DRAFT

FACTORY AUTOMATION:

AN ANALYSIS OF THE BUSINESS ENVIRONMENT

JANUARY 5, 1982

SCIENCE APPLICATIONS, INC.

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1. INTRODUCTION

1.1 Purpose and Goals of the Report

This report is a condensation of Science Applications, Inc. Robotic Applications Center's (SAI/RAC) summary and forecasts for the factory automation marketplace over the years 1982 to 1990. It is our goal to alert readers to new and important opportunities for business growth, improved productivity, and increased competitiveness (both foreign and domestic). The information contained in this report is intended as input to planning business strategy in 1982.

1.2 Defining the Terms Used in the Factory Automation Field

To orient the reader, and illustrate the depth of the field, the following definitions are provided:

- Manufacturing segment of the economy accounts for the largest share of the GNP, followed by other segments such as mining, agriculture and service industries. This holds true for highly industrialized nations such as the U.S., Japan, France, Germany, etc.

- Factory automation replaces human labor with machinery in manufacturing settings. There are two general forms. Hard automation consists of fixed sequence machines and transfers; soft automation is programmable for variable sequences.

- Integrated factory design calls for the linking of the design function, the materials ordering and handling, the fabrication, assembly, test and shipping through automation systems (e.g., computers).

- CAD/CAM can be an element of integrated factory automation that allows automated design, industrial engineering, and machine tool programming through a linked computer system.

- Other pieces of the integrated automated factory are automated warehousing, driverless delivery vehicles, flexible machining centers, robotic machining cells, and automated assembly stations.

- The devices that make up automated machining centers, cells and stations are numerically controlled (NC) tools and robots. Modern machine tools are often computer driven (CNC).* Robots are generally capable of easy

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*Only 31% of all machine tools are NC tools.

reprogramming either by playback, point teaching, or computer programming.

- All these components of automation lead to increased productivity. This is the measure of sales, or value added per worker for a factory. On the national level it is the value of the goods produced per man hour worked.

These basic definitions will be referred to often in the following report, and they form the basis for understanding the factory automation environment today.

1.3 Why Factory Automation is Important to America

Much of America's early success in the industrial age was the leading role American industry played in developing efficient production capacity. America got out front in the beginning of the manufacturing race. American plants were able to take advantage of economies of scale, and of learning or experience curve economies to lower the cost of goods. Innovative use of automation and new sources of power (e.g., electrical motors) sparked whole new industries such as that of the passenger automobile, shipbuilding, steel, aluminum, and aircraft assembly. Many observers credit the U.S. victory in World War II primarily to the surge capacity of U.S. industry.

By 1950, the United States led all other nations by wide margins in every indicator of manufacturing strength. The inevitable catching up process by the rest of the world that has taken place in the last 30 years, however, caught America napping. Perhaps due to complacency, perhaps due to lack of national policy and goals for manufacturing, the U.S. stands today threatened for its once secure leadership. These facts are not entirely obvious from the statistics of national productivity and annual growth of productivity as shown in Exhibit 1. Therefore SAI/RAC has developed an analysis of these data, the results of which are shown in Exhibit 2. Here, when growth rate is plotted against productivity level an interesting pattern emerges. One path (rainbow) is business-as-usual. This scenario assumes rapidly growing countries such as Japan will follow the same path as the U.S. and Europe and saturate their ability to grow, and slowly approach our level. This suggests that productivity is subject to diminishing returns and thus the currently most productive countries are near the end of the "rainbow". A less sanguine view is of parallel tracks which do not converge at the level of American productivity. The success story of Japan needs more examination since the national productivity levels do not show the higher levels of

GROWTH OF PRODUCTIVITY FOR PERIOD 1960-75

JAPAN	9.7%
NETHERLANDS	7.1
BELGIUM	7.0
ITALY	6.2
GERMANY	5.7
FRANCE	5.6
CANADA	4.0
GREAT BRITAIN	3.8
UNITED STATES	2.7

RELATIVE PRODUCTIVITY RANKING OF MAJOR INDUSTRIALIZED NATION'S (1980)

UNITED STATES	100
NETHERLANDS	92
CANADA	92
BELGIUM	90
FRANCE	89
GERMANY	89
JAPAN	69
ITALY	61
GREAT BRITAIN	60

Exhibit 1. Relative National Productivity Rankings, and Productivity Growth Rates for Nine Highly Indstrialized Economics. Levels are 1980 data, annual rates are averaged from 1960 to 1975.
Source: Bureau of Labor Statistics with SAI analysis.

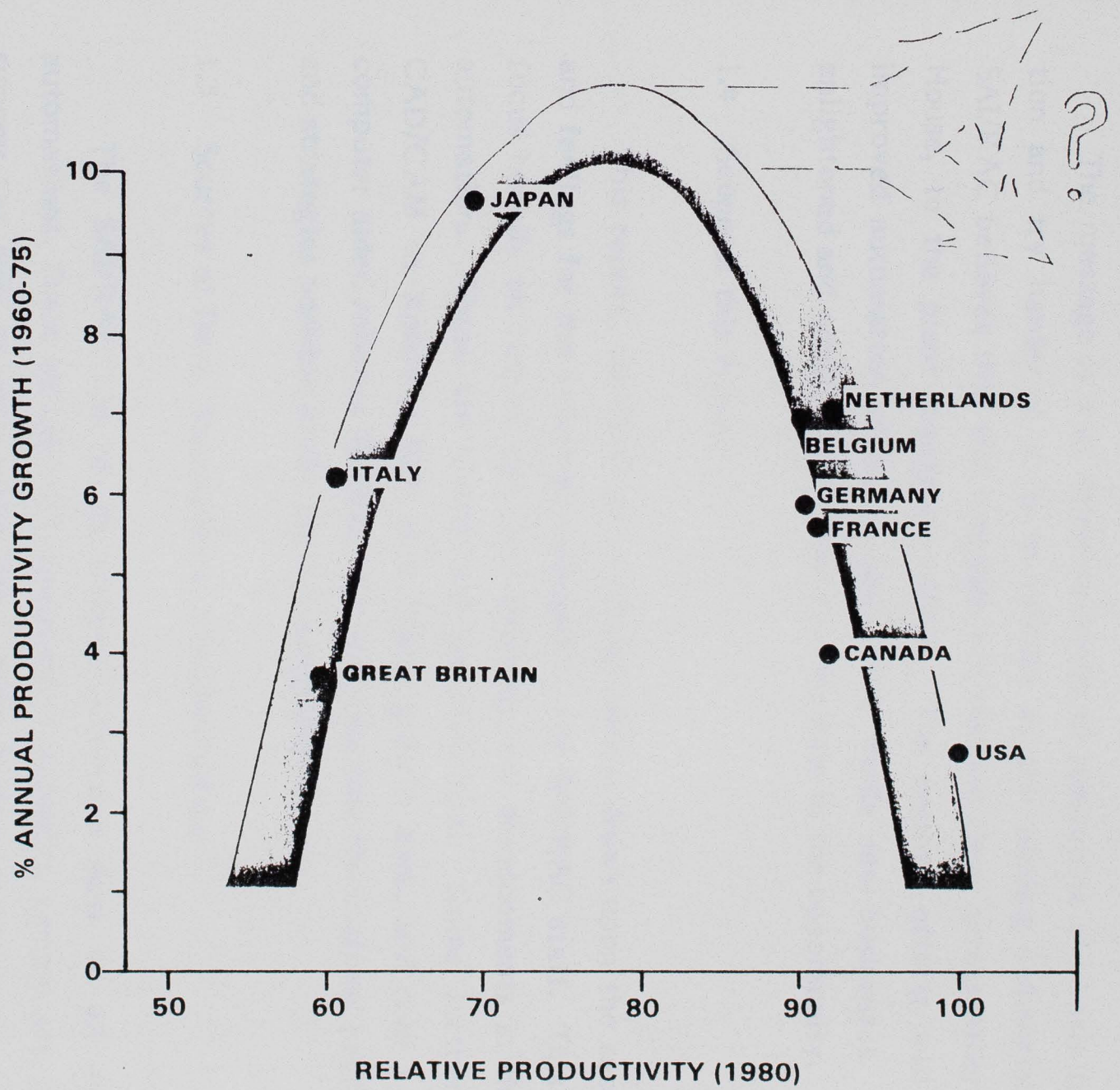

Exhibit 2. Graph of National Productivity of Nine Industrial Nations, with Speculative Trend Lines.

productivity achieved by the more modern sectors of Japanese industry compared to the US and other nations. There have been many reports of Japan's success in heavy manufacturing, automobiles and consumer electronics. The story behind the success story in productivity is Japan's dedication to automation and robotics.* This newly realized emphasis may mean that the traditional path is not a valid forecast. Perhaps other paths such as are illustrated in Exhibit 2 are possible.

The message is that America needs to reexamine the basis for factory automation and try harder if it is to remain as the leading industrial nation on earth. SAI/RAC believes that this message will become clear across America from the White House, to the plant manager's office. The ensuing efforts will demand new and improved automation products, and create whole new businesses. This is a time for enlightened and creative planning to participate in the opportunity.

1.4 Scope of this Report

This report, the first of an annual series, draws upon the resources, data bases and feelings for the industry developed by the SAI/RAC staff. This year we intend to focus heavily on two of the most exciting new developments in the field of factory automation. These are CAD/CAM and Robotics. Going further we identify the CAD/CAM to Robotics link as a heavy growth area, and coin a new term, CAR- computer aided robotics for this. We will examine the business posture, opportunities, and strategies possible in the factory automation arena.

1.5 Sources of Data, Assumptions, and Limitations

The SAI/RAC has at its disposal extensive data on all aspects of factory automations. These include U.S. government statistics, periodicals, private studies and surveys, as well as staff expertise. Nevertheless there is an important filtering function that takes place as the pieces of the puzzle are put together. This judgement factor includes our opinions, experience gained from visits to factories, corporate offices, and research labs worldwide, and a sensitivity to the industry gained over

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*See for example the SAI/RAC recent study on Japan: "Productivity, Automation, and Robotics Lessons from the Japanese Experience,", T. M. Knasel and J. Gerber, October 1981.

years of involvement. The basic assumptions are that American business leaders will recognize the need for automation and the market will be driven by this need. Technical specifications, delivery times and after-sales support will influence choice of vendors within the larger market thrust. The reader should be cautioned that the data will be extrapolated over large time periods, and in a growing field such as this numerous uncertainties can be anticipated.

2. EIGHT-YEAR SALES PROJECTIONS IN THE FACTORY AUTOMATION FIELD

2.1 Sales Environment

U.S. manufacturing productivity, though the highest in the world, is not growing. Long-term average annual growth of 4 to 5 percent in the 1950's and 1960's fell to 2 to 3 percent in the 1970's. In the late 1970's and early 1980's, growth fell even further and in some recent quarters has been negative (i.e., in decline). The 1973 "oil shock" and subsequent worldwide recession contributed. In the U.S. our increasing requirements for health and safety equipment, general public resistance to plant expansion, etc., also contributed. The age of the capital equipment stock in the U.S. is reaching nearly 50 years, and smaller portions are new equipment than in other industrial nations. U.S. plant use as a percent of capacity normally in the mid-80 percent range is now closer to 75 percent as we enter a second recessionary period since 1973. The recovery from the 1979-80 recession was one of the shortest and most feeble on record. U.S. capital equipment spending as a percent of the GNP is one of the lowest of any industrialized nation, but recent changes in our tax laws are expected to improve this somewhat.

On balance despite a recession almost certainly through 1982, orders from plants for automated equipment should be up substantially. As many vendors enter this technically exciting field competition is expected to be very stiff. Payoff should come with the recovery anticipated in the 1982 to 1983 time frame, as firms "shake out" in the marketplace. As firms utilize strategic business planning effectively to avoid pitfalls and position their products they will succeed.

2.2 Machine Tool Sales

As one key indicator of plant expansion numerical control (NC) machine tool (MT) sales are forecast to increase substantially through 1990. Machine tool sales characteristically follow a 5-year cycle. At the present time we are completing a downswing and anticipating an upswing caused by modernization of the U.S. auto industry (driven by foreign competition) to retool for smaller cars, by increased sales of commercial aircraft and by projections for larger defense spending. The U.S. machine tool industry has nearly $4 billion in annual sales today. The bulk of these sales is in the metal cutting MT area while a smaller amount (15-20 percent) is in metal forming MT. In 1980 numerical control machine tools comprised 31 percent of all MT sales. Their sales are forecast to increase at a 15 percent compound growth rate through this decade. The principal machine tool sales categories are: lathes 25 percent, grinding machines 10 percent and machining centers 10 percent.

The numerical control machine tool market has historically been only a small percent of all machine tool sales for several reasons. The NC tools require complicated programming resulting in a paper tape program that is relatively difficult to use, and subject to problems when read repeatedly for each program cycle. The tools are exprensive, and due to their capabilities and speed can saturate the ability of a shop to use them efficiently. Programming, loading and unloading of work and switching between jobs can be a major contributor to lost cutting time. Computer numerical control (CNC) tools are easier to program, and use instructions stored in a memory rather than repetitive use of paper tape. Sales of this newer type have largely replaced straight NC machine tools. Direct (computer) numerical control (DNC) tools offer computer to computer transfer of data and instructions and more flexibility. Because the computer capability of modern tools is obtained through microelectronics the costs of newer and more capable tools do not necessarily increase proportionally to their true worth. DNC tools allow more efficient shop utilization. The latest trends are for introduction of parts data from CAD data bases, and the use of robots to load and unload the work. These features will increase time available for machine tool cutting. Thus the value of the tool will increase perhaps disproportionately to the added cost of these features.

The leading American machine tool vendors and their approximate share of the market are ranked as follows. Cincinnatic Milacron, about 15 percent; Cross and Trecker, Warner and Swasy, and Ex-Cell-O total, about 30 percent; below these are Acme- Cleveland, Giddings and Lewis, Litton, Houndaille, Textron White, Gleason and Bendix averaging about 3 to 5 percent of the market each.

The industry is characterized by its stability and lack of rapid innovation. The firms are all well-established. Cross and Trecker, a recent merger of Cross with Kearney and Trecker, is the only new name in the line-up.

Foreign competition in the NC area comes from Toshiba and Fujitsu Fanuc of Japan, Siemens of Germany, and other foreign firms. At present we have only limited data available on further details of foreign competition.

2.3 CAD/CAM Service Sales

The sale of CAD/CAM for use in the design and manufacture of goods is one of the boom industries of the late 1970's and 1980's. As a part of total factory automation, CAD/CAM can allow a firm greater accuracy and control in design, and manufacturing with much higher productivity. Presently sales of CAD/CAM equipment and services are estimated at about $500M annually, or about 10 percent of the total machine tool sales base but not distinguished between CAD/CAM for product design and/or manufacturing; CAD for architecture engineering and construction (AEC), mapping and earth sciences (MES), utilities and services, or other applications. Precedents in other industries would allow increases projected to 20 or 30 percent levels on top of an increasing base of machine tool sales. CAD/CAM is a rapidly evolving market, with many new entries, and much jockeying for position.

According to a recent survey by Auther D. Little, Inc., the industry predicts CAD applications will continue a worldwide growth rate of 25 percent to 1984 with sales going from $590 million in 1979 to more than $2 billion in 1984. The CAM side of the market is projected to will increase by 10 percent through 1984. International Data Corporations projections for US installations are a 42 percent growth in 1981 and

a 44 percent growth in 1984. Merrill Lynch's 1980-1984 growth rates by manufacturing category indicate 40 to 60% growth through 1984.

According to Input, a Palo Alto-based market research firm, the area of greatest activity will continue to be in the mechanical area, which is projected to increase from a 45 percent share of the 1980 market to a 51 percent share of the 1986 market. Other estimates of percent of the worldwide market by manufacturing category are listed in the following table, Exhibit 3.

2.4 Robot Sales

Sales of industrial robots in the U.S. in 1980 totaled about $100M. The leading U.S. firm, Unimation (a division of the CONDEC Corporation), has estimated sales of about $40M. The next rank of firms include Cincinnati Milacron $30M, DeVilbiss $10M (division of Champion Spark Plug), ASEA-US $7.5M, Prab Conveyors, Inc. $6M and Auto-Place $4.5M. The leading robot producers are thus typically divisions of much larger and broader based corporations.

Sales of industrial robots are expected to grow very rapidly in the U.S., Europe and, especially, Japan. U.S. sales should grow to over $1B by the end of this decade, while worldwide sales could top $5B annually. These growth rates will mean that in ten years there could be over 1 million industrial robots worldwide, most of them requiring programming for new tasks and assignments.

Although estimates of 1981 sales of $150M, and 1982 sales of $220M are available, these should be approached with caution. The current recession and cutbacks at auto producers may reduce the short term potential. There is unresolved worker resistance to the robot in the U.S. and elsewhere. U.S. unused plant capacity is high and unemployment is also high. U.S. robot production is being strained to fill orders now and skilled engineers for installation are hard to find. Mediating these trends is the overall well recognized need to improve plant, as well as a long-term shortage of skilled machinists. Both of these trends argue for increased use of robots. The Japanese experience of robots leading to upgraded worker roles and increased production without layoffs suggests that worker resistance can be overcome.

Exhibit 3

Sales Breakdown and Sales Growth Projections for the CAD/CAM Industry

CAD/CAM APPLICATION AREA	1980 SALES IN $ MILLIONS	SALES IN %	YEAR	TOTAL CAD/CAM SALES	ANNUAL GROWTH %
Mechanical	200	39	1980	515	65
Electrical	150	29	1981	765	50
Civil	75	14	1984	2200	44
Cartography	70	14	1986	5800	60
Other	20	4			
TOTAL	515	100			

*Data Sources:

Auther D. Little
Frost and Sullivan
Merrill Lynch
Input Corp.
SAI Estimates

2.5 The CAD/CAM/Robot Sales Forecast

Several firms have already identified the marriage of CAD/CAM with robots as the new growth industry of the 1980's. Though sales currently are under $1M, mostly to U.S. government agencies in the form of advanced RμD, many firms are testing the water.

Perhaps the leading firm in this area is MCAUTO, using their strength developed over a 3-year USAF ICAM (Integrated CAM) project. MCAUTO has developed a special programming language MCL (machine control language) and demonstrated program control over a Cincinnati T3 robot performing sheet metal riveting operations. MCAUTO displayed this capability via video tapes at the 1980 AUTOFACT II show.

The leading firm in CAD/CAM sales, Computervision (CV) followed at the 1981 show (AUTOFACT III) by demonstrating CAD/CAM off line programming for a Unimation PUMA robot, on the show floor. The CV display was of an automated manufacturing cell with a CAD system integrated also to a Pratt and Whitney machine tool and a Bendix coordinate measuring system. Also at this same show Automatix demonstrated CAD/CAM welding programming via a Computervision terminal. Automatix was formed by several former Computervision executives and is currently being sued by CV. Automatix would seem to be applying CAD/CAM technology, along with automated visual inspection to the robotic area. The eventual tie into CV may be a strong one historically but CV's recent legal action may destroy the relationship. GE also displayed robots at this show but not explicitly tied to any CALMA/GE CAD/CAM software.

GCA Corporation, a manufacturer of automated equipment for the semiconductor industry, has recently acquired a firm making nuclear hot cell manipulation controls--PaR of Red Wing, Minn., and hired a team of outside managers including Dennis Wisnosky of ICAM and Margaret Eastwood of McDonnell Douglas Aeronautics. Other firms known to be active in CAD/CAM for robots include IBM, Emhart Corp. and Westinghouse.

IBM is about to enter the robot market. Their first cartesian gantry assembly robots have been shipped. It is likely that this will be interfaced with CAD/CAM software but no details are presently available.

Worcester Polytechnic Institute, (WPI) through a tie with Emhart Corp (part of United Technologies) that includes both funding and staff assigned to WPI is investigating CAD control of robots. A Computervision CAD terminal has been selected for research in optimal paths for robot arm and subsequent off-line programming.

Westinghouse Corporation has made what may be the largest corporate commitment of any U.S. firm to factory automation. One aspect of this is a 7 million dollar Air Force TECH + MOD project that among other things calls for Westinghouse to integrate CAD/CAM with robotic work stations. Computervision has been selected as a partner in this work.

3. AUTOMATION USER INDUSTRY PROFILES

3.1 Factory Automation and Robots

Users of factory automation equipment range from small contract machine shops to the largest aerospace and automotive shops. Machinery manufacturers, except electrical, are the largest users of NC and CNC equipment with about 58 percent of the total installed machines in 1980. Work done by this group can be described as small to medium lot production of castings, bars, mill shapes and plate. Most of the companies have fewer than 1000 employees and some of the small shops started in business by purchasing only NC machines, primarily lathes, machining centers, boring and drilling machines and grinders.

The transportation equipment industry utilizes 18 percent of the total installed machines and of this, 82 percent are used by the aircraft industry, the original users of NC technology to produce their complex parts. Motor vehicle and car body manufacturers have a surprisingly low percentage of this segment, only 2 percent.

Fabricated metal product companies use about 10 percent of the total installed NC machines, primarily punch presses, and the electric and electronic equipment producers use approximately 8 percent of the total installed machines.

The primary users of robots are the automotive industry, electrical machinery manufacturers, metal fabricators, primary metals companies and heavy machinery manufacturers. The number one reason for using robots is to reduce labor costs. Those blue collar workers most likely to be replaced perform hand labor in batch manufacturing, production volume manufacturing and warehousing facilities. These details are summarized in Exhibit 4.

Exhibit 4

Robot Market Share by Selected Industries*

	1981	1985
Electrical Machinery	23.9%	37.4%
Fabricated Metals	15.2	15.3
Primary Metals	13.9	0.7
Automotive	12.3	12.3
Heavy Machinery	10.8	2.9
Electronics	6.8	16.0
Other	17.1	15.4

*Source: Frost and Sullivan

4. EQUIPMENT/SOFTWARE VENDOR PROFILES

4.1 CAD/CAM Vendors

Major suppliers of CAD/CAM systems are Computervision with 35 percent of the 1980 market, Applicon and Calma each with 14 percent, Auto-trol Tech and M&S Computing each with 10 percent, IBM with 5 percent, and Gerber Systems Technology with 4 percent.

Computervision of Bedford, Mass., the industry leader, was founded in 1969. It began European operations in 1975. Today Computervision dominates both the overseas and US markets. Their 1980 sales were approximately $180 million, and their stock is traded on the New York Stock Exchange. Subsidiaries are located in Britain, West Germany, France, Italy, Belgium, The Netherlands, Sweden, Spain, Japan and Australia.

Computervision uses a Designer V system with applications in mechanical design and drafting, printed circuit design, integrated circuit design, cartography, piping design and analysis, structural design and analysis, and wiring diagrams. The system uses Fortran, APL, Strudel and other industry-standard languages and is priced at approximately $300,000 (application data and prices from Computerworld, April 1981).

Applicon, is considred the stongest challenger to Computervision's first place overseas position. Applicon's recent agreement with Structural Dynamic Research Corp. (SDRC) of Milford, Ohio, is projected as a plus in increasing overseas sales. About 25 percent of SRDC's business is overseas, with clients incuding Rolls-Royce, Volkswagen, Volvo and British Aerospace. SDRC is acknowledged as the foremost designer of software for mechanical engineering applications of CAD/CAM. Applicon's 1980 sales were $73 million.

Applicon uses an Application Graphics System (AGS) with applications in mechanical enginering and manufacturing, architectural design, printed circuit board design, integrated circuit design and mechanical design. The system uses Fortran IV Plus and Basic and is priced at $300,000 to $325,000 for a four-terminal system (depending on processor).

Calma, based in Santa Clara, California, had sales of $70 million in 1980 and was recently acquired by GE. They market several systems depending on their user's demands: DDM for design drafting and manufacturing; CHIPS for integrated circuit and VSLI design; and CARDS for printed circuit boards. Applicon areas include mechanical design, finite element analysis, parts nesting, printed circuit board design, wiring and piping design. All of their systems use Fortran V and are priced in the $200,000 to $700,000 range.

Auto-trol Technology, with 10 percent of the 1980 market, had sales of $50 million. Based in Denver, Auto-trol has subsidiaries in West Germany, France and Italy and distributors in Japan, Australia, Britain, Norway and The Netherlands. Auto-trol uses an AD/380 system with applications in manufacturing and mechanical design, architectural engineering,, the petrochemical industry, facilities management and space planning. Their system uses Fortran, RPG-III and Cobol and is priced from $150,000 (for a small system with limited applications) and up.

4.2 ROBOTICS VENDORS

Projected U..S. robot sales could reach $438 million by 1985 and Western European sales could be as high as $106 million by 1985. Leaders in the manufacturing and marketing of robots are Unimation with an estimated 35 percent of the 1981 market share and Cincinnati Milacron with an estimated 30 percent. Other companies include Devilbiss, ASEA, Prab and Auto-Place.

Unimation, Inc. is a subsidiary of the Condec Corp. which recently announced that 20 percent of Unimation's stock would be sold to the public. That sale in late November 1981 was at about 50 times earnings. Cash-poor Condec had been looking for a way to raise capital for Unimation's growth for some time. Since 1966, Unimation pioneered in robot development and manufacturing. Unimation sells several Unimate, Apprentice and PUMA models with capabilities in machine loading and unloading, material transfer, arc welding, spot welding, die casting, small parts handling and assembly, forging and heavy material transfer. Prices range from $27,000 to $80,000.

Cincinnati Milacron is the U.S.'s largest machine tool builder. They introduced their first robot in 1974. Models today include th T-3, HT-3 and T3R3 which are capable of spot welding, arc welding, loading and unloading, palletizing, parts handling and spraying. Prices range from 64,800 to $130,000.

DeVilbiss, a subsidiary of Champion Sparkplug, is an industrial spray equipment manufacturer. They entered the robot marketplace in 1975 when they reached an agreement with Trallfa, a Norwegian manufacturer, to distribute their continuous path

robot in the U.S. DeVilbiss's Trallfa model is capable of spraying, painting, coating, sandblasting and flame spraying and is priced at $100,000.

ASEA is a Swedish firm which manufacturers the IRb-6 and the IRb-60 robots. These models are capable of deburring, arc welding, loading and unloading, spray painting, grinding, drilling, routing and polishing. They are priced from $83,000 to $150,000.

Prab Robot (a division of Prab Conveyors, Inc.) located in Kalamazoo, Michigan, is now available over-the-counter. They market several models of Praba and Versatran robots which are capable of die casting, materials handling, injection molding, forging, loading and unloading, investment casting, multiple parts handling and spot welding. Their robots are priced at $22,000 to $32,000 for Prab models and $40,000 to $150,000 for Versatran models. Prab recently went public (fall 1981) and is currently traded to about 16 bid on the OTC.

Auto-Place, located in Troy, Michigan, manufacturers robots to handle small loads of 5 to 30 pounds. They market the AP-10 and the AP-50 which are capable of pick and place, assemble, loading and unloading and parts transfer. The AP-10 is priced at $14,600 and the AP-50 at $20,000.

There are numerous other companies emerging into the robot marketplace: IBM, and GE have major prospects directed toward product introduction. Other major firms such as Texas Instruments and Hewlett Packhard are exploring the waters. Many small companies have been recently formed with robotic equipment or accessories as their chief product.

5. SUMMARY AND RECOMMENDATIONS

Although we wish to be cautionary about the near term prospects over the next few years, the factory automation industry, loosly defined as NC machine tools, CAD/CAM, and robots will boom. The boom will be fueled by a need to regain productivity growth, to replace obsolete capital stock, and to counter foreign

competition. The anticipated business expansion of the 1983 to 84 time frame should be a good one for the factory automation group. While sales of conventional machine tools may remain relatively static, NC tools, and the other components needed to integrate an entire factory: CAD/CAM, robots, automated warehousing, driverless delivery vehicles and the like will do well.

In the context of ever new capabilities, factory automation will derive more benefit from existing production equipment, allowing sales on services such as CAD/CAM, or accessories, such as robots to leapfrog basic equipment sales. The role of the system integrator will be a key one in developing the plans for the best use of new and existing equipment. The integrator will tackle the interface issues - end of robot arm tooling, signal interface circuits for controllers, special purpose sensors, and other special equipment, as well as choosing the best vendors and subcontractors for factory automation tasks. Tasks that address the system integration problem, such as CAD/CAM programming of robots, or computer assisted robotics, CAR, should have a bright future, and multi million dollar per year sales potentials.

The executive challenges are to make the optimum deliberate strategic decisions on robotics. The evidence is too strong to permit a wait-and-see attitude. The alternatives of participation or leadership can be approached through concentration on one aspect of the growth field, vertical integration with internal growth, joint ventures, merges, acquisitions, or tailored combinations of the above. The complexities of market prediction are compounded by the inflationary and high interest pressures for return on investment. Some decisions may truly "bet the company" on the results of assessments of the individual company's situation and opportunities.