DOCUMENT RESUME

ED 286 322 EC 200 501

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TITLE Employment Opportunities for the Handicapped in Programmable Automation.
PUB DATE 85
NOTE 6p.; In: Discovery '84: Technology for Disabled Persons. Conference Papers (Chicago, Illinois, October 1-3, 1984); see EC 200 494.
PUB TYPE Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Automation; *Computers; *Employment Opportunities; Man Machine Systems; *Manufacturing; Physical Disabilities; *Programing; *Severe Disabilities; Technological Advancement
IDENTIFIERS *Computer Integrated Manufacturing

ABSTRACT

A Computer Integrated Manufacturing System may make it possible for severely disabled people to custom design, machine, and manufacture either wood or metal parts. Programmable automation merges computer aided design, computer aided manufacturing, computer aided engineering, and computer integrated manufacturing systems with automated production techniques such as robotics and computer inventory retrieval systems. The employment outlook for programmable automation is mixed, but education requirements would include a strong foundation in analytical and problem solving skills. The working environment will become more accessible as a prerequisite to automation. Robotics is not likely to be a promising field for rehabilitation trainees with physical disabilities. Computer Integrated Manufacturing Systems will have great effects on rehabilitation engineering. (CL)

EMPLOYMENT OPPORTUNITIES FOR THE HANDICAPPED IN PROGRAMMABLE AUTOMATION

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ABSTRACT

The possible uses of numerical controls interfaced with computers include the opening of employment windows for persons with severe disabilities. Areas that show promise are computer aided design, computer aided manufacturing, computer aided engineering, computer integrated manufacturing systems, and programable automation. Numerical control systems are described and their occupational outlook examined. The potential of these employment areas to be filled by a workforce of persons with severe disabilities is great, but educational steps must be quickly taken.

Ben Cey, a bright 22 year old exmachinist from Flint, Michigan, came to Michigan's State Technical Institute and Rehabilitation Center (STIRC) in 1978 after a diving accident paralyzed him from the neck down.

Ben came from a family of metal working auto makers. His father was a tool and die maker, his brother a welder, and grandfather a retired foreman in a local GM engine plant. After graduating from high school, Ben got a job as a milling machine operator and was paid a higher wage than the 12% of his classmates who went on to college could expect to earn after college graduation.

That was before his accident made his old job unaccessible. Ben's vocational rehabilitation counselor referred him to STIRC for a new program to train the severely handicapped in computer programming. This project was initiated with the assistance of the IBM corporation and the West Michigan Data Processing industry. It appeared to offer great promise for Ben in retraining to become a business application computer programmer.

In spite of good aptitude scores, extensive interviews and much hard work, Ben was failing in his "only chance for a good career." In a termination meeting with the center's staff that included Ben and his parents, it was suggested that perhaps numerical control (NC) programming might be an alternative for Ben to try.

It wasn't very long into this pilot program when it became apparent that a high level quad like Ben could be trained. One of the biggest problems encountered were sketches and drawings. Mouthstick and CP drawings were often unrecognizable. In the meantime, however, the center drafting program was desperately trying to survive technical obsolescence with the introduction of Computer Aided Design (CAD) to the industry. With some special help from the State Rehabilitation Office in Michigan the center acquired four CAD stations with plotters. The addition of these CAD stations also provided an answer to the problem with drawings by students with upper limb physical impairments. The real question: Could a quad be placed? was answered when the AC Spark Plug Company hired Ben as an NC programmer. Since that time, other severely handicapped students have been successfully trained and placed in the manufacturing industry as NC programmers.

A Computer Integrated Manufacturing System (CIMS) that will link two language graphic terminals through a DEC computer to both a N.C. controlled milling machine in the Machine Tool training lab or a three dimensional CNC router in the Cabinetmaking Shop has been purchased and should be installed in 1985. With a CIMS system it is conceivable that a high level quad like Ben could use a mouthstick on a graphic tablet to custom design, machine and manufacture either wood or metal parts from his bed at home. This capability comes at a time when the new "just in time" inventory systems are demanding that suppliers automate into CIMS or evaporate.

NC-CNC-CAD-CAM-CIMS-CAE-PA

"NC" Numerical Control Programming

NC dates from 1951 although it did not become widespread until the middle '60's. Prior to 1951 most machine tools were hand operated/controlled or equipped to make one part automatically, continuously. This type of mass manufacture certainly played an important role in this country's development but required large expenditures for single purpose machines and necessitated long production runs and large inventories. Henry Ford's Model T comes immediately to mind - all identical, made for years.

As in common with most new processes it was originally believed NC would quickly "take over" and relegate conventional machine tools to the scrap yard. However, many of the new NC controls were difficult to program, broke down, and were difficult to repair as they required a service person well versed in electronics-hydraulics and mechanics. The need for this type of service person still plagues the industry.

Programs for early NC machine tool controls were developed manually. Lengthy mathematical computations and complicated geometry/trigonometry sketches/mechanical drawings were the order of the day.

Computer Aided NC Programming moved out of the laboratory testing environment and into manufacturing about 1964. In common with NC's beginnings, early attempts at Computer Aided NC programming were troublesome, frustrating and costly. Many languages were promulgated, virtually every machine tool or control manufacturer had a proprietary language, usually they ran only the owners brand of machine tool or control.

In order to program a shop full of various makes and types of machines, management was saddled with five or six languages; costly and cumbersome at best, this was often a nightmare.

In the early 70's languages that would operate a wide variety of machine tools became available. Again, many were offered but few survived.

NC languages are generally identified/classified by the number of axes they will control. General manufacturers use 2 to 3 axes while sophisticated aerospace-defense industries use as many as eight. There are only three general, axes length-width-height, but any tool or part inclination/rotation is considered axis.

"CNC" Computer Numerical Control

A CNC control basically is a standard NC control:
1. Equipped with a keyboard so that programs can be entered or modified and,
2. Equipped with a memory to store programs or routines, and,
3. With several computational functions built into the control.

It is "smart" control, if you will. Most CNC applications are in small shops that do not have a programming department nor access to a computer. CNC controls are not as capable as Computer Aided NC Programming but they are Better than manual machine operation and considerably less costly than Computer Aided NC programming either time shared or in-house.

"CAD" Computer Aided Design

This is the creation of manufacturing drawings by use of CRT keyboard light pen and plotter. It replaces drawings done by a draftsman. Systems range from those capable of only simple drawings to those with analytical design abilities capable of lengthy mathematical computations.

CAD/CAM, CAE, CIMS

These attempt to merge design drawing, and engineering areas with NC programming. Basically they create the NC programs at the same time that the drawing is created.

CAD-Computer Aided Design
CAM-Computer Aided Manufacturing
CAE-Computer Aided Engineering
CIMS-Computer Integrated Manufacturing System

PA-Programmable Automation merges CAD, CAM, CAE, CIMS with automated production techniques such as robotics and computer inventory retrieval systems.

"NC" Programmers

NC Programmers are generally classified by:
1. Machine tool, lathe, mill
2. The number of axes they can program. A two axes programmer earns about $16,000 to $20,000 and seven axis aerospace programmers about $50,000 to $60,000.

The level the STIRC program provides training for is a 2-3 axes, mill program. The level of mathematics needed increases dramatically as the programmer level increases.

Employment Outlook for PA

In a recent study conducted by the congressional Office of Technology Assessment, the net change in national employment caused by programmed automation "will not be major in the 1990's, it will however have some definite effects on some individuals (like the handicapped) and some regions (such as the Midwest).

The study indicates that the potential long term impact of programmable automation on the number and kinds of jobs available is enormous. However, the Office of Technology Assessment expects that job creation by PA producers to be less than the job loss. This is also supported in a study by Tim and Allan Hunt of the W. E. Upjohn Institute for Employment Research in Robotics. The Hunts' also expect a skill twist; highly trained engineers, programmers, technicians and repairpersons will be in demand as replacements for relatively untrained operators.

So, while P.A. will create new accessible career opportunities for some well trained physically handicapped persons, like Ben, it can expect to bring to light many more learning disabled persons whose problems would not have surfaced in the days of high paid assembly work.

Education

According to the U.S. Bureau of Labor Statistics, 21% of all American workers are still involved in manufacturing (28% in Midwest), thus, production automation can continue to be counted on as a force to reshape American education.

It demands a strong foundation of basic skills to build analytical and problem solving skills. These skill changes indicate the need for effective education and career guidance services for youth and adults to head in the right direction.

Working Environment

While telecommuting (working via terminal at home), is possible, it is not likely to be widespread for a variety of social, management, and traditional reasons. The overall working environment will become more accessible as a prerequisite to automation and less physically hazardous, thus, less work related physical disabilities should occur. There is some concern expressed in the OTA report that relegating the craftsman's skill to an "error free machine" may result in the increase of psychological hazards for some workers. The lack of trained PA workers may affect the rate of growth in PA application. Much more on-the-job training and retraining can be expected to occur on the factory floors.

Sheltered workshops can also expect to feel the impact. At Goodwill Industries in Kalamazoo, Michigan, a CNC router turns out wood parts two shifts a day for the assembly of a variety of high quality products such as wood wheeled, back rollers and computer furniture. These products can also provide increase in self-esteem to the sheltered workshop participants over printed circuit board assembly and/or subassemblies. These high quality products can provide the workshop with profitable return investment that may be used, eventually, for higher wages for workshop employees.

Robotics

Robotics is currently generating a great deal of attention. Very little information is available to assist the vocational rehabilitation/special education community in counseling educators and students for these training programs. How big will robotics be? How quickly will it grow? What occupations will be created? Will unemployment dramatically increase because of robots? Are we training workers whose skills will become obsolete? Does robotics make a good "fit" with handicapped workers? Such questions were addressed in the Hunt study.

In a trade off between job placement and job creation, jobs are semi-skilled and unskilled. The skilled jobs created requires significant technical background. This supports the notion that the future labor market will demand greater skills from workers.

Quite surprising is the presently modest size of the robotics industry. U.S. robot population has been placed at 7,000. Some of the most sophisticated capabilities attributed to robots are not yet in widespread use. Often robots are used with existing automated production equipment.

According to the Hunt study, there is no question that many robotic technicians will be employed. However, most of these technicians will be retrained by the auto industry; little outside hiring is expected. Thus, only a small number of robotic technicians were used in other industries before 1990. An oversupply of robotic technicians because of high student interest is a real area of concern. After all, the function of robots is to eliminate human labor, not increase it.

In examining the robotic positions available, the National Industrial Center for Handicapped Employment (NICHE) reported that changing the motors, gears, and arms of a robot would not make a good vocational fit for most physically handicapped persons. Thus, rehabilitation trainees should avoid embracing this occupation.

Rehabilitation Engineering

With the new CIMS it is possible for a rehabilitation engineer to design and manufacture one-of-a-kind adaptive devices for storage in a data base memory. They could be transferred or changed for similar problems at a later date. It also provides an opportunity for limited production runs that are quick, easy, and cheap, even for small numbers of handicapped persons needing non-mass market devices. This eliminates the need for inventories of such devices; they can now be made when needed.

Summary

The opportunities and challenges of programmable automation are great for handicapped persons, but their future and ours lies in field awareness. It is hoped that this program is a start in that direction.

REFERENCES

Congressional Office of Technology Assessment, Computerized Manufacturing Automation: Employment Education and the Workplace, U.S. Government Printing Office #052-003-00949-8.

Corrigan, Richard. "Choosing winners and losers," National Journal Special Reports: High Technology Public Policies for the 1980's.

Education Commission of the States (1982). "Education for a high technology economy," National Governors' Association Annual Meeting, August 8-10, Afton, Oklahoma.

Feingold, S. Norman and Miller, Norma Reno. Emerging careers: New occupations for the year 2000 and beyond, Garrett Park Press, Vol. 1.

Gates, Max. (1982). "Robotics no panacea industry officials say," The Grand Rapids Press, March 14, p. 20.

Gottlieg, Daniel. (1983). "High technology training surges," High Technology, Vol. 3, No. 10, p. 70-73.

Hunt, H. Allan and Timothy L. Robotics: Human resource implications for Michigan. The W.E. Upjohn Institute for Research.

Levin, Henry M. and Rumsberger, Russell W. (1983). The educational implications of high technology, Institute for Research and Educational Finance and Governance, Stanford University, Project Report No. 83-AY, February.

Levin, Henry M. and Rumsberger, Russell W. "High technology potential for creating jobs may be exaggerated," The Washington Post.

Long, James P. and Warmbrod, Catharine P. Preparing for high technology: A guide for community colleges, The National Center for Research in Vocational Education, The Ohio State University, Research and Development Series No. 231.

Maxwell, G.W., West, Linda Naires. (1980). Handbook for developing competency-based curriculum for new and emerging occupations: A handbook for California vocational education.

Nisbitt, John (1983). "The new economic and political order of the 1980's. People's Business, Vol. 8, No. 9, September.

Nelson, Bryce. (1983). "Computers: Worker menace? The New York Times, September 4.

Nicholson, Tom, Fineman, Howard and Ruiz, Rick (1982). Growth industries for the future, October 18, p. 83.