in the park, companies can make use of the universities' mass spectrometers, phytotrons which can duplicate the climate of the Sahara, 6.5 million-volume library system, and the Triangle Universities Computation Center, with one of the world's largest educational computers.24/ In addition, the close proximity of the universities provides ample opportunity for scientists working in the area to become adjunct professors or to continue their educations.25/

Although not directly connected with the Triangle universities, State-run research projects serve much the same purpose, that of creating an atmosphere within which the quest for new technological developments flourish. In 1963 North Carolina became the first State to create an agency to encourage scientific research and technological application, with the establishment of the North Carolina Science and Technology Research Center.26/ The State recently approved the expenditure of $24 million to help construct a nonprofit microelectronics center by late 1983.27/ The center has been cited as a major factor in General Electric's decision to build a $50 million integrated circuit plant in the park.28/

Ties between industry and institutions of higher learning have also proven strong in the area near Route 128. Corporations support 10 percent of MIT's on-campus research, as compared with an average corporate support of research at all American universities which stands at 3-1/2 percent.29/ As part of this corporate involvement in university research, Exxon has sponsored an $8 million project on combustion research at MIT.30/ DuPont made a $6 million grant to Harvard Medical School's Genetics Department, retaining the right to make exclusive use of discoveries made through its financial support.31/ Harvard encourages its researchers to obtain patents on any discoveries made while at the university, and it assists in the licensing of companies outside the university to exploit the development rights.32/

Stanford's president, Donald Kennedy, views these developments as "a new era in university-industry relations."33/ On January 8, 1981, Governor Brown of California sought to aid in the development of this collaboration between industry and universities by proposing that the State spend $2.6 million next year for a microelectronics research center at the University of California, Berkeley. The State would then help finance research with yearly expenditures of $5 million.34/ The plan does have its critics, however. Some claim that microelectronics research has taken place on the Berkeley campus since 1960, and the $2.6 million proposed by Brown only represents the amount of money already requested by the university last year. At that time,

Governor Brown vetoed a portion of the funds. Solomon J. Buchsbaum, executive vice president of Bell Laboratories, believes that an adequate research center would require $150 million each year in order to operate, not the $5 million that the Governor proposes to spend.35/ Mr. Buchsbaum thus places very little faith in the ability of the proposal to benefit California business to any great degree.

In general, all three high technology centers show important ties with universities in the area, a factor that would appear to be important in their success. Some idea of the importance of this relationship was documented in a case history study of 15 Boston, 12 San Francisco, and 5 Milwaukee high technology companies by the Research and Planning Institute, Inc. On the role of university involvement, the study concluded:

> In an extraordinary number of cases a university played a major role in the history of the company. There were a number of companies that started to pursue the results of research done at the universities, although generally a significant amount of development work was still required. Often, the original research was performed under government grants. In other cases, especially apparent at MIT, the university encouraged faculty members to do outside consulting work for industry. When the consulting work begins to mushroom, colleagues or students are recruited to help and soon a company is born.
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> For companies in extremely advanced technologies, a continuing relationship with the academic community not only keeps the senior staff informed of new research developments, but helps the company acquire the most competent technical personnel.36/