MINNESOTA'S HIGH TECHNOLOGY INDUSTRY ITS IMPACT: NOW AND IN THE FUTURE

Answers to Questions Raised During Panel Discussions 1 & 2 January 14

onference Presented to the Minnesota
slature on January 14-15, 1985

minnesota high technology council, inc.

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Dear Legislator:

Thank you for attending the Legislative High Technology Seminar on January 14 and 15. You will recall at the time of the seminar we promised to answer as many questions directed to the panelists verbally as we could in the time allotted and to answer the balance of the questions later by letter. It has taken some time to gather the answers that were addressed to our panelists. Further, some questions were general questions directed to no specific panelist. Therefore, we have some questions which have been answered by a panelist and some questions which have been answered by our staff or myself.

We promised further to mail responses directly to questioners who identified themselves. If you are one such, you will by now have received a letter with the answer to your question in it. We also have tabulated all the questions that we received and have provided answers to each one. This list is enclosed for your interest.

Should you have further questions or would like to make further comments to our Council, we would be more than happy to communicate with you. Thanks again for the interest you have shown.

Sincerely,

Herbert C. Johnson
Chairman

HCJ/lr
Enclosure

Panel 1

Panelists: Whitney McFarlin
Tom Moser
Wilbur Maki
Gerald Mueller

1. QUESTION: As a tax payer who probably pays more in state income taxes than most engineers in high tech, where or from whom does Mr. Mueller suggest we raise the tax money to pay for greater math and science in elementary and secondary schools and computer and engineering education at the university level?

ANSWER: Regarding the need to improve math and science in the elementary and secondary schools, this can be done without spending substantially more sums of money. What is needed is to change the emphasis in those schools so that there is more focus on math and science. The Minnesota Business Partnership Report on K-12 Education in Minnesota includes an excellent plan for doing this within the constraints of present spending.

Regarding engineering and computer education at the university, there is no question that modern facilities and equipment are necessary and these will cost money. Much of this money can come from a rearrangement of priorities within our institutions of higher learning. What remains must be provided out of either an increase in taxes or a diversion of funds from elsewhere in the state budget.

ADDITIONAL COMMENT: The Minnesota High Technology Council has a program they are recommending for improving the quality of technical education in the State entitled, "The 1% Solution: A Key Investment in Minnesota's Future". This program recommends additions in the entire educational system from K-12 through graduate school. It would cost about 1% of the State's revenue budget per year for ten years to bring this quality of education to the level we judge as necessary to sustain our technology industries in the State.

2. QUESTION: Please comment on why U.S. technical position has slipped. Is U.S. slipping or are others getting better? What are our competitors doing?

ANSWER: As we pointed out in our panel presentation, the U.S. technical position has slipped in relative terms, not in absolute terms. Our technical capabilities have improved and the United States still is No. 1 in its technical abilities

in the world today...but our competitors are catching up and they are catching up fast.

Of particular concern is the fact that competing countries are turning out increased numbers of engineers and scientists compared to the United States. Also we are concerned that these new engineers and scientists are superior in some of their skills and abilities.

ADDITIONAL COMMENT: The literature is full of examples illustrating the point that the U.S. is failing to provide the quality of medical, scientific, and technical education that competing nations are providing. Also, our State, although it is highly ranked in education, falls well below many other states in terms of engineering and technical education allocations.

3. QUESTION: Governor wants University budget increased 21%. Governor wants 12.8% increase in State spending. Governor wants to remove Federal deductibility ($700M). How can Minnesota Legislature change the deep pockets attitude in taxes?

ANSWER: With your facts and figures, you make two points very convincingly. Our state cannot continue to increase its spending and, at the same time, reduce taxes. If it is going to continue to increase spending faster than personal income, it must reach deeper into the taxpayers pockets.

The way the Minnesota Legislature can change its deep pockets attitude is to realize that upper middle income and upper income people cannot foot the bill for the State's increased appetite to spend money. If that continues, we will not retain or attract people in those income brackets and there will be less state income tax revenue. Moreover, even if you could tax all of those people to the hilt of their ability to pay, there still would be a short-fall in state revenue.

Rather, if the Legislature closely were to examine its revenue sources, it would discover that the State's largest source of revenue is middle income people, those with incomes ranging from $15,000 to $60,000. These people do not have money filling deep pockets....

ADDITIONAL COMMENT: We could argue that the increase of the University budget of 21% recommended by the Board is not only necessary to bring the University back where it needs to be after several years of recession. We believe further that this is the best investment in our State's future that the State can make.

4. QUESTION: You are critical of Minnesota income tax. We use that money to support education and train good teachers in our schools. Often we lose the good teachers to your industry because teacher salaries are not competitive. Where do you feel we should get more taxes to support a better educational system?

ANSWER: We are critcal of the Minnesota personal income tax because it is so high relative to other states. We believe that this high level of taxation is a deterrent to retaining people within the state and attracting people to the state.

There is no question that money is needed to support education and train good teachers. However, we believe that our state could do a better job in allocating funds for education.

In industry, we feel that we have a responsibility to help keep good teachers in the classroom. Therefore, for those teaching disciplines that have a relationship to industrial employment needs, we think that there should be comparable pay. In other words, we think that science and math teachers should be paid more than other teachers. Higher pay would help alleviate shortages in those disciplines and also help compensate teachers for the additional training required.

5. QUESTION: Should we have done more to get MCC and what can we do to be sure we will be ready for next opportunity?

ANSWER: I was not part of the effort to attract MCC to Minnesota and am unfamiliar with the details. However, it is my impression that Minnesota mounted a very good effort to attract MCC to our state. The decision by MCC to locate in Austin, Texas was not based upon the quality of salesmanship by Texas vis-a-vis Minnesota, but rather on other factors. A chief consideration was the proximity of a first-class university that could relate to development of microelectronic technology. To the satisfaction of the people making the decision, the University of Texas was shown to have greater potential for relating to MCC's needs than the University of Minnesota.

ADDITIONAL COMMENT: Bobby Inman, the head of MCC, was a speaker at the Minnesota High Technology Council first annual meeting two years ago. He made the point very strongly that Minnesota was not in the top three candidates for location because this state was not supporting the University of Minnesota to the level that MCC felt was necessary and that the number of engineering graduates that the University

was capable of producing was less than they felt was optimum to support MCC's activity. It should also be understood that the State of Texas and the business community there made a number of dramatic concessions to attract MCC. We sincerely doubt our State would have been able or willing to match their offer.

6. QUESTION: Why does the State need to do anything different to meet high tech occupational shortages, i.e., has the supply and demand process short-circuited somehow? Will not high demand force up wages to meet these shortages?

ANSWER: We believe the problem is not simply wages but rather supply of people. It takes four, at least four, years to create an engineer, and there's no way to short-circuit the process. There are a number of things the State can do to provide technology and support people for our engineers and, indeed, it is doing so. We are training computer programmers in almost every part of our educational system. We are training engineers in many other parts of our system. Companies are training their own personnel, and finally, we are importing a large number of these people from other states. The report prepared by Professor Maki, of which you received a summary, will be printed soon. It will, like the summary, show that we are simply not educating enough top quality engineers and professionals to service the demands of technology intensive industry in Minnesota.

7. QUESTION: Please briefly discuss competitive "brain drain" for high-tech scientists and personnel by the increasing military-tech use of these personnel. How is this affecting Minnesota industries, e.g. in the medical tech area?

ANSWER: There is undoubtedly some brain drain for high-tech scientists moving into military-tech jobs both in Minnesota and in other states. We know of no statistics that separate out industry competition such as military-tech versus medical-tech. However, we would observe that the basic skills and general interest are so different in these two areas that we doubt there is a direct one-on-one relationship between them.

Engineers and technical people are in short supply everywhere, making it more difficult for Minnesota to staff its growing industries. The American Electronics Association has just published an excellent treatise on this subject that can be obtained from them. It certainly supports everything that Professor Maki says and then some.

8. QUESTION: As an economist, what real effect does either the super fund or the level of Minnesota personal income tax have on high technology industries as shown by your slides?

ANSWER: The St. Paul Pioneer Press and MHTC did a survey of MHTC members and other technology industries to determine the effect of various factors upon technology intensive industry in our State. We would be willing to send you a summary of this data at your request. One of the things it showed was that the super fund was simply not an issue for most of our members. Further, it seemed to be more of an issue for very large corporations than it was for the medium and small corporations. Since most technology intensive industry products are high value added products with relatively few waste or byproducts, we can understand that this is not a serious issue with them. Both large and small companies in the survey commented upon the personal income tax as being detrimental to their business. Aside from the pain of paying taxes, the high general level and very high progressive rate of these taxes makes it much more difficult to attract highly paid individuals from other states.

9. QUESTION: What specific programs would you suggest to encourage the expansion of high-tech industries in Minnesota?

ANSWER: The Minnesota High Technology Council has a specific program to encourage the expansion of high technology in Minnesota. It's entitled "The 1% Solution: A Key Investment in Minnesota's Future". These recommendations are limited soley to educational programs because we feel that quality people are the key to the success of our industry and quality education is what will distinguish them from people in competing states and nations.

10. QUESTION: I would like Tom Moser to comment on the effect he thinks the multi-state, multi-city competition to attract MCC - and the extraordinary financial package that was ultimately put together by Austin, TX - the effect this will or is having on economic development strategies of states and cities. Is this sort of financial incentive competition healthy or useful?

ANSWER: I think Tom would say that the extraordinary package that was put together to lure MCC to Austin is having the effect of spurring other states to come up with more aggressive programs of their own. He travels a great deal in his role as the head of the national high technology section of his firm and regularly comes back with tales of this or that program or facility being established in other states. Whether this kind of competition is healthy or not, is almost academic. It is a fact. We have seen comparisons of Minnesota's offerings with other states. While we are not at the bottom, we are certainly a long way from the top in what we offer

firms to come here. Our experience and background in the Council has been that it is more cost effective to have programs that keep companies that start here staying here rather than trying to attract companies from other states. Our weather and our taxes may be ok once you adjust enough, but they are both barriers to attracting other companies here.

11. QUESTION: If we pass programs to encourage spin-offs from our current high-tech businesses, will the major businesses such as 3M or Honeywell oppose our actions?

ANSWER: We don't think so. Control Data, for example, has an aggressive program to attract and support new technology industry in our state. The MCO that was established by private industry to aid formation of new businesses is supported broadly by current high technology business. The Minnesota Business Partnership has an innovative program for helping small businesses get started. It appears quite clear that the larger businesses see that there is more to gain than there is to lose by having more technology businesses in our State.

12. QUESTION: What can the State of Minnesota and the high tech industries do to provide more financial aid for graduate students?

ANSWER: We do a lot. For example, the American Electronics Association of Minnesota is sponsoring a program among its member companies to provide four-year tuition fellowships for graduate students in Minnesota. The purpose of this program is to retain top quality graduates in our State rather than having them moved outstate by other universities that have generous tuition support programs. Many do. We also can support the University in terms of providing overhead cost recovery money to help fund additional research which employs graduate students and provides an income to them while learning. (Incidentally, the State makes money on this investment because it brings in more money in federal grants than it costs the States.) Additionally, the State of Minnesota can provide money to the University to employ teaching assistants who are usually graduate students. This has the combined advantage of providing income for these TA's and a better teacher/pupil ratio for students. High tech industries can employ graduate students on a part-time basis (and do) to help sustain them during their education process.

13. QUESTION: High-tech industries have a reputation for generating a large amount of "hazardous waste". Is this true, and if so, what solution is being offered by the industry?

ANSWER: We generally don't believe that high tech industries have a reputation for generating large amounts of hazardous waste. Most of the high tech industries in our State manufacture high value products, have relatively small amounts of materials associated with them, and, thus, relatively small amounts of waste. We contend this is one of the advantages of such industries in our State. This is not to say that there are no industries that generate hazardous waste. There are. We would cite also the fact that most industries in the December 31 survey conducted by the St. Paul Pioneer Press showed little concern about hazardous waste regulations. The current controversy concerning the super fund law seems to involve a relatively few number of companies.

14. QUESTION: It's difficult to believe there are 12 high tech industries in Cottonwood County, part of District 2B which I represent. May I know what they are?

ANSWER: We wish we could help you. Apparently the data from which the map was created that shows 12 high tech industries in your county no longer exists. We have made requests to the Governor's Science and Technology Office for this data and have been told that their files on the study which generated this map do not have listings of these companies. We have attempted to obtain this data from other sources and have, so far, been unsuccessful. Your request is noted. If we are able to somehow find the list from which this data was taken, we will certainly advise you.

15. QUESTION: What percentage of the labor force in Minnesota is employed in high technology industries? What are the projections for the future? What is the average level of education required for high tech jobs?

ANSWER: The summary of the Maki report which was handed out at the seminar deals in depth with the first two questions. We will send an extra copy in our personal response to you. It is difficult to say the average level of education required for high tech jobs. Bear in mind that in Minnesota the average technology intensive company studied in the Maki report has 11 engineers per 100 employees. Most of these are four-year graduate engineers. The 89 other employees in the company range from assembly workers, technicians, sales people, designers, etc., all requiring fair amounts of education to excel in their job. To give you one surprising example, Honeywell's micro-circuit factory employs vo-tech graduates who, with computer aided design equipment, design micro-circuits. These vo-tech graduates receive considerable extra training by Honeywell but, nonetheless, are capable of doing jobs that we believe anybody would classify as high tech.

16. QUESTION: Are the new jobs of longevity? Any studies on this? Aren't we in a Catch-22 situation? As a State, we pump millions into education and training. Then these people leave the state for more lucrative job offers elsewhere, or other reasons. Aren't we investing and spending for someone else's benefit? What's happened to those states that were the first in high tech? Are they still going strong or branching off into new areas -- i.e., Mass Plastic Endeavors?

ANSWER: As a matter of fact, the Maki study and the MHTC future job need survey both indicate that technology intensive companies are both staying and growing in Minnesota. We are projected to employ more and more people in these businesses while the same data base indicates a decline in the more traditional industries that we think of as stable in our State. Further, we don't seem to be able to educate enough engineers and scientific people within Minnesota to fuel growth of these industries, so we, on balance, import them from other states. Obviously, some people do leave Minnesota for more lucrative jobs elsewhere. On balance, however, we bring more people in than we lose in these industries. Discussions that we have had with member firms who have more plant locations generally indicate that they are both staying and growing in Minnesota, although they may also be growing in other states as well.

You mention Massachusetts as one of the first high tech states. It is. The rapid growth of technology intensive industry in Massachusetts has a great deal to do with bringing the overall tax base down from earlier, higher levels. So far as we know, technology intensive industry is continuing to thrive in that state. In California, another early high tech state, the growth of these industries has been phenomenal. It's so great, in fact, that "Silicon Valley" is overcrowded to the point that these companies are putting branch plants elsewhere. If I only had the choice to invest in either electronics or steel today, it would certainly be electronics.

17. QUESTION: Public expects close controls and efficiency with public money. Be more specific. How much capital is needed on what terms? Who should and could decide how much to risk and on what ventures?

ANSWER: The High Tech Council is not making any recommendations that the State invest in private ventures. We don't think any state has set a good track record in doing this, and we think it is unlikely that Minnesota would do any better. Instead, we believe that the State should invest in its educational system and provide a broader more quality education.

If we move from manufacturing into information economy, it will be this that provides our State a competitive edge if any. We believe that it is best to let the market sort out the winners and losers.

18. QUESTION: The panelists have called for greater investments in human capital -- more and better science and math in elementary and secondary education, more post-secondary high-tech (engineering) opportunities, better high-tech (engineering) post-secondary opportunities. How would you prioritize these if resources are not sufficient for all? Is quality more important that quantity or vice versa?

ANSWER: The question calls for choices that we would rather not make. Our position is that the State has a responsibility to its citizens to maintain the quality of life we have here and to maintain quality educational programs according to need throughout the system. The Council has identified over 30 individual programs that we would recommend in our entire State's educational system from K-12 through graduate school that would certainly improve the quality of education and particularly in math, science and technical education. We suspect that both quality and quantity are important, but that critical edge in the coming decade will be quality.

19. QUESTION: What impact will the development of high-pay, high-tech jobs have on service industry wage rates?

ANSWER: It's difficult to say. In some cases, high paying, high tech jobs will set a standard that service industries will have to meet. On the other hand, development of high tech industries such as CAD/CAM, word processers, etc. make it easier for people to magnify their effectiveness and to utilize people with lesser training for some sophisticated jobs. Oddly enough, there seems to be a pattern that the high tech states are the high paying states as well. We think this may be because quality investments and quality employees make these states more competitive.

20. QUESTION: What kind of investment can rural Minnesota realistically expect from the high tech industry -- investment in plants, labs, etc., that could help maintain the economic viability of outstate, greater Minnesota? What elements, educational facilities, labor force, etc., need to exist for an outstate community to attract a high tech business?

ANSWER: This is a critical question. The fact is that there are more outstate, high tech type factories than most people realize. There are two types of outstate plants that can be briefly discussed. One is a branch of a larger,

metro based company that is high tech and financially supported and sustained by the main company. This kind of plant requires little from the local community other than quality citizens, good environment in which to live and work, and good schools for their employees' children. It helps to have a quality higher educational institute nearby because children grow up and want to attend institutions of higher learning as well. The parents of such children generally encourage them to do so. The second type of company is a stand-alone company that has its entire being in the community in which it is located. These companies require the same general conditions as the branch companies, however, in addition, they have a better chance of survival if they have a support base around them which consists of other businesses and service industries to help them. This kind of company can also use the help that a strong technical school nearby can provide. A school not only will provide quality graduates to work in these companies but also technical backup and support as needed to help keep growing.

We do not have any data on how many outstate technical businesses there are, but there are more than one would think, bearing in mind that half the population in Minnesota is centered in the metro area.

21. QUESTION: Do you believe electronics is now a "back to basics" core course (topic) to be included (required) in all secondary education schools?

ANSWER: We don't know if electronics should be a core course or not. It certainly would seem to have strong arguments for favoring it over some of the more traditional "manual training" courses that still exist in some of our schools. We think that a good basic training in math and science is a much better investment because it gives the student more flexibility in his future life and better basics for understanding whatever new techniques they will be dealing with in future life. We certainly are not bold enough to say what these techniques will be.

22. QUESTION: How can tech help the farmer (agriculture) without displacing them and their families?

ANSWER: We really doubt that technology is displacing the farmer and agriculture; in fact, we would argue that economics and social trends are making it more difficult for the farmers to lead the kind of life that they used to even ten years ago. Technology by making farmers more efficient can help keep them on the farm. We understand that a high percentage of students in the Institute of Technology come from outstate

Minnesota. Upon graduation, they will have jobs that we think, in the main, their parents will be pleased for them to have.

23. QUESTION: I have been informed that most of the new jobs will occur in the "low tech" area. High tech jobs will only account for no more than 5% of the jobs -- U.S. Dept. of Labor.

ANSWER: We have read the study that contends that high tech jobs only account for 5% of all jobs. On a national average, that may be so. In fact, nationally, we employ only 2.9 engineers per 100 employees. This incidentally is a very low percentage compared to Japan. In Minnesota, we currently employ over 13% of our total employment in technology intensive companies. Of course, not all of these employees are engineers. Is a computer salesman a "low tech" job? Is an engineering tech a "low tech" job? We don't think so. In any event, Minnesota ranks somewhere around #8 in the nation as a supplier of high tech jobs. I think we currently rank #3 in terms of high tech electronics manufacturing jobs. We think this is the basic strength of our State. Certainly, we are the envy of many other states in this regard.

24. QUESTION: Should a state government be directly involved in establishing sources of capital for development of high tech industries, e.g., Department of Economic Development grnats?

ANSWER: We are, as mentioned earlier, leery about the State directly funding the development of high tech or any other industries given the success rate of other states in this endeavor. Many states offer incentives of various kinds to businesses to lure them to their state. Minnesota offers few. Yet our State's employment has risen more rapidly than many other states that offer significantly higher incentives and lower taxes. We believe that, at least for high technology industry, the development of quality education for all the state's citizens and particular focus on math, science and technology education are the keys to success.

There have been numerous studies done on development programs pursued by both city and state government. North Carolina, Utah, Massachusetts and several others are examples of states with such programs. In all of these, a strong university complex seems to be a critical component.

25. QUESTION: Do you believe high tech industries can (and will) locate in non-urban areas -- and, if not, do you foresee need for another strong rural-to-urban migration of the more able and better motivated youth of the state?

ANSWER: High Tech or rather "technology intensive" industries are already locating in non-urban areas. If our base data (which isn't very good) is correct, there are already hundreds of such companies in "Greater Minnesota". The growth has been dramatic. From almost none ten years ago to now. I can't comment very well on a repeat rural-to-urban migration except to note that the rate of migration has slowed the last few years but still continuing.

26. QUESTION: Much has been stated about the number of jobs to be created by high-tech promotion. What about the recent studies showing that many jobs created are actually low-paying, unskilled or clerical jobs -- indicating high tech should not be considered a panacea for our unemployment problems.

ANSWER: According to the Maki study, the average salary for engineers, technicians, scientists, etc. is just about twice the State average income. Remembering that there are approximately ten other jobs per engineer in high tech companies and that these tend to be high-paying companies, I believe that in Minnesota we raise the average income. In some California companies that have a very high worker to engineer ratio, I am sure that a number of lower paying jobs are created. Unfortunately, what tends to happen with these lower paying businesses is that they get exported offshore so they do not last very long in the United States.

There was a report written a year or two ago by two professors who made a very strong point about technology not being a very good job creator and that the jobs were relatively low paying. I have read the report and don't think that is so for Minnesota. For example, in my company our average annual salary per employee is $25,000 which is just over twice the State average income.

By the way, if you would like to see a report that argues that high technology does not create jobs, I could send you a copy. Let me know if you are interested.

27. QUESTION: By what vehicle does industry make known its need for education system products -- i.e., graduates? (A) to the University of Minnesota and other institutions and (B) to the Legislature?

ANSWER: Most companies seek graduates in a variety of ways. They recruit at the University and other institutions. They use employment agencies. They advertise in newspapers and trade publications. Unfortunately, none of these provide an aggregate figure as to how many actual graduates are needed at any point in time.

Two years ago, the High Tech Council conducted a survey of its membership to try to determine what future employment needs would be. This report was done using a professionally generated survey form and was professionally analyzed by a major accounting firm. Despite this, there was wide disbelief in the output of the report. This disbelief was one of the reasons that we commissioned Professor Maki to do an independent study of the State to determine, on the basis of econometric modeling, what future employment would be in the technology intensive industries and elsewhere. The results of the study came out surprisingly close to the study that we had conducted two years previously. He claimed his results were very conservatively stated. Even so, they were higher than the results of our own survey.

28. QUESTION: Are you willing to help upgrade our educational systems, such as contributing more money to private colleges such as St. Thomas who educate a large portion of the types of graduates you are looking for? Would a tax incentive help this along?

ANSWER: Membership of the MHTC does contribute substantially to helping upgrade our educational system. They do so in many ways. They contribute money. They contribute equipment. They provide adjunct professors and teachers. They support special programs such as the Math Counts Program, etc. In fact, the survey of our members reveals that in 1984 they contributed almost $10 million. In our 1985 proposal to the Legislature, we have recommended that a tax credit be given for equipment donations to private colleges and high schools and community colleges to encourage more such donations.

29. QUESTION: Would you consider passage of the so-called "economic conversion" bill a deterrent or help to Minnesota business?

ANSWER: We plead ignorance. If you would kindly send us a copy of the economic conversion chart, we will study it and tell you what we think.

30. QUESTION: What percentage of your new hires are new graduates? If you could fill all your needs from the University of Minnesota would you want to hire from other schools? How short does the University fall in filling your needs and is that because of the number of available graduates, training, or what?

ANSWER: This is a difficult question to answer in a general way, and I'm afraid a company specific answer would not be very helpful.

Small technology intensive companies (particularly fast growing ones) can't afford to hire many new graduates because they don't have the resources to train them. They prefer to hire people who have some experience and preferably bring new knowledge and skills into the company.

Large companies like to hire new grads. It's economical for them, they have the training resources, and they can train these people into operating within their system.

According to our data (The Maki Report), technology intensive industries are hiring about 5,000 engineers, mathematicians, computer specialists, etc. a year in Minnesota. The University is only producing 1,000 in total.

Obviously, hires are coming from other in-state schools, out-of-state schools, in-state companies, and out-of-state companies. Additionally, companies are doing a lot of training in house. Unfortunately, we don't have good data on what percent of each occurs or how it breaks out according to company size.

31. QUESTION: As we strive to improve the skills and climate for more (and more capable) high tech intensive companies and workers, what should Minnesota do to improve conditions and opportunities for people without the will or the capability to become high tech careerists?

ANSWER: A recent survey conducted by U.S. News Today indicated that Minnesota had the best quality work force of any state in the United States. This, we are sure, is one of the reasons that technology companies have formed here, grow here, and stay here. These companies employ all kinds of people from secretaries, clerks, production workers, janitors, accountants, etc. In fact, considering the major shifts in our State's economy that are taking place at this time, it appears reasonable to assume that technology intensive industry will employ a larger and larger percentage of our State's people. Incidentally, this same study named Rudy Perpich as the best "high tech" governor.

Minnesota is noted for having one of the most generous welfare programs of any state in the union. In addition, it is noted for having a generally high quality of life. We have the largest number of people graduating from high school per capita of any state in the union. I am not sure what else one could ask for except possibly to have all these things and pay dramatically less taxes at the same time.

32. QUESTION: If we will need 27,000 new engineers, scientists, mathematicians, and computer specialists during the next five years and each one of these jobs creates 11 jobs within its own company and 12 jobs in other parts of the economy, where will we get the 648,000 people people that will be neededd to fill all of these jobs?

ANSWER: Your mathematics are very good. According to our projections, they come very close to what we are projecting the employment needs to be five years from now. In fact, your number is a little low. It is probably closer to 25% of our total employment. At the present time, we are employing about that amount of people today in technology intensive industries and indirect support jobs.

33. QUESTION: Improve education, provide start-up money, make a larger dollar commitment to Institute of Technology at U of M, cut personal income tax for middle and upper income people while farmers are dying from high property tax. Expand tax base (sales tax?). Somehow all of this doesn't fit together. Comment.

ANSWER: This sounds to us like the kind of issue we would be fools to get involved in. However, the program that we are recommending to the Legislature this year calls for spending 1% of the State's income on improving the quality of education throughout the entire educational system. If we don't improve the quality of education in our State, the chances of remaining competitive with other states and nations decline, and if these healthy, tax paying companies start leaving or dying, the State's tax base will certainly suffer a dramatic decline. Speaking personally, I would be more than happy to pay more taxes if they were funneled into improving the quality of education in our State because I believe, along with Governor Perpich, that brain power is our major means of survival in the coming information age.

34. QUESTION: Which specific high tech industries are the most lucrative for growth in Minnesota? Why? What can the state do to foster (encourage) development in these areas? <u>Should</u> the state target these areas?

ANSWER: That is an excellent question. Minnesota is the largest, almost the only producer of supercomputers in the world. This position results from a fortuitous combination of circumstances.

Minnesota is also the home of many small electronics companies serving diverse markets in diverse ways. It also is the home of a great variety of medical service and service suppliers. I personally contend that our great electronics firms of today were helped in their early growth by the strong Institute of Technology back in the mid 50's to mid 60's and that the rapid growth of the medical companies has a direct cause-effect relationship to the development of our Medical School over the past 20 years. Believing this, I support rebuilding the Institute of Technology as the best way to help technology industry. I think the market not government should select for success.

Panel 2

Panelists: Roger Heinisch
Donald Sullivan
Dr. Rex Krueger
Joyce Thompsen
Dr. Ettore Infante - Summation Speaker

1. QUESTION: What would be a normal or desired ratio between undergrads to grad students? Is it not cheaper to train undergrads? Let someone else carry the high expense of the grad student!

ANSWER: The ratio of undergraduates to graduates varies considerably depending upon the school. University of California, Berkeley has a ratio of approximately 2:1. Minnesota has about 4½:1. We think that somewhere on the order of 3.3:1 is a desirable goal for Minnesota with our technology intensive and knowledge industry base.

It is less expensive to train undergrads than grads, although the issue is not a simple one. For example, graduate students require more time from their advisors and more support, and their classes in graduate school tend to be smaller. On the other hand, graduate programs receive federal support and, in some cases, industry support. However, it is still more expensive to train graduate students.

If we let others train these graduate students and seek to bring them to Minnesota after they are trained, the companies in the state incur substantial recruiting costs. Internal surveys of the Technology Council indicate that it costs on the order of $30,000 per person to recruit people from other states. Not only that, they are less likely to stay here than students who were educated here. On that, I would say educating graduate students in Minnesota makes good economic sense.

2. QUESTION: What five institutions will N.S.F. fund for supercomputer and why was the U of M's application deficient?

ANSWER: The four institutions the N.S.F. will fund for the supercomputer are: Princeton, University of California (San Diego), University of Illinois, and Cornell. As I understand it, the evaluation process involved a number of factors. One factor in which Minnesota was rated poorly was in the financial support for computer science. You may be interested to know that the University of Minnesota provided the least support for computer science in terms of dollars per student. Using Minnesota as a base of one, Illinois spends twice as much, Cornell five times as much, and Princeton six times as much.

It was also noted that the University already has a supercomputer. In fact, Minnesota was the first university in the world to have a Cray supercomputer. The University has done a considerable amount already with that computer, so it was felt that the need for more support was less than it was at the institutions that did not have this history. We have recently learned that N.S.F. does intend to provide increased support for our proposed supercomputer institute.

3. QUESTION: (A) Given the decline in the quality of IT's output and its inability to fulfill the needs of Minnesota's business, does it make sense for the legislature to do something that would break IT's monoploy of technical, graduate-level education? (B) What do you think is the most important quality that we should look for in the University of Minnesota's new president?

ANSWER: I don't know whether it makes sense for the legislature to break the monopoly of graduate level education or not. I would say, first, that the legislature should appropriately fund IT graduate program, for that will have the fastest, most immediate payback, and then let us see where we go from there.

The Council addressed a letter to the search committee for the new president. As I recall, we urged that they seek an excellent administrator, a good spokesperson for the University, and a scientist with a proven academic record. We used Dr. Saxon, a man who was rejected by the search committee ten years ago, as an example of whom we thought would be an ideal candidate. In retrospect, Dr. Saxon proved himself to be so. He went on to be Chairman of the University of California (Berkeley) and then a professor emeritus at Massachusetts Institute of Technology.

4. QUESTION: In brief, what do you believe it takes to attract top quality graduate students to Minnesota?

ANSWER: I think the questioner knows the answer to this question. It takes a quality graduate program not only in the areas of interest to the student but an overall quality graduate program in the institute of higher education.

5. QUESTION: You both spoke exclusively about IT and, to a lesser extent, State universities in your presentation. What are the roles of AVTI system and community college system in meeting needs of technology?

ANSWER: We have a tendency to speak mainly about the importance of engineers to technology intensive industry. In Minnesota's technology intensive industry, approximately 10% of their employment is in the form of engineers, computer scientists, etc. The other 90% are people of other skills and disciplines. Among these are skills provided by AVTI, community colleges, private colleges and the like. AVTI plays a vital role in the technician levels in technology companies. In my company, for example, we have a variety of software programmers whose training ranges from AVTI on up to Ph.D.'s . Honeywell, in their advanced microcircuit division, utilizes vocational school graduates to actually lay out the microcircuits for their microchips, using sophisticated equipment. You might think of them as 21st century drafts people.

6. QUESTION: Education investments advocated by the panelists cost money and will inevitably reduce funds available for tax cuts. What is <u>most</u> important: increased education expenditures or tax cuts?

ANSWER: What is more important, increased education expenditures or tax cuts? This is a question that seems to be flying around the legislature this year. I would argue that education expenditures are investments in our future and tax cuts are grants to current consumption. If we don't appropriately invest in our future, we will not have future consumption choices available to us. I would argue, therefore, that however important tax cuts may appear, appropriately funding our education systems is more important still.

7. QUESTION: If we have to make a choice, should we emphasize K-12 or college or graduate school?

ANSWER: This question was posed on the floor. It's what we engineers call a "Hobson's choice". You simply must do all three. The fastest payoff will come from investment in graduate school, the next from college education, and the last from K-12. If we don't invest in all three, our economy will suffer in the future.

8. QUESTION: Should teacher have a B.S. in math, etc. or a B.S. in education and in teaching methods, etc.? In other words, should teachers know the subjects they teach.

ANSWER: I think the questioner knows the answer to his or her own question. If teachers don't know the subjects they are supposed to teach, it is doubtful that they could do a good job of teaching them even though they may understand the methodology of teaching very well.

9. QUESTION: Numerically or quantitatively, could the predicted shortfall in technically trained personnel be made up by encouraging women to enter fields such as engineering so that the level of female participation is equal to that of male?

ANSWER: The shortfall in engineers, computer scientists, etc. that we are projecting is so great that it could not be made up solely be recruiting females to the engineering field. However, I am pleased to note that there is an increasing number of women entering the engineering professions these days and that they are doing very well. There is a women's engineering society at the University of Minnesota which is very active in promoting women in engineering.

10. QUESTION: Last Saturday, a 48-year old graduate chemical engineer called me to ask me not to vote for increased state funding for IT at the U. He claims, as does another 56-year old graduate chemical engineer from the closed Bemis Tech. Center, industry will not hire well-qualified middle to older individuals. He has been looking for over two years. Please comment.

ANSWER: Industry does hire well qualified middle to older individuals, although admittedly, it's harder for them to find positions than younger people for a variety of reasons. It is a curious anomaly at Minnesota that the top ranking department in the Engineering School is chemical engineering while Minnesota industry actually employs very few chemical engineers. In fact, I'm told, most chemical engineering graduates are forced to leave the state to find employment. I think the engineer who asked you not to vote for increased funding is missing the point completely. I am afraid he may have to go and look where the jobs are.

11. QUESTION: Panelist Sullivan proposed that the state spend more money on elementary and secondary education (on such items as forgiveable loans and higher teachers' salaries). Is money sufficient? Or would you propose that some accountability measures be introduced into elementary and secondary education? If not, why not? If so, what?

ANSWER: I think panelist Sullivan made it very clear that money alone is not enough even though money is needed in order to increase the number of qualified math and science teachers that we have available for our schools. I think Sullivan would also say that he approves strongly of accountability measures in both elementary and secondary education. The Alliance for Science has done quite a bit of work on this area as have other organizations including the Minnesota Business Partnership. It isn't a matter of ideas, it's a matter of will.

12. QUESTION: Why has Minnesota fallen so far behind the nation in number of graduate and post-graduate degrees earned in high technology fields? Or did I misunderstand the presentation?

ANSWER: Minnesota has fallen behind the nation in number of graduate and post-graduate degrees earned in technology fields because we haven't put enough money into the University of Minnesota's technology programs. Even if we had, we would still be short of engineers because the growth of technology industry in Minnesota has exceeded the national growth rates by such a wide margin.

13. QUESTION: Given the very tight budget and the call for reduced taxes, where does the High Tech Council recommend the money come from to carry out these recommendations, including higher teacher salaries and increased support for post-secondary institutions?

ANSWER: The State of Minnesota now has one of the biggest surpluses of any state in the nation. Our tight budget is a matter of policy rather than need. In our view, a considerable improvement could be made in our educational system by spending 1% of our State's revenues on education enhancements above what we normally spend. One percent per year would amount to about $50 million each year. We propose that this money be spent consistently for a ten-year period in order for our schools to be built back up to levels they were at 25 years ago.

14. QUESTION: Why did Minnesota lose the NSF Grant for a supercomputer research institute?

ANSWER: It is our understanding that Minnesota lost the NSF Grant for a super research institute for a variety of reasons. Please see our answer to Question #2.

15. QUESTION: What percentage of the demand for engineers, etc. are related to the great military buildup? What would the demand be if the buildup levels off? In 1973, engineers with 20 years of experience could not find work -- why will that not happen again?

ANSWER: We don't have good data to support what percentage of Minnesota industry relates to military or defense as compared to more civilian enterprises. I'm guessing that, among our technology industries, no more than 25% of our total employment is devoted to military and defense ends. I recall a period in 1973 when a lot of engineers were unemployed. Many of

them were engineers who had worked in defense industries. It's unfortunate but true that when Washington has their hand in the spigot, flow can dry up very suddenly. It happened then; it could happen again. (I also recall that it wasn't very long before there was a shortage of engineers once again.)

16. QUESTION: Science and math are obviously important for technical skills. But several corporate executives with whom I have spoken have said a major problem they experience is employing engineers who are not effective in written and oral communication. Are these skills of importance to the MHTC? If so, what programs do you advocate to attract effective communication teachers? Finally, critical thinking skills are frequently sought -- are these skills solely developed in science and math courses?

ANSWER: Communication is a critical skill for engineers and even more so for engineer trained managers. I think this is particularly true in the knowledge based and technology intensive industries such as we are growing in Minnesota. They are, indeed, important. I don't know what programs we could advocate to attract effective communications teachers that we are not now using.

It is true that communication skills are not necessarily best taught in science and math courses which tend to emphasize left side of brain linear thinking. It's no accident that the presidents of many of our technology intensive industries are not engineers but graduates from the liberal arts.

17. QUESTION: My impression is that hi-tech industries pay less than others on average -- is that ture? If so, why not just keep our current industries and support them with special programs to keep them healthy?

ANSWER: The Maki Study that we recently completed indicated that technology intensive industries pay well above average. It's only in some special circumstances that I think you will find higher paid individuals outside of technology based industry. The study I referred to above found that engineers and technical people on average were paid almost exactly twice the average income of our state's employees.

I don't see how this bears any relationship to keeping our current industries healthy. In fact, our high techology industry helps keep other industries healthy and competitive. In some cases, however, there is simply no way that current industries can be independent and viable as they once were given increasing competition, international markets, etc.

18. QUESTION: Will essentially all of the expansion of high technology employment be centered in the Twin Cities (or possibly Rochester), or is there a potential for small high industries in major unemployment areas such as Northeastern Minnesota?

ANSWER: I personally believe there is considerable potential for high tech industries in major unemployment areas such as northeastern Minnesota. In fact, we are now starting to see the first of these develop and flourish there, while there was essentially none as recently as 25 years ago. A quality University is the key to the nurturing and growth of such industries.

19. QUESTION: To most people "quality of government" would mean things like lack of corruption, openness, voter participation, access; what did the executives who responded to the St. Paul newspaper poll mean by "quality of government"?

ANSWER: I wish I knew. I personally feel that we have one of the better state governments in the United States. We may be expecting too much. We have set such high standards for ourselves in other areas. In any event, put me down as not agreeing with those other executives.

20. QUESTION: Is there any evidence that high tech people prefer to work in states where they go to school? If not, why not let other states train the people and let Minnesota companies hire them? (Minnesota has done a good bit of training of high cost graduates who have migrated elsewhere.)

ANSWER: There is, indeed, evidence that high tech people prefer to work in states where they go to school, particularly if the quality of life in that area is good. I commented further on this issue in the answer to question #1.

According to data that I have seen, approximately 60% of the engineers who graduate from the University stay in Minnesota. However, a surprising number of engineers who take their first job in another state return to Minnesota after some period of time. We don't have good data on the percentage of Minnesota grads who return.

21. QUESTION: The Minnesota business community is requesting dramatic increases in funding for higher education and is also requesting a significant decrease in the personal income tax rate. The first is a request for increased expenditures and the second a request for a decrease in revenue. How are these two requests reconciled?

ANSWER: First, I don't think there is any such thing as an integrated Minnesota business community that speaks with one

voice. Some segments of the business community value quality education more than others and some value tax cuts more. The Technology Council is a segment of the business community that is requesting more funding for higher education.

I would not claim that this is a dramatic increase. In fact, our state is currently funding higher education at a lower level than needs of our state require. It's down below the mid-point of all states in funding for higher education. We think the University should be funded at least equal to other Big Ten Schools, that would require a 30% increase for the University alone. More money for other parts of our higher education system is needed as well. We are talking about technology enhancements for the entire educational system that should cost no more than 1% of our total state revenue. If other needs were fully funded, it would probably be another percent. This hardly seems a dramatic increase.

I commented earlier in the answer to question #6 that expenditures for education are investments and expenditures for tax cuts are consumption.

22. QUESTION: Do the panelists have insights as to whether technological change today (for example, in robotics) might abolish more jobs than it creates--unlike the experience of the past when human skills were not as cheaply replaceable by technology?

ANSWER: I would like to rephrase the question to ask, "If we don't invest in technological change and automation, where will our jobs come from?" In Minnesota, for example, there are a number of companies that have significant employment devoted to providing robotics and automation to industries. Those are clearly jobs that wouldn't exist without technology. Second, we have a number of companies that employ automation and technology whose manufacturing jobs could very well depart offshore if technology did not render the difference in wage costs immaterial. It seems to me we really don't have a choice. We invest in technology and grow jobs here or we don't invest in technology and lose many of the jobs we now have.

23. QUESTION: How can we cut taxes and yet fund additional large expenditure for education? Where do dollars come form?

ANSWER: This question was asked three times I believe. I discussed it in my answer to questions #6 and 13. We are not talking about large, additional expenditures for education. The dollars come from huge surpluses that the state has generated. A surplus that, I might add, is the envy of many including our closest neighbors.