I. INTRODUCTION

LAST YEAR, IN LINE WITH THE INNOVATION POLICY ADOPTED BY THE BOARD IN JULY 1980, WE MADE THE FIRST IN-DEPTH INNOVATION REVIEW. SINCE THEN YOU HAVE, OF COURSE, SEEN VARIOUS PARTS OF THE TOTAL INNOVATION PICTURE IN VARIOUS REPORTS TO THE FULL BOARD; IN THE BUSINESS BOARDS; IN THE CORPORATE RESEARCH ADVISORY COMMITTEE, AND IN THE STRATEGIC PLAN REVIEW LAST SEPTEMBER.

THIS EVENING, THEN, I'M PRESENTING THE SECOND ANNUAL REPORT TO TIE TOGETHER THE FULL SCOPE OF INNOVATION ACTIVITIES. THIS REPORT WILL COVER NOT ONLY THE COMPUTER BUSINESS, AS DID LAST YEAR'S REVIEW, BUT ALSO THE SMALL BUSINESS SERVICES PORTION OF CCC. AS WE ARE NOW BRINGING CCC MORE FULLY INTO OUR STRATEGIC PLANNING
PROCESS, BY NEXT YEAR THIS PRESENTATION WILL NOT HAVE TO
BE RESTRICTED TO JUST THAT ONE PART OF CCC. THEN A
TRULY COMPANY-WIDE INNOVATION REPORT WILL BE POSSIBLE.

IN THE REPORT TONIGHT, I HAVE ALSO ATTEMPTED TO BRING
MORE PERSPECTIVE TO OUR INNOVATION EXPENDITURES BY
DISCUSSING THEM IN THE CONTEXT OF THEIR SIGNIFICANCE TO
THE FIVE MAJOR STRATEGIES THAT CONTROL DATA IS
Pursuing.

(CHART 1)

SO TO START, LET ME STATE THE STRATEGIES:

0 AN EMPHASIS ON COMPUTER SERVICES.
0 BUILDING THE EDUCATION MARKET.
0 CONTINUING LEADERSHIP IN PERIPHERAL PRODUCTS.
0 CONCENTRATION ON SIX PRIMARY APPLICATION MARKETS
IN THE COMPUTER MAINFRAME BUSINESS: EDUCATION,
ENERGY, MANUFACTURING, ELECTRIC UTILITIES,
PETROLEUM/MINING AND ENVIRONMENTAL.
0 DEVELOPING THE POTENTIAL OF THE SMALL BUSINESS
MARKET.
PRECISELY ASSIGNING A TOTAL DOLLAR FIGURE FOR INNOVATION SPENDING TO EACH STRATEGY WOULD BE MATHEMATICALLY TORTUOUS (SINCE CERTAIN PROGRAMS SUPPORT MORE THAN ONE STRATEGY) AND STRATEGICALLY MISLEADING (SINCE DOLLAR INVESTMENT AT A GIVEN POINT IN TIME MAY NOT BE INDICATIVE OF STRATEGY PRIORITY). SO, THE DOLLAR AMOUNTS I DISPLAY IN THE STRATEGY DISCUSSION ARE ONLY INTENDED TO PROVIDE SOME DEGREE OF PERSPECTIVE AS TO THE INTENSITY OF THE COMMITMENT TO EACH OF THESE STRATEGIES.

I'M TALKING "COMMITMENT."

AS YOU WILL SEE OUR DOLLAR COMMITMENT TO INNOVATION IS UP 18 PERCENT IN 1982 COMPARED TO LAST YEAR. IN THE THREE YEAR PERIOD 1982-1984 WE HAVE PLANNED EXPENDITURES THAT EXCEED LAST YEAR'S THREE-YEAR FORECAST BY 26 PERCENT. THIS DESPITE A LESSENED OPTIMISM WITH REGARD TO THE BUSINESS CLIMATE IN THE FIRST IMMEDIATE YEAR. SO OUR COMMITMENT TO INNOVATION IS REAL, NOT HYPOTHETICAL.

THE BOTTOM LINE OBJECTIVE, OF COURSE, IS TO PUT OUR EFFORTS INTO NEW BUSINESS OPPORTUNITIES THAT OFFER THE HIGHEST REWARD, CONSISTENT WITH OUR CAPABILITIES. IN
BROAD TERMS. THAT MEANS EMPHASIZING LESS CAPITAL INTENSIVE GROWTH MARKETS--SERVICES--WHILE MAINTAINING OUR POSITION IN OUR TRADITIONALLY CAPITAL INTENSIVE MARKETS--HARDWARE. THE LONG TERM RESULT SHOULD BE FUNDAMENTALLY BETTER FINANCIAL AND MARKET BALANCE.

ANYWAY, NOW THAT I'VE WHETTED YOUR APPETITE, HERE GOES.

II. OVERVIEW

(CHART 2)


TOTAL INNOVATION EXPENSE, YOU WILL RECALL, COMPRISSES FIVE CATEGORIES OF EXPENDITURE: ADVANCED TECHNOLOGY,
ADVANCED PRODUCT DEVELOPMENT, PRODUCT AND SERVICE DEVELOPMENT, NEW BUSINESS DEVELOPMENT AND CONTINUING BUSINESS DEVELOPMENT. THE BREAKDOWN BY THESE CATEGORIES IS SHOWN ON THIS NEXT CHART.

(CHART 3)

QUANTIFICATION OF THE FIRST THREE INNOVATION CATEGORIES IS STRAIGHT FORWARD--IT IS THE TECHNICAL EFFORT LINE ITEM OF THE OPERATING STATEMENT.

ADVANCED TECHNOLOGY IS THE EARLY BASIC RESEARCH AIMED AT GAINING FUNDAMENTAL KNOWLEDGE OF A COMPONENT OR PROCESS. ADVANCED PRODUCT DEVELOPMENT IS THE APPLICATION OF TECHNOLOGY TO DEMONSTRATE PRODUCT FEASIBILITY. PRODUCT AND SERVICE DEVELOPMENT IS, OF COURSE, THE FINAL DEVELOPMENT OF THE PRODUCT OR SERVICE.

THE LARGEST PART OF OUR TECHNICAL RESOURCE IS DEVOTED TO THE PRACTICAL IMPLEMENTATION OF OUR STRATEGIES AS SHOWN BY THE PRODUCT AND SERVICE DEVELOPMENT CATEGORY.

CONTINUING ON THIS CHART (CHART 3), YOU SEE THAT THE REMAINDER, WHICH IS OVER HALF, CONSTITUTES AN INNOVATION CATEGORY CALLED BUSINESS DEVELOPMENT. DEVELOPMENT OF A
NEW SERVICE BUSINESS IS A DIFFERENT PROCESS THAN THAT OF JUST DEVELOPING A NEW PRODUCT FOR AN EXISTING BUSINESS. SO FOR THESE DEVELOPING BUSINESS CATEGORIES QUANTIFICATION OF INNOVATION EXPENSE REQUIRES SOME DEFINITION. HERE WE CLASSIFY THE GROSS EXPENDITURES, THAT IS ALL COSTS AND EXPENSES, AS THE INNOVATION EXPENDITURE. WE CALL NEW BUSINESSES THOSE GENERALLY UNDER TWO YEARS IN AGE, WHILE BUSINESSES WITH A LONGER GESTATION PERIOD ARE PUT IN THE CATEGORY OF CONTINUING BUSINESS DEVELOPMENT. OBVIOUSLY, THESE DEFINITIONS ARE SOMEWHAT ARBITRARY. ALSO FOR SIMPLICITY SAKE WE DON'T ALLOW CROSS-OVER FROM "NEW" TO "CONTINUING" DURING THE THREE YEAR PERIOD UNDER REVIEW. SO, A NEW BUSINESS DOES NOT MOVE INTO THE CONTINUING CATEGORY, SAY IN 1983 OR 1984, EVEN THOUGH AT THAT FUTURE DATE IT WOULD EXCEED TWO YEARS IN AGE.

NOTE, THEN, THE ENLARGEMENT OF THE BUSINESS DEVELOPMENT PORTION OF THE PIE OVER THE NEXT TWO YEARS--FROM 58 PERCENT TO 61 PERCENT TO 67 PERCENT. THIS IS DUE MOSTLY TO THE INCREASING TOTAL EXPENDITURES PLANNED FOR SMALL BUSINESS SERVICES. I'LL COME BACK TO THIS POINT WHEN I COVER THE FIFTH MAJOR STRATEGY.
BECAUSE OF THE NATURE OF INNOVATION IN THE BUSINESS DEVELOPMENT CATEGORIES, WE MUST ALSO LOOK AT WHAT WE CALL "NET" INNOVATION EXPENSE, AS WELL AS "GROSS" EXPENSE. NET INNOVATION EXPENSE IS THE BOTTOM LINE FOR THESE BUSINESSES, I.E., TOTAL COSTS AND EXPENSES LESS REVENUES. WITH SERVICES DEVELOPMENT AS OPPOSED TO HARDWARE DEVELOPMENT, THERE IS EVEN IN THE VERY EARLY STAGES REVENUE GENERATED AS THE SERVICE IS BEING FASHIONED. BECAUSE WE ARE LOOKING AT AN EXTENDED TIME PERIOD IN THIS REVIEW, WITH SOME NEW BUSINESSES REACHING MATURITY AS WELL AS NEW ONES BEING STARTED, THE AMOUNT OF THESE REVENUE OFFSETS BECOMES QUITE SIGNIFICANT.

(CHART 4)

THIS NEXT CHART, THEN, SHOWS NET INNOVATION EXPENSE. AS YOU WILL NOTE, NET EXPENSE ACTUALLY PEAKED IN 1981. BUT THE ASSOCIATED, AND IMPORTANT, POINT IN ALL THIS IS ONE I HAVE MADE BEFORE. WE HAVE A LOT OF IRONS IN THE FIRE AND MANY OF THEM HAVE BEEN THERE FOR SOME TIME. THAT IS, WE HAVE A LOT OF CONTINUING BUSINESS DEVELOPMENT.

WHILE GROSS INNOVATION EXPENSE FOR BUSINESS DEVELOPMENT WENT FROM 58 TO 61 TO 67 PERCENT, NOTE THAT NET GOES FROM 17 PERCENT TO 11 PERCENT TO 4 PERCENT. THIS
REFLECTS THE PLANNED GROWTH IN REVENUES OF THESE BUSINESSES AS THEY REACH MATURITY.

(CHART 5)

THIS IS REFLECTED MORE PRECISELY IN THIS NEXT CHART WHICH JUST COMPARES GROSS AND NET. SMALL BUSINESS SERVICES IS THE MAJOR PIECE OF NEW BUSINESS DEVELOPMENT AND YOU CAN SEE IT'S SIGNIFICANCE COMPARED TO ALL OTHER NEW BUSINESSES. BY 1984 SMALL BUSINESS SERVICES SHOULD BE OUT OF THE NEW BUSINESS DEVELOPMENT CATEGORY. IN BOTH NEW AND CONTINUING BUSINESS DEVELOPMENT, WE'RE CHURNING A LOT OF REVENUE BUT HAVEN'T FINISHED THE JOB. THE MAJOR TASK FOR THE NEXT TWO YEARS IS TO GET THESE BUSINESSES OUT OF DEVELOPMENT AND OVER INTO THE ON-GOING BUSINESS CATEGORY.

HAVING TAKEN THIS QUICK LOOK AT THE GROSS AND NET ASPECT, IT WILL BE SIMPLER TO JUST USE ONE OF THEM. SO FOR THE REST OF THE PRESENTATION, UNLESS OTHERWISE NOTED, I'LL BE USING THE GROSS EXPENDITURE NUMBERS.

(CHART 6)
THIS NEXT CHART IS A DIFFERENT CUT AT INNOVATION EXPENDITURE. THE PURELY TECHNICAL EXPENSE PORTION IS BROKEN INTO THREE COMPONENTS: R&D, SUPPORT AND COST OF SALES (OR CUSTOMER SPECIFIC) ACTIVITY. DOLLARS GOING INTO STANDARD R&D OR BUSINESS DEVELOPMENT ARE MORE HIGHLY LEVERAGED, I.E., THE SAME DOLLAR YIELDS A PRODUCT OR SERVICE SOLD TO MANY CUSTOMERS, WHEREAS A DOLLAR GOING INTO COST OF SALES (CUSTOMER SPECIFIC) PRODUCES A PRODUCT SOLD TO JUST ONE CUSTOMER--POOR USE OF PRECIOUS TECHNICAL RESOURCES.---(ELABORATE ON 1 PERCENT TO 2 PERCENT)---IN RECENT YEARS, WE HAVE KEPT A TIGHT CLAMP ON COS TECHNICAL EXPENSE. THE DESIREABILITY OF REDUCING SUPPORT COSTS IS OBVIOUS ENOUGH AND THE TRENDS IS RIGHT FOR THE NEXT THREE YEARS AS YOU CAN SEE.---(ELABORATE 14 PERCENT TO 11 PERCENT TO 8 PERCENT IS A SIGNIFICANT CHANGE--STANDARD PRODUCTS--MORE FRONT END DESIGN EFFORTS TO REDUCE ONGOING COSTS--GOOD).

(CHART 7)

YET ANOTHER PERSPECTIVE IN INNOVATION IS BY MAJOR BUSINESS SEGMENT. IN THE PURE TECHNICAL EXPENSE PORTION OF THE TOTAL INNOVATION EXPENDITURES, YOU CAN SEE THAT HARDWARE EXPENDITURES CONTINUE TO DOMINATE.---(ELABORATE PPCO--INCREASE IN '82--IN SPITE
OF SOFT MARKET WE HAVE PLANNED LARGE INCREASES--ALSO NOTE SERVICES--MORE IN-HOUSE DEVELOPMENT AND CONTRACT R&D AS OPPOSED TO ROYALTY ARRANGEMENTS).

(CHART 8)

HOWEVER, ON THIS NEXT CHART WHICH REFLECTS TOTAL INNOVATION EXPENDITURE, THE DOMINANCE OF SERVICES IS CLEARLY EVIDENT. AGAIN THIS IS LARGELY DUE TO--AND EVEN SOMewhat DISTORTed BY--SMALL BUSINESS SERVICES. AGAIN REMEMBER WE ARE DEALING WITH GROSS EXPENDITURES FOR DEVELOPING SERVICES BUSINESSES.

III. MAJOR STRATEGY PERSPECTIVE

WITH THOSE SEVERAL PERSPECTIVES OF THE NUMBERS IN TOTAL, LET ME TURN TO THE FIVE MAJOR STRATEGIES I MENTIONED AND THE INNOVATION PROJECTS AND EXPENDITURES ASSOCIATED WITH THEM. AGAIN, I HAVE NOT TRIED TO BE MATHEMATICALLY PRECISE WITH THE NUMBERS BUT RATHER TO GIVE SOME PERSPECTIVE AS TO THE LEVEL OF EXPENDITURE.
IIIA. SERVICES

(CHART 9)

THE FIRST STRATEGY IS THE EMPHASIS ON COMPUTER SERVICES. I WILL HIGHLIGHT SEVEN OF THE KEY PROGRAMS THAT ARE EXPECTED TO CONTRIBUTE SIGNIFICANTLY TO OUR SERVICES STRATEGY.

1. INTERNATIONAL SERVICES—ALPS

AS WE'VE DISCUSSED SEVERAL TIMES, WE HAVE A MAJOR EFFORT IN INTERNATIONAL SERVICES TO DEVELOP PRODUCT OFFERINGS THAT ARE UNIQUELY SUITABLE TO INTERNATIONAL MARKETS. OUR TOTAL INNOVATION EXPENSE IN THIS REGARD IS ABOUT $23 M OVER THE 1982-1984 PERIOD. I'LL NOT DESCRIBE ALL OF THIS WORK, BUT HERE IS A TYPICAL EXAMPLE.

STATE-OF-THE-ART PROCESSING SYSTEMS ARE INADEQUATE TO TRANSLATE COMPLETELY FROM ONE LANGUAGE TO ANOTHER. HOWEVER, MACHINE ASSISTED TRANSLATION SYSTEMS ARE COMING INTO BEING. OUR INTERNATIONAL SERVICES ORGANIZATION IS MARKETING ONE SUCH TRANSLATION SYSTEM KNOWN AS ALPS.—(AUTOMATED
LANGUAGE TRANSLATION SYSTEMS). ULTIMATELY THIS ACTIVITY WILL BENEFIT FROM THE ARTIFICIAL INTELLIGENCE PROGRAMS THAT I WILL DISCUSS LATER. ALPS HAS AN ENGLISH ANALYZER WHICH HIGHLIGHTS AREAS OF POTENTIAL MIS-TRANSLATION. FRENCH AND GERMAN ANALYZERS ARE BEING DEVELOPED. CURRENTLY ALPS PROVIDES ASSISTANCE IN ENGLISH TO FRENCH, ENGLISH TO GERMAN, AND ENGLISH TO SPANISH TRANSLATION.

2. **PLATO STAYWELL**

IN THE LIFE EXTENSION INSTITUTE PART OF OUR HEALTHCARE SERVICES ORGANIZATION WE'VE BEGUN A MAJOR EFFORT TO DELIVER STAYWELL VIA PLATO. THIS IS BELIEVED TO BE THE MOST INNOVATIVE APPLICATION OF TECHNOLOGY, TO-beHAvIOR-SCIENCE TO DATE. BEYOND EDUCATING PARTICIPANTS TO HEALTHIER LIFE STYLES, OUR COURSES WILL ALSO MOTIVATE THE PARTICIPANTS TO TAKE ACTION BY TEACHING WELLNESS SKILLS AND EXPLOITING PLATO'S ABILITY TO INDIVIDUALIZE COURSE CONTENT. THERE WILL BE DIFFERENT PATHS IN THE COURSES FOR DIFFERENT TYPES OF PEOPLE, UPDATED THROUGH EXPERIENCE. TWO AREAS OF HIGH HEALTH RISK, SMOKING CESSATION AND WEIGHT CONTROL, WILL BE DEMONSTRABLE THIS SUMMER WITH A SET OF COURSES READY FOR INITIAL TESTING LATE THIS YEAR.
3. HELP

IN MEDLAB WE HAVE A PROJECT WITH DR. HOMER WARNER OF THE UNIVERSITY OF UTAH AND LATTER DAY SAINTS HOSPITAL TO DEVELOP A COMPUTER ASSISTED MEDICAL DECISION MAKING TOOL CALLED "HELP." HELP IS HISTORY DRIVEN AND ASSISTS THE PHYSICIAN IN SELECTING AND VERIFYING THE MOST APPROPRIATE DIAGNOSIS AND TREATMENTS. IT'S CURRENTLY IN USE IN LATTER DAY SAINTS HOSPITAL, WITH FOUR MORE TEST HOSPITALS PLANNED TO BE IN OPERATION BY 1983. THOUGH WE HAVE RECEIVED FAVORABLE REACTIONS TO THE DEVELOPMENT, IT WILL BE A FEW MORE YEARS BEFORE EXTENSIVE MARKETING CAN OCCUR.

4. AGRICULTURE SERVICES

THE CONCEPT FOR OUR AGRICULTURAL SERVICES DELIVERY STRATEGY HAS EVOLVED INTO A CENTER KNOWN AS AN AGRICULTURAL AND BUSINESS SERVICES CENTER, OR "ABC."

SERVICES OF THE ABC ARE DELIVERED TO FARMERS THROUGH LOCAL RURAL DEALERS WHO PROVIDE A VARIETY OF PRODUCTION AIDS, EDUCATIONAL COURSES, AND A PROBLEM-SOLVING INFORMATION SYSTEM. CONTROL DATA
HAS DEVELOPED A WELL-DESIGNED AND CAREFULLY PACKAGED SET OF COMPUTER HARDWARE, SOFTWARE, EDUCATIONAL COURSEWARE AND BUSINESS METHODS AND PROCEDURES FOR THIS MARKET. THE SERVICES WILL BE IDENTIFIED AS CONTROL DATA SERVICES OFFERED THROUGH A LOCAL DEALERSHIP.

EXAMPLES OF SERVICES INCLUDE:

- EDUCATIONAL COURSES ON CROP AND LIVESTOCK PRODUCTION TECHNIQUES, DELIVERED VIA PLATO, VIDEOTAPE AND WRITTEN TEXT.

- AN INFORMATION SYSTEM THAT CLIENTS CAN USE TO OBTAIN QUICK ANSWERS TO PRODUCTION AND MARKETING QUESTIONS.

- FARM BUSINESS PLANNING AND FINANCIAL ANALYSIS.

BEGINNING IN 1983, ALTernate METHODS OF ACCESS ARE CONTEMPLATED. ON-FARM TERMINALS OR PERSONAL COMPUTERS ARE PLANNED TO TIE INTO THE LOCAL ABC TO ACCESS PROGRAMS RESIDENT ON A COMPUTER AT THE ABC OR TO ACCESS OTHER PROGRAMS RESIDING ON NATIONAL OR REGIONAL COMPUTER NETWORKS AVAILABLE THROUGH THE ABC.
CONTROL DATA WILL MAKE AVAILABLE A VARIETY OF SUPPORT SERVICES TO THE ABC DEALER, INCLUDING COMPREHENSIVE TRAINING, EQUIPMENT MAINTENANCE, LOCAL AND NATIONAL PROMOTION PROGRAMS, SUPPLIES, AND TECHNICAL ASSISTANCE. A NATIONAL DEALERSHIP PROGRAM WILL BE DEVELOPED TO ADMINISTER THE GROWTH OF THE RURAL RETAIL NETWORK.

5. NETWORK LINKAGE

THE GROWING POPULATION OF SMALL AND MEDIUM-SIZED PROCESSORS MUST BE ACCOMMODATED BY OUR NETWORKS AND OUR APPLICATIONS DESIGNED IN SUCH A WAY THAT WE CAN TAKE FULL ADVANTAGE OF THE CAPABILITY OF THESE PROCESSORS. A MAJOR CONSIDERATION IN THIS STRATEGY IS TO MAKE THE LINK BETWEEN THE SMALL PROCESSOR AND THE NETWORKS VERY SIMPLE FROM THE USER'S POINT OF VIEW. THIS WILL REQUIRE EXTENSIVE USE OF PLATO TECHNOLOGY, AND HIGHER LEVEL LANGUAGES SUCH AS IPF AND X/L.

6. GEOMETRIC MODELING

CONTROL DATA AND MIT HAVE ENTERED INTO AN ADVANCED RESEARCH PROJECT IN MECHANICAL COMPUTER AIDED DESIGN
WHICH HAS THE POTENTIAL FOR RADICAL IMPROVEMENT OF THE FUNCTIONALITY AND PERFORMANCE OF CAD/CAM GRAPHICS SYSTEMS. RESEARCH OBJECTIVES ARE:

0 IDENTIFY THE PHYSICAL AND FUNCTIONAL CHARACTERISTICS OF FUTURE CAD/CAM GRAPHICS SYSTEMS.

0 SYNTHESIZE, TEST AND EVALUATE METHODS INCORPORATING THE USE OF GEOMETRIC CONSTRAINTS TO REALIZE DESIRED FUNCTIONAL CHARACTERISTICS.

0 DEVELOP A CONCEPTUAL FRAMEWORK IN WHICH THE RESULTS OF THIS PROJECT CAN BE INTEGRATED WITH OTHER DEVELOPMENT EFFORTS.

A RESULT OF THE USE OF GEOMETRIC CONSTRAINTS COULD BE THE SCALING OF ENTITIES FROM A COMPUTER MODEL. (A FIVE HORSEPOWER MOTOR COULD BE AUTOMATICALLY SCALED UP TO A 10 OR DOWN TO A 3/4 HORSEPOWER UNIT.)
7. VISION ROBOTICS

THERE IS INCREASING INTEREST IN THE USE OF COMPUTERIZED VISION TO PROVIDE SIGHT FOR ROBOTS AND, BY FALL 1982 THE PSD TECHNOLOGY CENTERS WILL HAVE COMPLETED A COMPUTERIZED VISION PRODUCT DESIGNED TO REDUCE THE COST OF IMPLEMENTING SPECIFIC INSPECTION OR ROBOT VISION TASKS. THIS VISION CAPABILITY WILL BE OFFERED AS A PRODUCT AND WILL BE USED BY PSD STAFF AS A CONSULTING TOOL TO SOLVE CDC AND CUSTOMER RELATED PROBLEMS. LONG RANGE PLANS ARE TO INTEGRATE THIS SOFTWARE WITH OUR CAD/CAM SOFTWARE.

8. OTHER

I SHOULD ALSO MENTION BRIEFLY THREE OTHER INNOVATION ITEMS IN SERVICES: THE RESEARCH GRANT STARTED IN 1981 TO THE INSTITUTE FOR ECONOMIC ANALYSIS AT NYU FOR RESEARCH IN INPUT/OUTPUT ANALYSIS IS CONTINUING. THIS GRANT OF $350K IS EXPECTED TO END THIS YEAR ALTHOUGH WE ARE WORKING TO EFFECT SOME ONGOING ARRANGEMENT.

CDBAI AND CD TEMPS ARE ALSO INCLUDED IN THE FIGURES SHOWN HERE. THOSE OPERATIONS HAVE BEEN ADEQUATELY
COVERED IN THE PAST SO I'LL ONLY SAY THAT PROGRESS IN BOTH IS GOOD. IN ANOTHER YEAR, OR PERHAPS TWO, I EXPECT CD TEMPS TO HAVE "GRADUATED" TO THE ONGOING BUSINESS CATEGORY. CDBAI IS MAKING EXCELLENT PROGRESS--WITH EXPANSION INTO BOTH THE UK AND AUSTRALIA. BUT WE STILL HAVE A LOT TO LEARN ABOUT EFFECTIVE SMALL BUSINESS CONSULTING AND IT WILL BE A DEVELOPING BUSINESS FOR ANOTHER THREE OR FOUR YEARS.

IIIB. EDUCATION

THE SECOND STRATEGY, BUILDING THE EDUCATION MARKET, IS ALSO AN IMPORTANT PART OF THE OVERALL SERVICES THRUST. AS I THINK YOU KNOW, WE ARE MOVING IN THREE QUITE DIFFERENT MARKET SEGMENTS: BUSINESS AND INDUSTRY...ACADEMIC...AND VOCATIONAL EDUCATION. PROGRESS IS BEING MADE IN ALL THREE AREAS. IRONICALLY, ALTHOUGH WE HAVE STATED OUR STRATEGY FROM THE BEGINNING AS EMPHASIZING BUSINESS AND INDUSTRY, PROGRESS HAS BEEN SLOWEST THERE. THAT'S NOT INTENDED TO BE NEGATIVE BUT ONLY TO EMPHASIZE THAT WHERE YOU SET OUT TO CREATE A NEW MARKET IT'S IMPORTANT TO STAY FLEXIBLE AND NOT GET A LOT OF PRECONCEIVED NOTIONS ABOUT HOW THINGS ARE GOING TO DEVELOP. YOU DON'T KNOW AHEAD OF TIME!
HERE, AS IN SERVICES, EFFORTS IN SUPPORT OF THE EDUCATION STRATEGY TAKE PLACE IN SEVERAL ORGANIZATIONS. WITHIN TOM MILLER'S BUSINESS DEVELOPMENT GROUP, PROGRAMS ARE NOTEWORTHY.

1. ARTIFICIAL INTELLIGENCE (A-I)

ARTIFICIAL INTELLIGENCE IS AN EXAMPLE OF ADVANCED TECHNOLOGY EXPENDITURE SPECIFICALLY AIMED AT SERVICES--AND EDUCATION IN PARTICULAR. IT HAS RAMIFICATIONS, HOWEVER, FOR OTHER PRODUCTS AND SERVICES AS WELL. COMMERCIAL IMPACT OF THIS TECHNOLOGY IS PROBABLY FIVE YEARS OFF, MAYBE MORE.

A-I IS THE FIELD OF COMPUTER SCIENCE THAT INVESTIGATES THE SIMULATION OF HUMAN BEHAVIOR BY MACHINES. IT INCLUDES THE STUDY OF LEARNING, SYMBOLIC REASONING, INDUCTIVE DISCOVERY, PROBLEM SOLVING AND NATURAL LANGUAGE. IT ALSO EXPLORES THE MACHINE REPRESENTATION OF KNOWLEDGE.

I COVERED A-I IN LAST YEAR'S REPORT AND WORK CONTINUES. THE PROGRAM FOCUSES ON:
1) NATURAL LANGUAGE PROCESSING AND MACHINE INFERENCING, 2) DATA BASE INTERACTIONS, 3) ROBOTICS AND MACHINE VISION, AND 4) OPTIMIZATION OF CYBER 205 CODE. THE PROGRAM INCLUDES BASIC RESEARCH WITHIN CONTROL DATA, AS WELL AS CONTINUED CORPORATE SPONSORSHIP OF THE LEADING SMALL INDEPENDENT A-I ORGANIZATION.

2. AUTHORING LANGUAGES

LAST YEAR I TALKED ABOUT SOME ADVANCED TECHNOLOGY WORK WITH REGARD TO A "PLATO DESIGN LANGUAGE." THIS IS NOW BEING APPLIED TO TWO ADVANCED SOFTWARE TOOLS WHICH WILL SPEED THE CREATION OF COURSEWARE WITH LESS PROGRAMMER INVOLVEMENT.

THE FIRST OF THESE, WHICH IS DUBBED COURSEWARE DEVELOPMENT AND DELIVERY, OR CD², OPERATES ON CENTRAL PLATO USING THE CDC-110 AS A WORKSTATION. FOR A GIVEN MICROCOMPUTER, CD² WILL VERIFY THAT THE PROPOSED SCREEN FORMAT WILL FIT PROPERLY ON THAT MICROCOMPUTER, AND WILL ALSO PROVIDE A STRUCTURE FOR LOGICALLY TYING TOGETHER A SEQUENCE OF SCREEN FORMATS WITH LITTLE PROGRAMMER EXPERTISE REQUIRED. COURSEWARE FOR THE CDC-110 AND OTHER MICROCOMPUTERS CAN BE CREATED AND VALIDATED ON CD².
The more powerful advanced development is CD³...the third "d" stands for "design"...is, in effect, a programmerless authoring tool. Design can be accomplished directly on the screen rather than on paper. Prompting messages, instructional models and graphic input devices all speed the development process, yielding about a four to one improvement in courseware development time versus conventional methods. Once developed on CD³, courseware is deliverable on various microcomputers including CDC-110, Apple, and Atari at present.

3. PRE-ENGINEERING CURRICULUM (ACADEMIC)

The pre-engineering curriculum is a step toward alleviating the shortage of engineers by assisting the faculty through individualized instruction and by making education available to more types of students. Five universities have committed faculty to assist in defining and testing this curriculum. The first three courses, Chemistry I, Physics I, and FORTRAN will be available for testing in the fall of 1982.
4. BUSINESS AND INDUSTRY COURSEWARE

COURSEWARE IS BEING TARGETED FOR SIX INDUSTRIES: DATA PROCESSING, ELECTRIC UTILITIES, MANUFACTURING, HEALTH CARE, PETROLEUM, AND AVIATION. THE LARGEST EXPENDITURES CURRENTLY ARE FOR MANUFACTURING. IN THIS REGARD, COURSES IN THE INTRODUCTION AND FUNDAMENTALS OF ELECTRONICS AND MICROPROCESSORS ARE AIMED AT MAINTENANCE TECHNICIANS FOR REMEDIAL TRAINING OR SKILLS UPGRADING. ALSO, AN EXTENSION AND CONSOLIDATION OF THE CAD/CAM CURRICULUM IS UNDERWAY AND A NEW COURSE OFFERING IS BEING PREPARED IN HYDRAULICS.

5. VOCATIONAL COURSEWARE

VOCATIONAL COURSEWARE AIMED AT REMEDIAL TECHNICAL TRAINING IN INDUSTRY IS BEING DEVELOPED. ONE EXAMPLE IS THE MAINTENANCE TRAINING PACKAGE WHICH MEETS THE TRAINING NEEDS RESULTING FROM PLANT AUTOMATION. INCLUDED IN THIS PACKAGE ARE LEARNING-TO-LEARN MATH, ELECTRONICS, AND BLUEPRINT READING COURSES. FURTHER, THE ENTIRE CONTROL DATA INSITUTE COMPUTER TECHNOLOGY CURRICULUM AND MUCH OF THE COMPUTER PROGRAMMING AND OPERATIONS CURRICULUM
IS NOW SALEABLE BY MARKETING REPRESENTATIVES TO OTHER THAN CDI STUDENTS. THESE TWO CURRICULUMS WILL BE CONVERTED TO RUN ON THE CONTROL DATA 110.

WHILE THESE PROJECTS IN EDUCATION OFFER INSIGHT INTO SPECIFIC COURSEWARE ACTIVITIES, I SHOULD MENTION THAT COURSEWARE DEVELOPMENT CONTINUES AT A RAPID PACE IN VARIOUS OTHER PARTS OF THE COMPANY. TOTAL COURSEWARE SPENDING FOR THE CURRENT YEAR COMPANY-WIDE IS EXPECTED TO EXCEED $25M.

IIIC. PERIPHERALS

(CHART 11)

LET'S TURN TO THE THIRD STRATEGY...CONTINUING LEADERSHIP IN THE PERIPHERAL PRODUCTS MARKET.

THIS IS PROBABLY A GOOD POINT TO REMIND YOU AGAIN THAT THE CATEGORIZATION OF INNOVATION EXPENDITURES IS SOMEWHAT SUBJECTIVE AND A BIT ARBITRARY. THUS, HERE OPTICAL RECORDING DEVELOPMENTS ARE TREATED AS ADVANCED TECHNOLOGY AND MOST MAGNETIC RECORDING DEVELOPMENTS AS ADVANCED PRODUCT DEVELOPMENT OR PRODUCT AND SERVICE DEVELOPMENT. SO THE $35M, $80M SPLIT MAY NOT BE PRECISE
BUT IT IS ROUGHLY CORRECT AND WHAT IS TRUE IS OVER A
HUNDRED MILLION DOLLARS OF TECHNICAL EFFORT IS BEING PUT
INTO ADVANCED PERIPHERAL PRODUCTS OVER THE THREE YEAR
PERIOD.

1. PRINTER TECHNOLOGIES

AS YOU KNOW, WE ARE IN THE MIDST OF STRUCTURING A
DEAL WITH CENTRONICS, A LEADING INDEPENDENT SUPPLIER
OF LOW SPEED PRINTERS. THIS ACQUISITION OF ABOUT 35
PERCENT OF CENTRONICS COMMON STOCK AND THE RESULTANT
MERGING OF CPI's MEDIUM AND HIGH SPEED PRINTER LINES
WITH THEIR LINES WILL CREATE A FULLY INTEGRATED
COMPETITIVE SUPPLIER TO THE OEM MARKET. THIS IS THE
BEST WAY TO ACHIEVE THE DEPTH AND BREADTH OF
INNOVATION REQUIRED TO BE A MAJOR FACTOR IN PRINTERS.

UNTIL THE MERGER IS EFFECTIVE AND THE PRODUCT
PROGRAMS ALIGNED TO A COMMON SET OF STRATEGIES, THE
EXACT LEVEL OF TECHNICAL SPENDING WILL NOT BE
KNOWN. HOWEVER, IT'S FAIR TO SAY THAT THE CURRENT
CPI PRINTER TECHNICAL EXPENSE PROGRAMS IN IMPACT AND
NON-IMPACT PRINTERS, TOTALING $7.8M IN 1982,
COMBINED WITH CENTRONICS WILL RESULT IN A LEVEL AT
LEAST 60 PERCENT HIGHER, OR $12-14 MILLION.
THEREFORE, WE WILL BE ABLE TO APPROPRIATELY FUND TECHNOLOGIES SUCH AS INK JET, DOT MATRIX, AND MAGNETIC TRANSFER PRINTING NECESSARY TO INSURE A BROAD RANGE OF COMPETITIVE PRODUCTS.

OF COURSE, DISK MEMORY PRODUCTS ARE THE MAINSTAY OF PERIPHERAL PRODUCTS INNOVATION ACTIVITY.

2. THIN FILM HEADS AND MEDIA

THE AREAL DENSITY ON A DISK WILL INCREASE FROM THE PRESENT FIVE MILLION BITS PER SQUARE INCH TO TWELVE MILLION BITS PER SQUARE INCH TO FORTY-EIGHT MILLION BITS PER SQUARE INCH FOR THE NEXT GENERATION OF DRIVES DUE IN THE 1986-1987 TIME FRAME.

IN THIS REGARD, MAGNETIC RECORDING TECHNOLOGY IS APPROACHING THE END OF AN ERA. THE FAMILIAR FERRITE HEAD AND OXIDE MEDIA TECHNOLOGIES THAT HAVE BEEN REFINED FOR THE LAST 25 YEARS CAN'T DEAL WITH DENSITIES LIKE THOSE MENTIONED. THEY WILL BE REPLACED BY THIN FILM HEADS AND NEW MEDIA TECHNOLOGIES. THE COMPLEXITY OF THE THIN FILM HEAD MANUFACTURING PROCESS AND THE NEED FOR AN ULTRA-CLEAN ENVIRONMENT ARE AKIN TO THE SEMICONDUCTOR INDUSTRY.
BUT EVEN GREATER SOPHISTICATION WILL BE REQUIRED. THE NEXT GENERATION HEAD WILL HAVE FIVE TO TEN TIMES THE SENSITIVITY THAT IS OBTAINABLE WITH AN INDUCTIVE THIN FILM HEAD. THE SENSOR AND ITS ELECTRONICS ARE LIKELY TO BE INTEGRATED ON THE HEAD CARRIER OR SLIDER. ADVANCES IN THE SLIDER ITSELF WILL BE REQUIRED TO ELIMINATE THE CONTACT START/STOP PROBLEMS OF WEAR AND CONTAMINATION.

TODAY'S MEDIA WILL GIVE WAY TO THIN FILM TECHNOLOGY. PROBABLY FIRST IN THE SMALLER DIAMETER DISK PRODUCTS WHERE THE SIGNAL IS LOWER. THIN FILM MEDIA IS ONLY TWO TO FOUR MILLIONTHS OF AN INCH THICK, ABOUT ONE-TENTH THE THICKNESS OF CURRENT MEDIA. RESEARCH IS GOING ON TO DETERMINE THE ECONOMIC AND TECHNICAL MERITS OF DIFFERENT APPROACHES TO COATING SUCH MEDIA.

3. VERTICAL RECORDING

ANOTHER ADVANCED TECHNOLOGY PROJECT CONCERNS VERTICAL RECORDING. LOOKING BEYOND THE NEXT GENERATION TO THE LATE 1980'S OR EARLY 1990'S. VERTICAL MAGNETIC RECORDING MEDIA IS EXPECTED TO DOMINATE. IN VERTICAL MAGNETIC RECORDING, THE MAGNETIZATION IN THE MEDIA LIES PERPENDICULAR TO THE
SURFACE AS OPPOSED TO THE IN-PLANE MAGNETIZATION IN PRESENT MEDIA. SWITCHING TO THIS FORM OF RECORDING SHOULD INCREASE THE BIT DENSITY CAPABILITY BY MORE THAN AN ORDER OF MAGNITUDE.

4. OPTICAL RECORDING

OPTICAL RECORDING HAS BEEN IN THE RESEARCH STAGE AT MPI'S LAB IN COLORADO SPRINGS FOR THE PAST YEAR. IT HAS NOW MOVED TO THE ADVANCED PRODUCT DEVELOPMENT STAGE. THE PROGRAM CALLS FOR A LABORATORY PROTOTYPE IN MID-1982 AND OPERATIONAL ENGINEERING PROTOTYPES BY THE END OF THE YEAR.

THE INITIAL PRODUCT IS PLANNED TO HAVE A CAPACITY OF ONE BILLION BYTES ON A SINGLE 12-INCH DIAMETER DISK AT A TARGET MANUFACTURING COST OF $2,500. THIS CAPACITY IS EQUIVALENT TO 200,000 PAGES OF TYPICAL TEXT--EQUAL TO SEVEN FILE CABINETS. THE COMBINATION OF HIGH CAPACITY, COMPACT SIZE, AND LOW COST MAKE OPTICAL DISK PARTICULARLY ATTRACTIVE FOR LARGE ARCHIVAL APPLICATIONS INCLUDING EDUCATION.

OPTICAL RECORDING EXPENDITURES WILL ALSO BE LEVERAGED VIA TECHNOLOGICAL COOPERATION. WE HAVE
SIGNED AN AGREEMENT WITH PHILIPS IN HOLLAND TO JOINTLY DEVELOP AND MANUFACTURE OPTICAL RECORDING DEVICES AND THE ASSOCIATED MEDIA.

IIID. COMPUTER SYSTEMS

(CHART 12)

AS YOU SEE, THE BULK OF THE EXPENDITURE IN COMPUTER SYSTEMS IS FOR PRODUCT DEVELOPMENT. MUCH OF THIS EXPENDITURE BENEFITS THE OTHER PRODUCTS, SERVICES AND THEIR ASSOCIATED STRATEGIES BUT IT IS INCLUDED HERE.

THERE IS A SIGNIFICANT AMOUNT OF ADVANCED TECHNOLOGY AND ADVANCED PRODUCT DEVELOPMENT WORK ALSO. I WON'T TAKE THE TIME TO COVER ALL OF THE ADVANCED PROJECTS, BUT HERE ARE A FEW OF THE MOST SIGNIFICANT.

1. MICROELECTRONICS COOPERATION

ANY COMMENT ON INNOVATION FOR THE FUTURE HAS TO START WITH MICROELECTRONICS. BESIDES INTERNAL EFFORTS, THE EXPENDITURE FOR WHICH WILL BE $16.9 MILLION IN 1982, THERE ARE TWO MAIN COOPERATIVE THRUSTS: MEIS, THE JOINTLY-FUNDED INSTITUTE BEING
ESTABLISHED AT THE UNIVERSITY OF MINNESOTA, AND MCE, THE MICROELECTRONICS AND COMPUTER TECHNOLOGY ENTERPRISE FOR BROAD INDUSTRY COOPERATION. BILL NORRIS WILL COMMENT ON MCE TOMORROW SO I'LL RESTRICT MYSELF TO MEIS.

THE INITIAL GOAL OF MEIS WAS TO HAVE A $10M COMMITMENT BY PRIVATE DONORS BY THE END OF THE THIRD YEAR OF ACTIVITY. THEY SHOULD BE CLOSE TO THAT. IN THE LAST YEAR, MEIS HAS OBTAINED $1 MILLION IN SUPPORT FROM 3M OVER A TWO-YEAR PERIOD WITH AN IDENTICAL EXTENSION LIKELY. CALMA, THE CAD/CAM SUBSIDIARY OF GE, HAS PROVIDED NEARLY $750K IN WORKSTATIONS. BOTH EXXON AND MOTOROLA ARE CANDIDATES FOR FUNDING THIS YEAR. AND AT LEAST ONE MAJOR FEDERAL GRANT IS EXPECTED IN 1982.

COURSES IN INTEGRATED CIRCUIT DESIGN ARE BEING TAUGHT IN TEAM FASHION USING UNIVERSITY STAFF AND EMPLOYEES FROM PARTICIPATING COMPANIES. AN EXTENSIVE CMOS COURSE WILL BE OFFERED NEXT FALL. GRADUATE ENROLLMENT WILL EXPAND BY 30 STUDENTS NEXT YEAR AND FIVE TO TEN NEW FACULTY MEMBERS ARE TO BE ADDED.
FINALLY, AN AGREEMENT IN PRINCIPLE HAS BEEN REACHED TO MOVE A SUBSTANTIAL PORTION OF MEIS ACTIVITIES TO CDC'S MINNEAPOLIS BTC. THROUGH ADDITIONAL LEASEHOLD IMPROVEMENTS AND PARTIAL RENT FORGIVENESS IN THE BTC, CONTROL DATA WOULD BE INVESTING FURTHER IN MEIS.

TOTAL FUNDS FLOWING TO MEIS FROM CDC IN 1982-1984 WILL BE $1.1M IN ADDITION TO THE ROUGHLY $600K PRO RATA SHARE OF THE ORIGINAL 2 MILLION DOLLAR GRANT.

THERE HAS BEEN GOOD PROGRESS IN OUR OWN IN-HOUSE MICROELECTRONICS PROGRAMS AS WELL OVER THE LAST YEAR. I'LL COVER FOUR ASPECTS OF THAT.

2. **VLSI ON-CHIP TESTING**

AN EXHAUSTIVE TEST OF COMPLEX HIGH DENSITY LSI CHIPS IS PROHIBITIVELY EXPENSIVE AND TIME CONSUMING. THEREFORE, THE TECHNOLOGY REQUIRES ITS USERS TO BECOME SKILLED IN THE USE OF "STATISTICAL" TESTING. THAT IS, INCOMPLETE TESTING.

THE LSI-HD (HIGH DENSITY) PROJECT HAS INVENTED A CLEVER TECHNIQUE TO PLACE SELF-TEST FACILITIES ON EACH CHIP. THE TEST ALGORITHMS ARE DERIVED USING
INFORMATION THEORY TECHNIQUES PREVIOUSLY USED FOR ERROR CORRECTION IN DISK MEMORIES AND COMMUNICATION CHANNELS. THIS NEW APPROACH FACILITATES DEFINITION OF "PERSONALIZED" TESTS FOR A WIDE RANGE OF CHIP OPTIONS. THESE CAN BE MODIFIED AS WE LEARN WHICH FAILURE MODES ARE OF THE MOST CONCERN.

3. LSI-HD CAD

THE LSI-HD PROGRAM HAS BEEN ABLE TO GET CRITICAL TEST CHIPS FROM THREE CMOS SOURCES ON COMPARATIVELY SHORT NOTICE. THIS REQUIRED A MAJOR DIVERSION, OR REPRIORITIZATION, OF CRITICAL RESOURCES AT THE FOUNDRY WITH NO PARTICULAR FINANCIAL CARROT. WE WERE ABLE TO DO THIS BECAUSE OF THE CREATIVE WAY WE COULD MANAGE OUR DESIGN RESOURCES TO FIT WITH THOSE OF THE FOUNDRIES. OUR EXCHANGE DOCUMENTS (CALMA TAPES) ARE STANDARD: WE CAN ADAPT TO THE FOUNDRY’S LAYOUT GROUND RULES, AND MOST OF ALL, THE CAD (SIMULATION) MAKES THE DESIGNS CREDIBLE AND UNDERSTANDABLE.
4. MODULAR HD CIRCUIT

A CIRCUIT USING OVER 25,000 GATES WAS DESIGNED SUCCESSFULLY IN A MILITARY DIVISION FOR WHOM. ONLY LIMITED SIMULATION RESOURCES WERE AVAILABLE. THEY BUILT FAST 16-BIT AND 32-BIT PROCESSORS BY USING SINGLE-BIT MODULES AROUND A CO-RESIDENT CONTROL SECTION. THIS WAY, ONLY A FEW MODULE TYPES WERE USED, SO THE CHANCE OF CIRCUIT DESIGN ERRORS WERE MINIMIZED.

SUCH APPROACHES ARE OFTEN PROMISED, BUT USUALLY GIVEN WAY TO "DETAIL" PROBLEMS. IN THIS CASE, THE DESIGN WAS WELL ENOUGH THOUGHT OUT, AND THE DESIGN DISCIPLINE WAS STRONG ENOUGH TO COMPLETE THE DESIGN AND DEMONSTRATE IT IN CMOS TECHNOLOGY.

5. MICRO-BIT (EBAL)

IN ADDITION TO THE IMPROVED PROSPECTS OF A NEW VENTURE FOR THE MICRO-BIT TECHNOLOGY, WE HAVE A FRESH APPROACH TO DEFINING ITS ROLE. COMPUTER AIDED MANUFACTURING (CAM) IS A FAR MORE APPROPRIATE DESCRIPTION FOR THE ELECTRON BEAM ARRAY LITHOGRAPHY (EBAL) SYSTEM THAN SIMPLY A PIECE OF PRODUCTION
EQUIPMENT. A SUCCESSFUL EBAL INSTALLATION WILL REVOLUTIONIZE CURRENT SILICON WAFER PROCESSING, NOT ONLY FOR FINE FEATURE CIRCUITS BUT CONVENTIONAL CIRCUITS AS WELL. COMPLETELY FREED FROM RESTRICTIONS IMPOSED BY CONVENTIONAL MASKS. INNOVATIONS IN UTILIZING LARGER WAFER AREAS CAN LEAD TO HIGHER YIELDS, ECONOMICAL SMALL VOLUME SPECIAL CIRCUITS, AND THE REDUCTION OR COMPLETE ELIMINATION OF CONVENTIONAL CHIP TO CHIP INTERCONNECTIONS.

TURNING FROM BASIC TECHNOLOGY DEVELOPMENTS TO THE APPLICATIONS AREA, I'LL ALSO COVER FOUR AREAS OF ACTIVITY.

6. PETROLEUM EXPLORATION

ONE OF THE MOST SUCCESSFUL APPLICATIONS OF THE CYBER 205 HAS BEEN IN PETROLEUM EXPLORATION. WE CONTINUE TO WORK WITH SPECIALIZED SOFTWARE VENDORS SUCH AS
PRAKLA* AND CGG* TO DEVELOP SEISMIC SOFTWARE. AS I MENTIONED IN JANUARY WE HAVE A NEW APPROACH TO THE EDUCATION AND TRAINING NEEDS OF THE PETROLEUM INDUSTRY. THROUGH A CONSORTIUM OF OIL COMPANIES A SERIES OF PLATO BASED GEOPHYSICAL AND GEOLOGICAL COURSES ARE BEING DEVELOPED. FROM 1983 TO 1987, WE EXPECT THIS INDUSTRY SEGMENT TO GENERATE OVER 800 MILLION DOLLARS IN REVENUE, WITH AN INDUSTRY SPECIFIC TECHNICAL EFFORT COSTING SLIGHTLY MORE THAN 20 MILLION DOLLARS OVER THE SAME PERIOD.

7. PETROLEUM PRODUCTION

IN THE AREA OF PETROLEUM PRODUCTION, THE EMPHASIS WILL BE ON DEVELOPING RESERVOIR SIMULATION APPLICATIONS. THIS YEAR TWO NEW RESERVOIR SIMULATION MODELS WILL BE INTRODUCED ON THE 205 (KNOWLAND BLACK OIL AND MISCIBLE FLOOD). WE ALSO WILL BE WORKING WITH VARIOUS UNIVERSITIES THROUGH SPONSORED RESEARCH PROJECTS FOR THE DEVELOPMENT OF COURSEWARE.
8. ELECTRIC UTILITIES

Computer assisted design and engineering is also important to the electric utility industry. Because few power plants will be constructed in the near future, the industry is under significant pressure to reduce the costs of operating existing plants. Thus the need is to upgrade and retrofit existing plants. An integrated fossil fuel application set is being developed to provide performance analysis, safety analysis and maintenance planning.

For the past ten years, we have struggled against the utilities' preference for custom developed energy management systems. We've made progress but this is still where most of the cost of sales tech effort is located. Standard product developments include: computer-aided engineering for planning and design, additional development of piping and structural analysis programs, and courseware for utilities plant operations personnel. Courseware for nuclear reactor operators is being developed in cooperation with several utilities, and under a sponsored research grant to the University of Maryland.
9. **CAD/CAM**

CAD/CAM REMAINS IN TOTAL THE SINGLE LARGEST EXPENDITURE OF THE SIX PRIMARY APPLICATIONS MARKETS I CITED EARLIER. IN MECHANICAL CAD, IN ADDITION TO STRUCTURAL ANALYSIS, FUTURE DEVELOPMENTS WILL FOCUS ON DATA BASE MANAGEMENT SYSTEMS AND ADVANCED SOLID MODELING TECHNOLOGY FOR GEOMETRY CREATION. WHILE SPECIALIZED TURNKEY MINICOMPUTER VENDORS ARE RECEIVING A GREAT DEAL OF ATTENTION IN THIS MARKET, WE EXPECT THE FUTURE REQUIREMENTS FOR ANALYSIS AND MODELING CAPABILITIES WILL ACTUALLY REQUIRE MORE POWERFUL MAINFRAMES. THE GEOMETRIC MODELING PROJECT I SPOKE OF EARLIER WILL UTILIZE THESE LARGER SYSTEMS.

WHILE A GREAT DEAL OF PROGRESS HAS BEEN MADE IN THE AREA OF CAD, DEVELOPMENT OF CAM HAS BEEN SLOWER. THE INTEGRATION OF CAD AND CAM IS A VITAL LINK TO MAKE. THE KEY WILL BE THE DEVELOPMENT OF DATA BASE MANAGEMENT SYSTEMS THAT PROVIDE ACCESS TO CAD GENERATED INFORMATION BY THE CAM PROGRAMS.

A COMMON THREAD RUNNING THROUGH EACH OF THE ABOVE APPLICATIONS ACTIVITIES THAT I JUST DESCRIBED IS THE USE OF PLATO TO PROVIDE UNIQUE USER BENEFITS THAT COMPETITORS WILL NOT BE ABLE TO MATCH.
III. SMALL BUSINESS SERVICES

(CHART 13)

THE FIFTH STRATEGY IS DEVELOPING THE POTENTIAL OF THE SMALL BUSINESS MARKET. THE FOLLOWING PROJECTS ARE NOTEWORTHY IN SMALL BUSINESS SERVICES:

1. MID-RANGE MICROCOMPUTER SYSTEM


THIS PROGRAM INCLUDES THE IMPLEMENTATION OF AN APPLICATION GENERATOR SOFTWARE TOOL, WHICH WILL ENABLE GREATLY INCREASED APPLICATION DEVELOPMENT PRODUCTIVITY.
2. **VERY SMALL BUSINESS COMPUTER SYSTEM**

A **VERY SMALL BUSINESS COMPUTER, PRICED UNDER THE** CDC-110, **WILL BE OFFERED LATE THIS YEAR. PRODUCT REVIEWS AND PRELIMINARY NEGOTIATIONS ARE NOW BEING CONDUCTED WITH SEVERAL POTENTIAL VENDORS, BOTH U.S. AND JAPANESE. **(ONY, HITACHI, IBM, AND WANG--OEM AND DISTRIBUTOR)--**THE PRODUCT WILL BE OFFERED SUBSTANTIALLY "AS IS" FROM THE VENDOR, WITH MAXIMUM UTILIZATION OF VENDOR SUPPLIED SERVICES, APPLICATIONS AND SALES AIDS. **THE PRODUCT WILL OFFER LESS EXPANSION CAPABILITY THAN THE MID-RANGE MICROCOMPUTER SYSTEM. TARGET MARKET FOR THIS PRODUCT IS THE PROFESSIONAL MANAGER, AS WELL AS THE VERY SMALL BUSINESS PERSON.**

3. **APPLICATION SOFTWARE**

APPLICATIONS SOFTWARE **IS BEING ACQUIRED OR DEVELOPED FOR OUR SMALL BUSINESS COMPUTER SYSTEMS. THESE INCLUDE:**

- **FINANCIAL MANAGEMENT**
- **FINANCIAL PLANNING**
- **WORD PROCESSING**
4. APPLICATION GENERATOR

An application generator is under development that permits customization of accounting and manufacturing applications to meet specific customer business requirements. These applications, initially offered on the Cyber 120, will also be offered on the mid-range microcomputer system beginning in 1983.

5. COURSEWARE

Stand-alone small business courseware will be developed this year through internal programs and with grants to several outside courseware development organizations. Specific courses are being targeted for re-certification of professionals in the real estate and dental occupations. Generic courses applicable to most small businesses are
BEING PREPARED TO TEACH FORECASTING METHODS, SMALL
BUSINESS TAXATION, "THE TELEPHONE AS A SALES TOOL," AND
IMPROVING CUSTOMER CONTACT SKILLS. THIS COURSEWARE WILL BE OFFERED INITIALLY ON THE CDC-110,
WITH LATER RELEASES FOR OTHER MICROCOMPUTER SYSTEMS.

IV. SUMMARY AND PERSPECTIVE

AS USUAL, THERE ARE MANY MORE THINGS WE COULD BE DOING
IN THE WAY OF NEW PRODUCTS AND SERVICES.

(CHART 14A, 14B)

THESE NEXT 2 CHARTS SUMMARIZE SOME OF THE MOST
SIGNIFICANT OF THESE.

RIGHT NOW WE PLAN TO FINISH THE YEAR WITH 109 BUSINESS
CENTERS IN TOTAL...WITH 57 MAJOR CENTERS (36 OLD RETAIL
BCs, 17 CCC/BCs, 4 SBC/BCs) AND 52 SATELLITE CENTERS.
THIS REPRESENTS ABOUT 60 FEWER BUSINESS CENTERS THAN OUR
ORIGINAL PLAN FOR 1982 CALLED FOR. THAT'S ANOTHER
$25 M. (RMP NOTE...DIRECTION IS IN 1983 TO CONVERT THE
CURRENT 33 SBC/DPS LOCATIONS INTO BUSINESS CENTERS THUS
INCREASING THE TOTAL TO ABOUT 90 BUSINESS CENTERS).

(Please)
MAJOR APPLICATION OPPORTUNITIES IN MINING, CONSTRUCTION AND UTILITIES WHICH WE HAVE DELAYED ARE ANOTHER $2.5M. IN SPITE OF THE FACT THAT CAD IS OUR LARGEST APPLICATION EXPENDITURE, THERE ARE SOME $15-20 MILLION IN ADDITIONAL DESIRABLE PROJECTS.

HARDWARE TECHNOLOGY REQUIREMENTS ARE TRULY ALMOST ENDLESS. SOME OF THE MAJOR THINGS ARE SHOWN HERE--THEY TOTAL SOME $20M BUT THAT REALLY JUST SCRATCHES THE SURFACE. WITHOUT MORE AND BIGGER COOPERATION PROGRAMS, MCE AND SO ON, THIS IS JUST GOING TO GROW AND GROW AND GROW. RELATIVE TO IBM AND THE JAPANESE, WE ARE SPENDING $250-300 MILLION TOO LITTLE ON HARDWARE TECHNOLOGIES.

EDUCATION PROJECTS HAVE BEEN CUT BACK SOME $10-15 MILLION BUT THERE IS ANOTHER $20 MILLION IN IDENTIFIED COURSEWARE REQUIREMENTS THAT DIDN'T GET INTO THE BUDGET REQUESTS TO BE CUT. ALL IN ALL, DOCUMENTED REQUESTS FOR ADDITIONAL TECHNICAL EXPENDITURES EXCEED $75 MILLION, EXCLUDING BUSINESS CENTERS.

BUT WE ARE STRAINING. ON A BASIS CONSISTENT WITH PRIOR YEARS, OUR 1982 BUDGETS REFLECT AN ROIC OF 8.7%, A DECREASE COMPARED TO LAST YEARS 9.3% FOR THE COMPUTER BUSINESS. WE HOPE TO BEAT THE BUDGET, BUT AT THIS POINT THAT IS FAR FROM A FOREGONE CONCLUSION.

THIS YEAR I'M NOT AS OPTIMISTIC BUT ALL-IN-ALL THINGS SEEM PRETTY WELL BALANCED. WE HAVE BEEN VERY GENEROUS IN NEW UNDERTAKINGS OVER THE LAST TWO OR THREE YEARS--AS I SAID EARLIER WE HAVE LOTS OF IRONS IN THE FIRE--WE REALLY MUST WORK SOME OF IT OFF.

THAT IS EXACTLY THE PLAN AS YOU CAN SEE FROM THIS FINAL CHART.

(CHART 16)

$96M IN NEW BUSINESS VENTURES NET EXPENDITURE ALONE IN 1982 IS THE MOST MEANINGFUL INDICATOR I CAN SHOW YOU IN THAT REGARD.
IF OUR EXECUTION MATCHES OUR PLAN, WE'LL HAVE LOTS OF HEALTHY NEW BUSINESSES A COUPLE YEARS FROM NOW AND THAT MUCH MORE ROOM TO UNDERTAKE OTHERS.

NOW, ARE THERE QUESTIONS?