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REMARKS BY

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LARGE SCALE TECHNOLOGICAL COOPERATION AND INDUSTRIAL COMPETITIVENESS

IT IS A PLEASURE TO BE HERE THIS EVENING AND SPEAK ABOUT LARGE-SCALE COOPERATION FOR IMPROVING U.S. COMPETITIVENESS. I CAN'T THINK OF A MORE IMPORTANT ISSUE THAN THE THREAT TO THE NATION'S ECONOMIC HEALTH CAUSED BY OUR STEADILY ERODING COMPETITIVE POSITION IN WORLD MARKETS. OVERSTATING ITS SERIOUSNESS IS DIFFICULT, CONSIDERING THAT OVER 70% OF THE U.S. DOMESTIC MARKET IS OPEN TO FOREIGN COMPETITION. THE PLAIN TRUTH IS THAT THE U.S. IS IN A GLOBAL STRUGGLE. THE COMPETITION IS FIERCE, AND WE ARE LOSING IN MANY MARKETS.

THE 1985 REPORT OF THE PRESIDENT'S COMMISSION ON INDUSTRIAL COMPETITIVENESS PROVIDED A GOOD PERSPECTIVE OF THE FOREIGN COMPETITIVE CHALLENGE. IT WARNED THAT OUR ABILITY TO COMPETE WAS ERODING, AND THAT WE WERE LOSING WORLD MARKET SHARE IN INDUSTRY AFTER INDUSTRY, INCLUDING SEVEN OUT OF TEN HIGH TECHNOLOGY INDUSTRIES.

UNFORTUNATELY, THE TRENDS FLAGGED BY THE PRESIDENT'S COMMISSION HAVE CONTINUED. ACCORDING TO THE DEPARTMENT OF COMMERCE, THE U.S. RECORDED ITS FIRST WORLDWIDE TRADE DEFICIT IN ELECTRONICS IN 1986, GOING FROM A $1.3 BILLION SURPLUS IN 1985 TO ALMOST A $1.9 BILLION DEFICIT LAST YEAR. AT THE SAME TIME, A REPORT PREPARED FOR THE JOINT ECONOMIC COMMITTEE OF CONGRESS PREDICTED THAT WHEN ALL THE FIGURES ARE IN, 1986 WILL PRODUCE THE FIRST FULL-YEAR HIGH TECHNOLOGY TRADE DEFICIT SINCE THIS CATEGORY WAS FIRST IDENTIFIED.

ADVERSE EFFECTS OF THE LOSS OF MARKET LEADERSHIP IN HIGH TECH IS NOT RESTRICTED SOLELY TO REDUCED TRADE AND LOSS OF JOBS IN HIGH TECH COMPANIES. THEY ARE FELT MUCH MORE WIDELY BECAUSE HIGH TECH PRODUCTS, SUCH AS MICROCOMPUTERS, ARE USED TO IMPROVE THE PERFORMANCE, QUALITY AND LOWER COSTS OF PRODUCTS,SERVICES AND PROCESSES IN OTHER INDUSTRIES. HENCE, THESE INDUSTRIES, WHICH REPRESENT A LARGE SEGMENT OF THE ECONOMY, ARE PLACED AT A SEVERE COMPETITIVE DISADVANTAGE WHEN THEY DO NOT HAVE THE SAME ACCESS TO THE MOST ADVANCED HIGH TECH PRODUCTS AS THEIR FOREIGN COMPETITORS.

IMPROVING THIS DISMAL SITUATION IS A GARGANTUAN TASK BECAUSE U.S. COMPETITIVENESS IS INFLUENCED BY MANY FACTORS, INCLUDING TECHNOLOGY, AVAILABILITY AND COST OF CAPITAL, TAX AND CURRENCY EXCHANGE RATES, EXPORT REGULATIONS, PERFORMANCE OF LABOR, EFFICIENCY OF MANUFACTURING AND AVAILABILITY OF HIGH QUALITY, RELEVANT EDUCATION AND TRAINING.

THE PIVOTAL ISSUE IS BETTER MANAGING OUR TECHNOLOGY, ESPECIALLY TO INCREASE THE EFFICIENCY OF CREATING AND APPLYING IT. A MAJOR

MEANS OF ACCOMPLISHING THIS IS A VAST INCREASE IN LARGE-SCALE TECHNOLOGICAL COOPERATION AMONG CORPORATIONS, UNIVERSITIES AND GOVERNMENT.

MCC

THE OUTSTANDING EXAMPLE OF LARGE-SCALE TECHNOLOGICAL COOPERATON IS MCC, THE MICROELECTRONICS AND COMPUTER COMPANY IN AUSTIN, TEXAS. MCC COMMENCED OPERATION IN EARLY 1983. INITIALLY, THERE WERE 11 PARTICIPATING COMPANIES, MAINLY FROM THE U.S. COMPUTER AND SEMICONDUCTOR INDUSTRIES. THIS NUMBER HAS GROWN TO 20. THE STATE OF TEXAS IS PROVIDING SUBSTANTIAL SUPPORT FOR MCC, AND 25 UNIVERITIES ARE PARTICIPATING IN THE RESEARCH AND DEVELOPMENT EFFORT. ALSO, PARTICIPATION BY THE FEDERAL GOVERNMENT IS EXPECTED IN THE FUTURE.

MCC CONDUCTS LONG TERM GENERIC RESEARCH AND DEVELOPMENT IN THE MICROELECTRONICS AND COMPUTER FIELDS. IN OTHER WORDS, IT IS NOT ENGAGED IN DEVELOPING PRODUCTS BUT SEEKS TO SUPPLY GENERIC TECHNOLOGIES WHICH MEMBER COMPANIES CAN USE IN DESIGNING PRODUCTS AND SERVICES FOR THEIR INDIVIDUALLY SELECTED MARKETS. ADDITIONALLY, TECHNOLOGY CREATED BY MCC IS LICENSED ON REASONABLE TERMS TO OTHERS, ESPECIALLY SMALL COMPANIES.

PROGRAMS: AT THE PRESENT TIME, MCC IS PURSUING FOUR MAJOR PROGRAMS WITH TIME FOR COMPLETION OF EACH VARYING FROM SIX TO TEN YEARS. MEMBER COMPANIES PARTICIPATE IN ONE OR MORE PROGRAMS AND SHARE THE COSTS EQUALLY OF EACH PROGRAM JOINED. THERE ARE SOME SOME 460 PEOPLE, OF WHOM 325 ARE SCIENTISTS AND ENGINEERS ENGAGED IN THESE PROGRAMS. MCC'S ANNUAL BUDGET IS CURRENTLY AT A LEVEL OF $75 MILLION.

BENEFITS FOR MEMBERS: THE MCC FORM OF TECHNOLOGICAL COOPERATION OFFERS A NUMBER OF BENEFITS FOR ITS MEMBERS. TWO MAJOR ONES ARE TECHNOLOGICAL LEVERAGE AND NEEDS FULFILLMENT.

Technological Leverage: TECHNOLOGICAL LEVERAGE IS A MEASURE OF THE DEGREE TO WHICH A PARTICULAR TECHNOLOGY CAN BE CREATED FOR A COST LESS THAN THAT REQUIRED FOR AN ORGANIZATION TO CREATE THE TECHNOLOGY BY ITSELF. THIS OCCURS BECAUSE OF THE CONTRIBUTIONS OF OTHERS. IN THE CASE OF MCC, CONTROL DATA ESTIMATES THAT FOR EACH DOLLAR INVESTED, IT WILL GET RESULTS ON AVERAGE COSTING FIVE DOLLARS, I.E., A LEVERAGE OF 5 TO 1. OTHER PARTICIPANTS WILL RECEIVE SIMILAR BENEFITS.

Needs Fulfillment: A HIGH MARK CAN ALSO BE ASSIGNED TO THE FULFILLMENT OF THE NEEDS OF PARTICIPANTS FOR TECHNOLOGY. THIS RESULTS FROM PARTICIPATIVE PREPLANNING OF THE RESEARCH AND ITS ASSIGNMENT TO HIGHLY CAPABLE RESEARCHERS. WHILE PARTICIPATIVE PLANNING OF A PROGRAM CAN LEAD TO COMPROMISED OBJECTIVES, WHICH MAY MEET AN INDIVIDUAL COMPANY'S NEEDS LESS PRECISELY THAN DESIRED; ALSO, IT CAN, AND INVARIABLY DOES, RESULT IN GREATER INSIGHTS CONCERNING THOSE NEEDS.

MCC HAS BEEN ABLE TO RECRUIT BETTER TECHNOLOGISTS THAN ITS INDIVIDUAL MEMBERS BECAUSE OF LARGER, LONGER TERM, MORE STABLE RESEARCH PROGRAMS, AS OPPOSED TO MUCH SMALLER AND SHORTER TERM, MORE PRODUCT DEVELOPMENT ORIENTED R&D AND FLUCTUATING BUDGETS IN MEMBER COMPANIES.

MCC OFFERS OTHER BENEFITS TO MEMBERS WHICH INCLUDE:

(1) AVOIDANCE OF DUPLICATE RESEARCH BY THE INDIVIDUAL COMPANY, THUS ALLOWING THOSE RESOURCES TO BE APPLIED TO ADDITIONAL RESEARCH.

(2) TAKING MORE THAN ONE APPROACH TO A GIVEN PROBLEM, THUS LESSENING THE RISK OF NO SOLUTION.

(3) ACHIEVING ECONOMIES OF SCALE IN UTILIZATION OF LABORATORY EQUIPMENT AND BRINGING TOGETHER A CRITICAL MASS OF RESEARCH PERSONNEL NEEDED FOR SPECIFIC PROBLEMS.

(4) INCREASING THE LIKELIHOOD THAT A SPECIFIC TECHNOLOGY WILL BE UTILIZED, THUS BETTER ASSURING SOURCE OF REVENUE TO SUPPORT ADDITIONAL RESEARCH.

RESULTS: ALTHOUGH THE COMPLETION DATE OF THE MCC PROGRAM OF SHORTEST DURATION IS STILL TWO YEARS AWAY, BENEFITS FROM MCC RESEARCH ARE BEGINNING TO BE REALIZED. ALREADY, MORE THAN 30 TECHNOLOGIES HAVE BEEN TRANSFERRED TO MEMBERS. FOR EXAMPLE, NCR RECENTLY ANNOUNCED AN ARTIFICIAL INTELLIGENCE SOFTWARE PRODUCT BASED ON MCC RESEARCH. BOEING AND 3M ARE UTILIZING MCC TECHNOLOGY IN MANUFACTURING PROCESSES. THE RATE OF SPINOFF OF TECHNOLOGIES FOR USE BY MEMBERS WILL ACCELERATE IN THE MONTHS AHEAD.

CONSIDERING MCC'S FAVORABLE EXPERIENCE, WHAT IS CALLED FOR IS THE IMMEDIATE FORMATION OF LARGE SCALE COOPERATIVE ENTERPRISES IN MANY MORE INDUSTRIES AND FIELDS SO THAT MCC-SIZED GAINS IN EFFICIENCY AND QUALITY OF TECHNOLOGY DEVELOPMENT OCCUR ACROSS THE BOARD TO PROVIDE A VERY SIGNIFICANT BOOST TO INNOVATION TO IMPROVE U.S. COMPETITIVENESS. FOR A NUMBER OF REASONS, THIS ISN'T LIKELY TO HAPPEN UNLESS PARTIAL FEDERAL FUNDING IS AVAILABLE.

ONE REASON IS THE FRAGMENTATION WHICH HAS OCCURRED IN COOPERATIVE ACTIVITIES -- MOST OF THE PRESENT TECHNOLOGICAL COOPERATION IN THE U.S. OFTEN INVOLVES ONLY A FEW COMPANIES AND A UNIVERSITY. A SECOND REASON IS THAT FIERCE GLOBAL COMPETITION IS SHRINKING CORPORATE PROFIT MARGINS WHICH LEAVES LESS FOR R&D. ALSO, EMPHASIS ON SHORT TERM RESULTS TO PROTECT AGAINST CORPORATE RAIDERS HAS REDUCED FUNDING FOR R&D. SIMILARLY, AFTER A TAKEOVER OCCURS, OR A LEVERAGED BUYOUT OR STOCK BUY BACK IS USED TO AVOID A TAKEOVER, MUCH HIGHER INTERESTS COSTS OF THE LARGE DEBT INCURRED FURTHER SHRINK THE R&D BUDGET. FOR EXAMPLE, GOODYEAR, IN AVOIDING A TAKEOVER, DOUBLED ITS DEBT AND THE RESEARCH AND DEVELOPMENT BUDGET WAS REDUCED FROM 300 MILLION TO 270 MILLION.

OTHER PROBLEMS ON THE CORPORATE SIDE ARE THE EXTREMELY HIGH RISK OFTEN PRESENT IN R&D PROJECTS, AS EVIDENCED BY A HIGH PERCENTAGE OF SUCH EFFORTS BEING UNSUCCESSFUL OR TAKING MUCH LONGER THAN PLANNED TO REACH OBJECTIVES, AND THE REALITY THAT INDIVIDUAL COMPANIES CANNOT FULLY REAP THE BENEFITS FROM INVESTMENT IN R&D BECAUSE IT IS NOT POSSIBLE TO CONFINE ACCESS TO THE TECHNOLOGY ONLY TO ITS SPONSORS. ECONOMISTS ESTIMATE THAT THE RATE OF RETURN TO SOCIETY FROM EXPENDITURES IN R&D IS TWICE THAT OF AN INDIVIDUAL COMPANY. CONSEQUENTLY, FROM THE STANDPOINT OF SOCIETY, COMPANIES UNDERINVEST IN R&D.

THE NET RESULT IS THAT FEDERAL AND STATE FUNDING IS REQUIRED IN ADDITION TO CORPORATE FUNDING TO ESTABLISH COOPERATIVE R&D CONSORTIA THAT WILL PROVIDE THE LEVERAGE AND QUALITY APPROACHING THAT OFFERED BY MCC. FEDERAL LEGISLATION, TO BE DISCUSSED LATER, WILL BE REQUIRED IN ORDER TO CATALYZE ACTION ON THE REQUIRED SCALE.

MTDI

LET ME NOW DESCRIBE THREE MORE LARGE-SCALE COOPERATIVE EFFORTS BEING PLANNED UNDER THE AEGIS OF THE MIDWEST TECHNOLOGY DEVELOPMENT INSTITUTE. THIS ORGANIZATION WAS FORMED TWO YEARS AGO BY A GROUP OF NINE MIDWEST STATES. A MAJOR OBJECTIVE OF MTDI IS TO EXPAND LARGE-SCALE TECHNOLOGICAL COOPERATION AMONG CORPORATIONS, UNIVERSITIES AND GOVERNMENT TO INCREASE THE EFFICIENCY OF R&D AND COMMERCIALIZATION OF THE RESULTS. THIS WILL BE ACCOMPLISHED BY THE ESTABLISHMENT OF A SERIES OF CONSORTIA, EACH FOCUSING ON SELECTED TECHNOLOGIES.

THREE CONSORTIA ARE PRESENTLY BEING PLANNED IN THE AREAS OF ADVANCED CERAMICS AND COMPOSITES, TECHNOLOGY FOR MORE PROFITABLE FAMILY FARMS AND ADVANCED MANUFACTURING.

ACCP: MTDI HAS PROPOSED THE FORMATION OF THE ADVANCED CERAMICS AND COMPOSITES PARTNERSHIP TO FACILITATE INDUSTRY/UNIVERSITY/

GOVERNMENT COOPERATIVE RESEARCH IN THE FIELD OF ENGINEERING CERAMICS AND COMPOSITE STRUCTURES OF CERAMICS, METALS AND/OR POLYMERS. AS YOU PEOPLE KNOW, THESE ADVANCED MATERIALS REQUIRE A LEVEL OF PROCESSING SCIENCE AND APPLICATION ENGINEERING FAR BEYOND THAT OF CONVENTIONAL MATERIALS. THE UNDERLYING TECHNOLOGY IS RELATIVELY IMMATURE, AND THERE IS A NEED FOR BOTH BASIC UNDERSTANDING AND PRACTICAL KNOW-HOW IN EXPLOITING ITS POTENTIAL. AND THEY ARE IMPORTANT TO A LARGE CROSS-SECTION OF INDUSTRIAL AND GOVERNMENT USERS AND SUPPLIERS.

ESTABLISHING AN INDUSTRY/UNIVERSITY COOPERATIVE RESEARCH PARTNERSHIP IN ADVANCED CERAMICS AND COMPOSITES IS BASED ON TWO MAJOR PREMISES:

1) THERE IS SIGNIFICANT WORLDWIDE OPPORTUNITY FOR NEW AND IMPROVED PRODUCTS AND PROCESSES IN THE FIELD OF ADVANCED CERAMICS AND COMPOSITES.

   IN 1985, SALES OF HIGH-PERFORMANCE CERAMICS AND COMPOSITES IN THE U.S. WERE ABOUT $2 BILLION. GROWTH IS EXPECTED TO BE ABOUT 15% PER YEAR OVER THE NEXT 15 YEARS TO EXCEED $18 BILLION BY THE YEAR 2000.

2) U.S. TECHNOLOGICAL AND MARKETING POSITION CAN BE ACCELERATED BY EFFECTIVE COOPERATIVE R&D BETWEEN INDUSTRIAL COMPANIES AND UNIVERSITIES.

THE AWARENESS OF THE TREMENDOUS POTENTIAL FOR ADVANCED CERAMICS AND COMPOSITES HAS BEEN HEIGHTENED BY RECENT DISCOVERIES OF NEW SUPERCONDUCTIVITY CERAMICS. HOWEVER, EVEN BEFORE THOSE REVELATIONS, THERE HAS BEEN GREAT INTEREST IN CERAMICS AND COMPOSITES IN FOREIGN COUNTRIES, PARTICULARLY JAPAN. JAPAN HAS INITIATED A 10-YEAR PROGRAM OF INTENSE TECHNICAL DEVELOPMENT TO ENSURE CONTINUED LEADERSHIP IN THE WORLD MARKET. THIS PROGRAM IS MARKED BY COMMITMENT AND EXTENSIVE COOPERATION AMONG GOVERNMENT, INDUSTRY AND THE UNIVERSITIES. FORECASTERS BELIEVE JAPAN'S SALES WILL CONTINUE TO LEAD U.S. SALES BY 25-30% THROUGH 1990.

IN THIS AREA OF INTENSE INTERNATIONAL COMPETITION, THE U.S. IS CONSIDERED STRONG IN THE BASIC SCIENCE OF CERAMICS AND COMPOSITES, BUT THREATENED BY JAPAN IN PUTTING THE SCIENCE TO PRACTICAL USE IN ENGINEERING AND COMMERCIAL APPLICATIONS.

THE SIZE AND SUCCESS OF THE OVERSEAS EFFORTS IN CERAMICS AND COMPOSITES, THEIR COORDINATED APPROACH BY INDUSTRY, UNIVERSITIES AND GOVERNMENT, AND THE CLOSE COUPLING OF R&D TO APPLICATIONS, ALL POINT TO THE SERIOUSNESS OF THE COMPETITYVE SITUATION FACING THE U.S. WITH ITS FRAGMENTED APPROACH IN INDIVIDUAL COMPANIES AND UNIVERSITIES.

MTDI HAS DESIGNED A COOPERATIVE PROGRAM AND BROUGHT IT TO THE LAUNCH POINT. ALTHOUGH THE RECENT BREAKTHROUGHS IN SUPERCONDUCTIVITY ARE SPURRING INTEREST IN CERTAIN CERAMICS, MTDI HAS IDENTIFIED A BROADER PRE-EXISTING INTEREST IN OTHER ELECTRONIC AND STRUCTURAL CERAMICS. MORE SPECIFICALLY, FOUR COOPERATIVE PROJECTS HAVE BEEN DEVELOPED INVOLVING COLLABORATIONS AMONG A NUMBER OF MIDWESTERN UNIVERSITY RESEARCHERS. FOURTEEN INTERESTED CORPORATIONS ARE NOW CONSIDERING PARTICIPATION IN THESE PROJECTS.

REP: IN THE FIELD OF AGRICULTURE, MTDI HAS SET UP THE RURAL ENTERPRISE PARTNERSHIP. A MAJOR THRUST OF THIS COOPERATIVE EFFORT IS TO MANAGE THE DEVELOPMENT OF TECHNOLOGY TO INCREASE THE PROFITABILITY AND NUMBER OF FAMILY FARMS.

FOUR INITIAL AREAS OF TECHNICAL EFFORT HAVE BEEN IDENTIFIED. THE FIRST ADDRESSES THE IDENTIFICATION, DEVELOPMENT, AND IMPLEMENTATION OF VITAL AGRICULTURAL TECHNOLOGIES WHICH CAN REDUCE FARM INPUT COSTS WHILE SIMULTANEOUSLY PROVIDING REGENERATION OF SOIL RESOURCES AND PROTECTION OF WATER RESOURCES.

THE SECOND HAS THE OBJECTIVE OF DEVELOPING FAMILY FARM SYSTEMS WHICH ARE INTEGRATED AND DIVERSIFIED ENTERPRISES, SIZED FOR EFFICIENCY AND REQUIRING MINIMUM CAPITAL INVESTMENT.

THE THIRD AREA COVERS THE DEVELOPMENT OF A NUMBER OF "EXPERT SYSTEMS" BY PARTICIPATING LAND GRANT UNIVERSITY FACULTY. IN THIS EFFORT, UNDER THE LEADERSHIP OF THE UNIVERSITY OF ILLINOIS-URBANA, KNOWLEDGE-BASED ARTIFICIAL INTELLIGENCE TECHNIQUES, SUCH AS THOSE NOW BEING USED IN MEDICINE, EDUCATION, MANUFACTURING AND BUSINESS, ARE BEING APPLIED TO AGRICULTURE. THESE EXPERT SYSTEMS IN AGRICULTURE CAN THEN BE USED BY INDIVIDUAL FARMERS TO MANAGE THEIR OPERATIONS MORE PROFITABLY BY TAKING INTO ACCOUNT A BROADER BASE OF AGRICULTURAL EXPERIENCE.

THE FOURTH AREA IS BIOTECHNOLOGY RESEARCH, PRIMARILY PLANT BIOLOGY RESEARCH. CLEARLY, BIOTECHNOLOGY CAN PROVIDE MAJOR IMPETUS TO THE MOVEMENT TO THE RIGHT TECHNOLOGY FOR VIABLE FAMILY FARMS, I.E., TECHNOLOGY WHICH IS A LOT LESS RESOURCE CONSUMING, MORE INTENSIVE, MORE NEARLY SCALE NEUTRAL AND ENVIRONMENTALLY ACCEPTABLE. PROJECTS IN BIOTECHNOLOGY RESEARCH WOULD BE MANAGED TO ACHIEVE THESE OUTCOMES.

ADVANCED MANUFACTURING

IN THE FIELD OF ADVANCED MANUFACTURING, THE COOPERATIVE EFFORT BEING PLANNED IS CALLED THE ADVANCED INTEGRATED MANUFACTURING SERVICE CENTER PARTNERSHIP (AIMSC). IT IS A NATIONWIDE PROGRAM FOR ACCELERATING THE WIDESPREAD UTILIZATION OF COMPUTER-AIDED DESIGN AND COMPUTER-INTEGRATED, FLEXIBLE MANUFACTURING SYSTEMS.

THE MAJOR IMPETUS FOR THE PROGRAM IS SIMPLY THAT THE U.S. IS NOT GETTING ADVANCED MANUFACTURING TECHNOLOGY IN USE SOON ENOUGH BY EITHER LARGE OR SMALL COMPANIES. THIS IS PARTICULARLY SERIOUS FOR SMALL BUSINESS BECAUSE MORE THAN 60% OF OUR MANUFACTURED GOODS COME FROM THAT SECTOR, AS WELL AS MANY OF THE TECHNICAL ADVANCES. HOWEVER, SMALL BUSINESS NO LONGER HAS THE RESOURCES TO MAINTAIN ITS LEADING ROLE.

SUBSTANTIAL RESEARCH AND DEVELOPMENT HAS BEEN UNDERWAY FOR MANY YEARS IN UNIVERSITY AND GOVERNMENT LABORATORIES TO DEVELOP ADVANCED AUTOMATED EQUIPMENT, COMPUTER-AIDED DESIGN AND COMPUTER-INTEGRATED MANUFACTURING TECHNOLOGY. AS A RESULT, THE UNITED STATES POSSESSES THE MOST ADVANCED MANUFACTURING TECHNOLOGY IN THE WORLD, AND THROUGH ONGOING RESEARCH, WILL LIKELY MAINTAIN THAT POSITION FOR MANY YEARS. YET, EXCEPT FOR A HANDFUL OF LARGER COMPANIES, CURRENTLY AVAILABLE TECHNOLOGY IS NOT BEING WIDELY USED IN ACTUAL MANUFACTURING. NOR ARE THERE PLANS EVIDENT TO DO SO. IN OTHER WORDS, OUR ADVANCED MANUFACTURING TECHNOLOGY LARGELY REMAINS IN LABORATORIES; WHEREAS OUR FOREIGN COMPETITORS, ESPECIALLY JAPANESE COMPANIES, ARE MAKING MUCH MORE EXTENSIVE USE IN FACTORY SETTINGS.

REASONS FOR SLOW UTILIZATION OF ADVANCED MANUFACTURING TECHNOLOGY INCLUDE THE LOW LEVEL OF TECHNICAL CAPABILITY IN MOST MANUFACTURING COMPANIES, DEARTH OF ENGINEERS IN THE FIELD OF ADVANCED MANUFACTURING, THE SUBSTANTIAL COST OF THE EQUIPMENT, COMPUTER SOFTWARE AND TRAINING, HIGH RISK AND A ROI WELL BELOW WHAT IS TRADITIONALLY ACCEPTABLE. ASIDE FROM THE RISK AND RETURN CONSIDERATIONS, MOST SMALLER AND MEDIUM-SIZED COMPANIES SIMPLY DON'T HAVE THE CAPITAL.

THE ONLY PRACTICAL APPROACH FOR ADEQUATELY COPING WITH THESE FORMIDABLE BARRIERS TO GET ADVANCED MANUFACTURING TECHNOLOGY IN WIDESPREAD USE SOON ENOUGH IS TO PLACE IN OPERATION A NATIONWIDE NETWORK OF REGIONAL COMPUTER-AIDED DESIGN AND COMPUTER-INTEGRATED FLEXIBLE MANUFACTURING CENTERS. THEY WOULD PERFORM DESIGN AND MANUFACTURING ON A SERVICE BASIS WHERE COMPANIES PAY FOR THE SERVICE AS IT IS USED WITH NO INVESTMENT REQUIRED IN THE REGIONAL FACILITY. EACH COMPANY WOULD UTILIZE THE CENTER THROUGH A WORKSTATION ON ITS OWN PREMISES CONNECTED BY A TELEPHONE LINE.

AN ADVANCED INTEGRATED MANUFACTURING SERVICE CENTER (AIMSC) WOULD HAVE THE CAPABILITY TO MANUFACTURE A WIDE RANGE OF PRODUCTS OF THE HIGHEST QUALITY, LOWEST COST IN THE SHORTEST POSSIBLE TIME AND IN SMALL QUANTITIES. GIVEN ACCESS TO THAT KIND OF FACILITY, U.S. COMPANIES, EVEN SMALL COMPANIES, COULD COMPETE OVER A WIDE RANGE OF PRODUCTS WITH THE LARGEST COMPANIES WORLDWIDE.

IN ADDITION TO COMPUTER-AIDED DESIGN AND COMPUTER-INTEGRATED MANUFACTURING SERVICES, EDUCATION AND TRAINING WOULD BE PROVIDED. THERE WOULD BE OPTIONS WITH RESPECT TO USAGE OF THE CENTERS. FOR EXAMPLE, A COMPANY MIGHT USE THE CENTER'S FACILITIES INITIALLY AND LATER DECIDE TO INSTALL SELECTED ROBOTIC EQUIPMENTS ON ITS OWN PREMISES. LARGER COMPANIES WOULD BE LICENSED TO REPLICATE THE ENTIRE FACILITY.

SINCE THE VAST MAJORITY OF SMALL FIRMS LACK THE SKILLED PERSONNEL AND CAPITAL NECESSARY TO IMPLEMENT AN ADVANCED MANUFACTURING SYSTEM, LET ME COMMENT FURTHER ON MAKING AVAILABLE TO THEM ADVANCED DESIGN AND MANUFACTURING SERVICES. AS MEMBERS OF THE AIMSC PARTNERSHIP, THEY WILL UTILIZE THE CENTERS'COMMON DESIGN AND MANUFACTURING SYSTEMS AND PROCESSES. MEMBERS CAN DESIGN AT REMOTE ENGINEERING WORKSTATIONS, CAPABLE OF TRANSFERRING MANUFACTURING DATA TO PROGRAMMABLE AUTOMATION. THUS, AIMSC WILL MANUFACTURE FOR ITS MEMBERS, SATISFYING A NEED FOR EARLY MARKET ENTRY WITH A WIDE VARIETY OF PRODUCTS. PROCESS FLEXIBILITY WILL ALLOW SHIFTING FROM ONE MANUFACTURING JOB TO ANOTHER, QUICKLY AND WITHOUT SOFTWARE MODIFICATION.

FOR EXAMPLE, IN THE MIDWEST REGION, THE AIMSC IN THE TWIN CITIES WOULD BE LINKED WITH THE UNIVERSITY OF MINNESOTA'S SUPERCOMPUTER CENTER, WHICH HAS SUPERB DATA PROCESSING AND COMMUNICATIONS CAPABILITIES. THIS REGIONAL CENTER WOULD BE THE HUB FOR LOCAL AREA, I.E., SATELLITE AIMSC's, LOCATED IN NON-METRO AREAS OF MINNESOTA AND IN NEIGHBORING STATES. A PRODUCT ENGINEER, LOCATED IN WISCONSIN, COULD DESIGN AN ELECTRONIC CIRCUIT CARD THAT WOULD BE MANUFACTURED IN A LOCAL AREA AIMSC LOCATED IN NORTHERN MINNESOTA. SIMILARLY, PRODUCT ENGINEERS LOCATED IN IOWA AND MINNESOTA COULD HAVE CASTINGS MADE AT A LOCAL AREA AIMSC LOCATED IN KANSAS. EACH AIMSC WILL SELECT A UNIQUE INDUSTRY (CIRCUIT CARD ASSEMBLY AND CASTING IN THIS EXAMPLE) IN WHICH TO SEEK EXCELLENCE. EACH PRODUCT ENGINEER WILL UTILIZE STANDARD SOFTWARE, PROTOCOLS AND PROCEDURES FOR UNIQUE PRODUCT DESIGN AND MANUFACTURING.

AN OPTIMUM INITIAL NUMBER OF REGIONAL CENTERS IS CONSIDERED TO BE TEN, WITH SEVEN TO EIGHT YEARS REQUIRED TO GET THE CENTERS IN FULL OPERATION. AND, AS NOTED, EACH CENTER WOULD HAVE SATELLITE OPERATIONS IN SURROUNDING AREAS. COST OF THE REGIONAL CENTERS PROGRAM, OVER AN EIGHT-YEAR PERIOD, IS ESTIMATED AT $800 MILLION. IT WOULD BE FINANCED WITH A COMBINATION OF FEDERAL, STATE AND PRIVATE FUNDS.

BEFORE COMMENTING FURTHER ON FUNDING IN CONNECTION WITH FEDERAL LEGISLATION, LET ME NOTE THAT THE PROPOSED PROGRAM IN ADVANCED MANUFACTURING HAS A NUMBER OF OTHER ADVANTAGES, SUCH AS PROVIDING THE MEANS OF UTILIZING MOST EFFECTIVELY OUR MOST INNOVATIVE SECTOR, SMALL BUSINESS, AND ACCELERATING THE MOVEMENT OF TECHNOLOGY FROM THE LABORATORY INTO THE MARKETPLACE. AS WE KNOW ALL TOO WELL, THE JAPANESE ARE DOING MUCH BETTER AT TRANSFERRING AND COMMERCIALIZING TECHNOLOGY THAN THE U.S.

FEDERAL LEGISLATION

TURNING NOW TO FEDERAL LEGISLATION, A MAJOR OBJECTIVE OF IT SHOULD BE TO PROVIDE A SUBSTANTIAL PERCENTAGE OF FUNDING DURING THE EARLY STAGES OF LARGE-SCALE TECHNOLOGICAL COOPERATIVE ENTERPRISES. WITHOUT SUCH FUNDING, THE REQUIRED NUMBER OF COOPERATIVE ENTERPRISES WILL NOT BE LAUNCHED. ONCE RESEARCH RESULTS START TO FLOW, FEDERAL FUNDING CAN BE REDUCED, AND TAX CREDITS USED TO HELP EQUALIZE BENEFITS BETWEEN THE PUBLIC AND PRIVATE SECTORS. AT THE SAME TIME, THIS ENCOURAGES CONTINUING PARTICIPATION IN LARGE SCALE COOPERATIVE CONSORTIA. IN ORDER TO HAVE THE DESIRED EFFECT, I BELIEVE THAT THE TAX CREDIT FOR PARTICIPATING IN A CONSORTIUM SHOULD BE DOUBLE THAT FOR COMPANY INTERNAL R&D. INTERESTINGLY, GREAT BRITAIN HAS SUCH A POLICY.

AIMSC; IN SOME CASES, SUCH AS THE ADVANCED INTEGRATED MANUFACTURING SERVICES PROGRAM, SPECIAL FEDERAL LEGISLATION WILL BE REQUIRED. SPECIFICALLY, FOR THAT PROGRAM, LEGISLATION SHOULD PROVIDE FEDERAL FUNDING FOR A LARGE PERCENTAGE OF THE AMOUNT REQUIRED DURING THE INITIAL PHASE, CONSIDERING THAT IT IS ESSENTIAL TO MOVE RAPIDLY ON A LARGE SCALE AND THE HIGH RISK AND UNCERTAINTY AS TO THE TIME REQUIRED TO ACHIEVE FULL OPERATION OF THE CENTERS. ONCE THAT POINT IS REACHED, THE MANUFACTURING CENTERS WOULD BE TAKEN OVER BY THE PRIVATE SECTOR AND OPERATED AS FOR-PROFIT BUSINESSES. AT THAT TIME, MANY MORE CENTERS WOULD BE ESTABLISHED, WHICH WOULD BE PRIVATELY FINANCED.

CONCLUSION

THERE IS MUCH MORE TO BE SAID ABOUT LEGISLATION OR, FOR THAT MATTER, I COULD MENTION A FEW OTHER LARGE SCALE TECHNOLOGICAL COOPERATIVE VENTURES BEING PLANNED; HOWEVER, IT IS TIME TO CONCLUDE. RATHER THAN SUMMARIZING WHAT I'VE SAID, I WOULD LIKE TO EMPHASIZE THE RELATIONSHIP OF U.S. COMPETITIVENESS AND LARGE-SCALE TECHNOLOGICAL COOPERATION.

OF COURSE, AS NOTED EARLIER, THERE ARE FACTORS OTHER THAN TECHNOLOGY WHICH BEAR ON U.S. COMPETITIVENESS, SUCH AS THE COST AND AVAILABILITY OF CAPITAL, THE EMPHASIS ON SHORT-TERM PERFORMANCE, TAX RATES AND GOVERNMENT REGULATIONS. JAPAN HOLDS DISTINCT ADVANTAGES OVER THE U.S. IN A NUMBER OF THESE AREAS, PLUS HAVING A FEW UNIQUE SUPPORTIVE POLICIES OF ITS OWN. IN OTHER WORDS, THE U.S.-JAPAN PLAYING FIELD IS TILTED IN JAPAN'S FAVOR. MOST OF THE CORRECTION WILL REQUIRE U.S. GOVERNMENT INITIATIVES. UNDER THE BEST OF CIRCUMSTANCES, A NUMBER OF YEARS WILL PASS BEFORE IMPROVEMENT IS ACHIEVED. MEANWHILE, THE U.S. DISADVANTAGES REMAIN.

ON THE OTHER HAND, LARGE SCALE TECHNOLOGICAL COOPERATION CAN BE A PRIVATE SECTOR INITIATIVE WITH THE FEDERAL GOVERNMENT IN A

SUPPORTIVE ROLE. HISTORY SHOWS THAT THE U.S. CONGRESS REACTS FAVORABLY TO WELL THOUGHT OUT, PRIVATE INITIATIVES IN THE PUBLIC INTEREST AND WHICH SEEK GOVERNMENT SUPPORT.

THE POINT IS SIMPLY THAT THERE IS THE OPPORTUNITY TO HELP U.S. COMPETITIVENESS IN A MAJOR WAY THROUGH PRIVATE SECTOR ACTIONS WHICH CAN BE COMMENCED IMMEDIATELY.

WHAT WE NEED TO DO IS DECIDE THAT WE WILL WORK TOGETHER TO ENCOURAGE, PLAN AND IMPLEMENT LARGE SCALE TECHNOLOGICAL COOPERATIVE PROGRAMS WHEN IT IS IN THE COMMON INTEREST TO DO SO.