



# CAD/CAM



July 1985

Information Compiled by the CAD/CAM Technology Advancement Council\*

## Summary of this Issue

- 1 - Fourth Canadian CAD/CAM and Robotics Conference and Exhibition
- 2 - CAD/CAM News Events
- 3 - Book Reviews
- 4 - Video Tape Course on Interactive Graphics
- 5 - CAD/CAM Articles of Recent Interest
- 6 - CAD/CAM Information Available
- 7 - CAD/CAM Conferences, Exhibitions, Workshops and Seminars
- 8 - Twenty CAD/CAM Abstracts Selected from World Literature (attached)
- 9 - Recent CAD/CAM Quotes

### 1. June 1985 CAD/CAM and Robotics Conference and Exhibition

As in other years, the 4th Canadian CAD/CAM and Robotics Conference and Exhibition, held June 18-20 in Toronto, was a major event in the Canadian CAD/CAM scene. Companies wishing to evaluate these technologies, and develop strategic implementation plans for themselves are urged to send representatives to this annual event which resembles the larger U.S.A. AUTOFACT conference and exhibition in many ways.

Keynote speakers at the morning and luncheon sessions drew attention to the importance of maintaining a competitive position for the Canadian manufacturing industry, and expressed concern over trade and other statistics which indicate a falling behind or weakening position. Canada lags in the adoption and application of new technology by as much as nine years behind its worldwide competitors, L. Thibault, President of the Canadian Manufacturers' Association said. He also advised attendees that the CMA is planning, with the help of the federal government, the establishment of a National Manufacturing Technology Information Centre, which will complement existing technology centres and fill identified gaps in the information market place.

Details concerning the exhibiting companies and their products are contained in the June 1985 issue of "CAD/CAM and Robotics" publication. The conference proceedings containing most conference papers are available, as noted below, from the Canadian Institute of Metalworking for \$50 plus postage or shipping charges.

As is common in nearly all technical conferences, while the proceedings are available, and at nominal cost, there is no substitute for being there when that is possible. Speakers frequently include additional slides, photographs or comments in their presentation, which augment the published paper in many useful ways.

A few selected papers are summarized below as an indication of the conference and proceedings content.

- "The Develop of a Flexible Robotic Welding Cell" - Dr. D. Bonham

Describes a project undertaken by the New Brunswick Manufacturing Technology Centre to design a work cell for the welding of a large production volume, complex, gear housing. The project, undertaken for a small but progressive New Brunswick manufacturing firm employing less than 200 people, represents an ideal case study for development and transfer of small scale flexible manufacturing technology. Realistic evaluation revealed that oil tight welds could be produced but modifications involving fixtures, pre-welding fit up of the parts and water cooling of the welding gun would be required in a second project phase.

- "Experiences in Installing a Computervision Designer V-X CAD/CAM System"  
- B. Patel

Difficulties and successes experienced during the installation in 1984 of a Computervision Designer V-X CAD/CAM System at the Westinghouse Canada, Inc. turbine and generator facility in Hamilton are described. The paper may be useful to other potential CAD/CAM system users due to the frank and open description presented, particularly with regard to system configuration, delivery, installation, and operating considerations.

- "Attitudes Towards Automation: A Comparison of Small and Large Manufacturers" - R.G. Craig and H. Noori

Observations are reported from two studies of Ontario manufacturers; one in 1981 involving a sample of 312 firms and a second in 1984 involving a sample of 514 firms. Canadian manufacturers are believed to have fallen behind in adopting advanced manufacturing technology. Differences between large and small business were given special study because small business traditionally lags big business in the adoption of new technologies. Both rely heavily on trade magazines, technical magazines, newsletters and similar media for information on new technologies, but large firms are much more likely to utilize formal feasibility studies and visits for evaluation while small firms rely more on discussion with colleagues. Both see finance as a major barrier to automation. A need is also seen for improved information services.

- "The Development of a Generic Job Shop Schedule and Shop Modeller" -  
V. Thomson, J. Neelamkavil

Authors from the National Research Council describe a software system that has been developed, and which will be available as a software package for scheduling in manufacturing job shops following evaluation in a manufacturing cell at NRC and Beta site testing at two industrial locations. Schedules can be built using various criteria such as; jobs finished according to due dates, minimization of work in progress (WIP) inventory, maximum throughput or minimization of setup time. The system includes a modeller to simulate and verify the schedule, to permit interactive modification, to identify potential trouble spots or respond to machine breakdowns.

Proceedings of the conference containing 47 papers are available as noted above for \$50 plus postage or shipping charges.

Contact: Canadian Institute of Metalworking  
1276 Sandhill Drive  
P.O. Box 7317  
ANCASTER, Ontario L9G 3N6  
Telephone: (416) 648-5011

2. CAD/CAM News Events

- A recent note (Robotics World, May 1985) advises that General Motors Corporation has ordered more than 425 automated guided vehicles, valued in excess of \$20 million, for the light truck assembly plant in Oshawa.
- An article (Globe & Mail, July 10, 1985) tabulates Statscan data for inventory to shipment ratios in eight different industry sectors from 1983 to 1985. The pronounced decrease in the ratio for transport equipment is attributed to the increasing use of "Just In Time" scheduling and inventory control techniques. Use of this technique by GM Canada, who currently have 70 of 178 key suppliers hooked into the system, is described.

3. Book Reviews

As readers of the CAD/CAM Newsletter are aware, the number of books dealing with this subject has begun to increase dramatically. The March 1985 Newsletter listed over one hundred titles, more than half of which were newly published within the preceding year.

At a recent meeting of the CAD/CAM Technology Advancement Council it was agreed that it would be highly desirable to include reviews in the newsletter of the books available in this field, in addition to the listings and description previously provided to readers. Many of the council members themselves are capable of acting as competent reviewers and have indicated a willingness to undertake this activity. We are confident that additional reviewers can be found from the newsletter readers and others, as may be required, providing copies of the newest or best known books are made available to them.

Readers interested to participate as reviewers are invited to contact the newsletter editor (see page 14). Book publishers have been contacted, and depending on the availability of appropriate books, participating reviewers might be requested to review one or two books per year, supplied to them for the purpose. In view of each reviewers contribution, which would be on a voluntary basis, it is expected that arrangements will permit the reviewer to keep the copy of the book provided on a complimentary basis.

Based on the books listed in the March Newsletter it is expected that most books to be reviewed would fall into the following subject categories. Readers contacting the editor regarding participation in this activity are requested to indicate on a copy of this list, those categories which match their interest and expertise.

- General books and texts on CAD/CAM or Computer Integrated Manufacturing (CIM)
- Manufacturing Productivity (from the technology point of view)
- Manufacturing Automation
- CAD/CAM and Graphics
- Data Bases for CAD/CAM and Manufacturing
- Group Technology
- Factory Networks and Communications
- Numerical Control
- Flexible Manufacturing Systems
- Robotics
- Automated Guided Vehicle Systems
- Sensors and Machine Vision
- Automated Testing

#### 4. Video Tape Course on Interactive Graphics

A video tape course on interactive graphics has been announced by the University of Massachusetts who are members of the Association for Media-Based Continuing Education for Engineers, Inc. (AMCEE), a non-profit consortium of engineering universities, with headquarters on the campus of the Georgia Institute of Technology, Atlanta, GA.

The course consists of thirteen colour video cassettes plus a study guide and text book (Fundamentals of Interactive Computer Graphics by J. Foley and A. Van Dam, Addison-Wesley 1982, 680 pp.)

Prices for the course are \$4810 (U.S.) for complete purchase, \$1625 (U.S.) for a thirteen week rental or \$125 for a two week preview package containing one video cassette, study guide and text.

For detailed information,

Contact: AMCEE Dept. 84-0585  
225 North Avenue, NW  
ATLANTA, Georgia 30332, U.S.A.  
Telephone: (404) 894-3362

5. CAD/CAM Articles of Recent Interest

- "Industrial Robots - A Strategic Forecast Using the Technological Delivery System Approach" - A. Porter, F. Rossini, et al. IEEE Transactions on Systems, Man and Cybernetics, July/August 1985, pp. 521-527.

Five authors with the Georgia Institute of Technology presented an analysis of robot types, factors influencing their application, labour displacement effects and possible social impacts. A useful table for classifying robot types is included. Factors affecting rate of adoption include pressure from foreign competition, political and media influences as well as application economics. Three alternative social impact scenarios for full automation/robotization to the year 2010 are offered, each of which involve widespread industry, government and social restructuring of great magnitude. The outcomes range from a new higher level of civilization and order as one possibility, to widespread social disorder, potential revolution and martial law for control as another.

- "Is Manufacturing Really Shrinking" - A. Ashburn  
American Machinist, April 1985, p. 5.

Editorial presents statistics to indicate that while employment in the manufacturing industry in the U.S.A. has decreased as a percentage of total nonagricultural employment, the value added in manufacturing by all industry as a percentage of GNP has remained almost constant from 29.7% in 1929, 33.7% in the post-war peak of 1955 and 28.4% in 1981. This would suggest that while productivity has increased, manufacturing continues to hold its own as a source of wealth creation.

- "How Robots and Other Automation Change the Nature of the Work Force" - S. Miller, American Machinist, May 1985, pp. 128-131.

The author, from Carnegie-Mellon University, comments on a number of government and other studies concerning how advances in automation may affect the work force. A study by the Office of Technology Assessment (OTA) sees programmable automation (PA) as an important tool not likely to generate significant net national unemployment, although it may exacerbate regional unemployment. A study by Leontif and Duchin provides model based projections to the year 2000 showing continued strong increases in private sector employment, expanding from 89 million in 1978 to 133 million by 1990 even with increasing use of computer based manufacturing automation. Other studies identified emphasize the skills-twist with increasing employment for some occupations such as engineers and reductions for others. Some studies point out that if any changes in worker skill requirements are experienced they will depend more on how management allocates work amongst individuals than on automation per se.

- "Industrial Robot Programming Languages: A Comparative Evaluation"  
W.A. Gruver et al., IEEE Transactions on Systems, Man & Cybernetics, July/August 1984, pp. 565-570.

While simple push-button teach and repeat methods are sufficient for many industrial robot tasks, the use of textual robot programming languages will become increasingly important in the future to facilitate use of sensor data, integration with CAD/CAM systems, off-line programming and other factors. The paper evaluates eight, commercially available, high level robot programming languages. While the eight languages are similar in many respects, differences exist in areas such as the handling of geometry, ability to interface to sensors, and debugging aids. A need is identified for improved ability to interface to factory communication networks.

6. CAD/CAM Information Available

- "CAD/CAM Technology in Canadian Manufacturing: A Study of Constraints, Incentives and Impacts" - W.C. Wedley, R.C. Vergin, 68 pages.

A report, in the series of one hundred reports produced under the Technological Innovation Studies Program of the Department of Regional Industrial Expansion, by two authors from the Faculty of Business Administration, Simon Fraser University.

This study investigates the responses of 285 manufacturers from Ontario and Western Canada regarding their perceptions of CAD/CAM constraints, incentives, and impacts. In addition, the constraint and incentive responses are analyzed for 30 CAD/CAM suppliers and 16 educational institutions. The purpose of the study is to provide background information for the formulation of policies.

Of the 285 responding manufacturers, 25 percent are Present Users of CAD/CAM, 20 percent are Actively Considering its use, 38 percent said they Might Consider its use in the next five years, and 17 percent said they Will Not Consider its use. The users tend to be the larger sized firms, although many small firms also find the technology appropriate. Greater usage occurs in the electrical manufacturing industry, while the apparel, paper, lumber, and miscellaneous manufacturing industries tend to have lower use. In higher-use industries, non-users are more receptive to becoming users themselves. This higher receptivity may be caused by the need to stay competitive or by the existence of role models which a firm can emulate. Probably both forces are causing the higher receptivity.

Those who have adopted CAD/CAM, for the most part, experienced higher productivity, increased sales, moderate to large increases in quality, and shorter lead times. The larger firms tend to decrease employment when adopting CAD/CAM, while the smaller firms expand employment. Amongst non-users, the expectations of impacts are more pessimistic, although still positive. Those Actively Considering CAD/CAM have expectations which are very close to the actual experiences of Present Users.

The most serious constraints seen by Present Users were the unavailability or high cost of capital and an inadequate return on

investment. All respondent groups rated these two constraints as being very serious. Those less inclined to use CAD/CAM, particularly the Will Not Consider category, saw the constraints and barriers to be bigger. Important constraints amongst the non-user groups include managerial inexperience in implementation, high financial risk, difficult integration into the present operations, management's lack of knowledge with CAD/CAM technology, and the unavailability of trained staff. The Might Consider and Will Not Consider groups also felt that there was no immediate need for them to change and that the technology was not yet appropriate for their industry.

Tax incentives for capital investment were judged to be the most desirous incentive. Except for a high rating placed on the training of operators and programmers, the importance of the incentives are in line with the severity of the constraints. The authors would have expected incentives to train managers to have been rated above operator training because management knowledge and experience appeared as a more important constraint.

Small firms reported that they expanded sales and employed more people after adopting CAD/CAM technology. They tend to experience fewer labour problems and achieve easy integration. Larger firms, on the other hand, have more complex manufacturing facilities, more computers, formal personnel systems, and more rigid labour relations. For them, integration is more difficult, but they benefit from higher productivity and increased quality. They generally decrease the size of their work force.

An analysis of leaders vs. laggards in the use of CAD/CAM revealed that the main difference was in their perception of constraints. Laggards see inadequate return on investment, high financial risk, and unavailable or high cost of capital as enormous barriers. These barriers, however, could be just perceptual. Laggards reported that their managerial team was unknowledgeable about CAD/CAM and inexperienced in its implementation. Their perceptions may be a function of their lack of expertise.

The report concludes with a series of recommendations for users, suppliers, unions, educational institutions and lastly for government.

Contact: Office of Industrial Innovation  
Dept. of Regional Industrial Expansion  
235 Queen Street (EOII)  
Ottawa, Ontario K1A 0H5

- "Employment Effects of Technological Change: Some Implications for Education" - K. Newton, Economic Council of Canada, April 1985.

Prepared as a conference address, this paper raises some issues concerning the impact of technological change on the labour market and its implications for the education system, drawing on project work in progress at the Economic Council. Although some "high-tech" industries

have been growing faster than the average 3.1 percent annual growth rate for the whole economy, the high-tech industries only account as yet for 25%, or 900,000 jobs, of overall employment. The five most rapidly growing high-tech industries accounted for only 5% (or 145,245) of all new jobs created in the 1971-81 decade. Debate continues as to exactly what occupational skills will be required in the future, and whether or not the skill content of technology - affected jobs will be enhanced or eroded. To keep up with the rapid rate of change, the challenge for workers is to develop flexibility, adaptability, versatility and "learning how to learn". 25 pages, 15 references.

Contact: Economic Council of Canada  
P.O. Box 527  
333 River Road  
OTTAWA, Ontario  
K1P 5V6

- "Group Technology and Computer-Aided Process Planning"  
D. Harburn, NRC Report No. 24420, 78 pages.

A state-of-the-art tutorial and review of computer-aided process planning (CAPP) systems. An overview of group technology (GT) systems is also included, since many CAPP systems rely on some form of GT classification and coding. Four principal GT systems are described (Optiz, Brisch, Multiclass and Code plus others), followed by descriptions of sixteen specific CAPP systems, including the system CAPP from McAuto and CAM-I; AUTAP, a generative system from Aachen in West Germany; CMPP, XPS-1 and XPS-E all developed at the United Technologies Research Centre; DCLASS from Brigham Young University and others. 93 references. Copies of the report are available from NRC.

Contact: Systems Laboratory, Building M-3  
Division of Mechanical Engineering  
National Research Council Canada  
Montreal Road  
OTTAWA, Ontario, K1A 0R6  
Telephone: (613) 993-9208

- Eight Publications Available from Robotics World

The following eight publications are available from Robotics World as a service to their readers in the U.S.A. and Canada. Add \$2.00 (U.S.) for postage to Canada per book.

- #R101 Robots at Work: This manual describes exactly what a robot is, the various types of robots and their control systems, cost effectiveness, and what applications are now implementing robotics. \$50.00 (U.S.).
- #R102 Robot Vision: The advent of computer technology has made it possible for robots to actually recognize parts. This book tells how vision systems are currently being used and outlines new and innovative applications. \$56.00 (U.S.).

- #R103 Automated Guided Vehicles: Automated guided vehicle systems are a means of further increasing automation. This book is an overview of the applications and economics of AGV's, with details of completed installations. \$59.50 (U.S.).
- #R104 The Design and Operation of FMS: This book gives insight into how to set up a flexible manufacturing system and run it successfully. Computer related technology is covered in-depth along with everything from robotics to human aspects. \$49.50 (U.S.).
- #R105 FMS at Work: An easy flowing insight into what makes an FMS work and what causes the problems and the various solutions to them. Also, examines how to build up the system in stages, introduce hardware and software, and train staff. \$59.50 (U.S.).
- #R106 Machine Vision, The Eyes of Automation: Machine Vision is now being described as one of the most rapidly advancing technologies for the factory of the future. This practical book helps managers understand the benefits of this newly available technology and exploit them for the improvement of their company's profits. \$19.50 (U.S.) (paperback).
- #R107 Programmable Assembly: Carefully and thoughtfully edited by internationally renowned Professor W.B. Heginbotham, this book offers the best selection of 28 papers by the world's leading specialists on the subject of computer vision, applied to Robotics. The first title in the International Trends in Manufacturing Series. \$56.00 (U.S.).
- #R108 Robots, Planning and Implementation: A practical guide for introducing robots into working environments. Written for people who are new to robot technology and who wish for some practical guidance to use robots. Includes defining needs, safety, personnel, finance, and case studies. \$59.50 (U.S.).

Contact: Book Dept.  
Communication Channels, Inc.  
6255 Barfield Rd.  
ATLANTA, GA 30328, U.S.A.

## 7. CAD/CAM Conferences, Exhibitions, Workshops and Seminars

- "Machine Vision in Electronics Manufacturing"  
September 18-20, 1985, Omni International Hotel, Baltimore, MD.

A three day, hands-on clinic sponsored by the Society of Manufacturing Engineers with tutorials, user-round tables, vendor round tables and hands-on sessions using machine vision workstations of ten participating suppliers. Fee \$525 (U.S.) for members of SME and its affiliates, \$595 (U.S.) for non-members.

Contact: Special Programs Dept.  
Society of Manufacturing Engineers  
One SME Drive  
P.O. Box 930  
DEARBORN, MI 48121, U.S.A.  
Telephone: (313) 271-0039

- "Understanding MAP"

September 9, 1985	Anaheim, California, U.S.A.
September 26, 1985	Tacoma, Washington, U.S.A.
October 1, 1985	Toronto, Ontario, Canada
October 3, 1985	Phoenix, Arizona, U.S.A.

A series of one day workshops sponsored by the MAP Users Group of the Society of Manufacturing Engineers (SME) and its Computer and Automated Systems Association (CASA), conducted by Mr. Glenn Yeager who has been closely associated with the development of the Manufacturing Automation Protocol (MAP) and currently with its first complete factory wide implementation for a major automotive manufacturer.

Fee \$160 (U.S.) for members of SME and its affiliates, \$195 (U.S.) for non-members.

Contact: Technical Activities Dept.  
Society of Manufacturing Engineers  
One SME Drive  
P.O. Box 930  
DEARBORN, Michigan 48121, U.S.A.  
Telephone (313) 271-1080

- "The Hands-on Approach to Learning Robotic Applications"  
GMI Engineering & Management Institute, Flint, Michigan, U.S.A.

A set of four separate workshops sponsored by Robotics International of SME in cooperation with the General Motors Institute (GMI) taught by Mechanical Engineering professors of the Institute. Includes robot laboratory sessions. The four workshop topics and dates are:

Integrating Lasers with Robots	September 24 - 26, 1985
Integrating Robots in Assembly	October 29 - 31, 1985
Applying Robots in Materials Handling Systems	November 12 - 14, 1985
Robots in Spray Finishing	December 3 - 5, 1985

Fee \$575 (U.S.) for members of SME and its affiliates, \$645 (U.S.) for non-members.

Contact: Special Programs Dept.  
Society of Manufacturing Engineers  
(as above under the Machine Vision Clinic)

- "Advanced Machining Technology for Cells and FMS"  
February 25-27, 1985, Clarion Hotel, Cincinnati, Ohio.

Call for papers has been issued by the SME for the above conference, with paper titles and abstracts of one hundred words or less due by August 26, 1985. Suggested topics include:

- Cutting tools
- Tool holding devices
- Cutting Fluids
- Deburring
- Fixtures
- Gauging & monitoring
- Tool managemeng
- Machines & control

Contact: Thomas T. Mitchem  
Technical Activities Dept.  
Society of Manufacturing Engineers  
One SME Drive  
P.O. Box 930,  
DEARBORN, MI 48121, U.S.A.  
Telephone: (313) 271-1500 ext.: 358

- "Graphics Interface 86"  
May 26-30, 1986, University of British Columbia, Vancouver, B.C.

Call for papers has been issued for Graphics Interface '86 which is the twelfth Canadian Conference devoted to computer graphics and interactive techniques, and is the oldest regularly scheduled computer graphics conference in North America. Now an annual conference and film festival, Graphics Interface has established a reputation for a high-quality technical program. The 1986 conference will be held in Vancouver 26-30 May 1986 in conjunction with Vision Interface '86 and is sponsored by the Canadian Man-Computer Communications Society.

Contributions are solicited describing research results and applications experience relating to the following areas of computer graphics:

- Graphics and Office Automation
- CAD/CAM
- Computer-Aided Building Design
- Computer Animation
- Videotex
- Graphics and the Arts
- Computer Cartography
- Graphics in Education
- Image Processing
- Interactive Techniques
- Image Synthesis
- Geometric Modeling
- Graphics and Robotics
- Industrial Graphics
- Graphics and Operations Research
- Medical Computer Graphics

A 1500 word extended summary or full paper is due 31 October 1985. Authors will be notified by 1 January 1986. The full paper is due by 28 February 1986.

Send papers to

Dr. Mark Green  
Graphics Interface '86  
Department of Computing Science  
University of Alberta  
EDMONTON, Alberta, Canada  
T6G 2H1  
Telephone: (403) 432-4584

Conference Information

Dr. Gunther Schrack  
Graphics Interface '86  
E.E. Department  
University of British Columbia  
VANCOUVER, B.C., Canada  
V6T 1W5  
Telephone: (604) 228-2326

- "1986 Canadian Conference on Industrial Computer Systems"  
May 28-30, 1986, Ecole Polytechnique, Montréal.

Call for papers for the above conference, held every two years, has been issued by the Canadian Industrial Computer Society (CICS). As in previous years, papers are invited from all industry sectors, with conference sessions organized to show how similar problems are approached in different industry sectors.

Papers are invited from the iron and steel industries, from pulp and paper, food, oil, chemical, mining and the metallurgical industries. Also from you pipeline, communications, power, energy, transportation, manufacturing, aerospace, automotive, textiles, robotics and computer hardware and software suppliers and system consultants -- indeed from the whole spectrum of the Canadian industrial computing scene.

Papers should focus on how computers are used in industry. The sessions will show how they are used in process control, simulation, simulators for training, and control algorithm development, as well as focusing on distributed control, micros and programmable controllers, and sensors. Other topics will be computer selection, operating systems, programming languages, data management, software engineering and data acquisition. Also featured will be problems of communications in the factory, computer networks, the use of computer graphics, CAD/CAM applications, analysis techniques, automated factories, flexible manufacturing units, management of computers and computer people, and training.

Abstract deadline is currently listed as September 15, 1985 with author notification October 11, 1985 and complete paper deadline March 30, 1986.

Brief abstracts of proposed contributions should be sent to:

Prof. J. O'Shea and Prof. M. Polis  
Technical Program Chairmen, CCICS '86  
Ecole Polytechnique  
CP 6079, Succ "A"  
MONTRÉAL, Québec  
H3C 3A7  
Téléphone: (514) 340-4887

- International Symposium on Theory of Robots"  
December 3-5, 1986, Vienna, Austria

Call for papers has been issued by the International Federation of Automatic Control (IFAC) for the IFAC/IFIP/IMACS International Symposium on Theory of Robots, organized by the Austrian Centre for Productivity and Efficiency.

The aim of the symposium is to present, to discuss and to summarize recent advances in theoretical aspects of robots and related topics in the broadest sense.

The main topics of the symposium will be:

- Kinematics and kinetics including elastic structures and redundant degrees of freedom
- Models for the dynamic behaviour (including drives and gears)
- Synthesis of advanced control algorithms, adaptive algorithms, optimal control algorithms, ...
- Path planning including collision avoidance (path optimization)
- Questions of implementation (Software)
- Simulation aspects including CAD
- Programming and programming languages
- Processing of sensor signals including robot vision
- Artificial intelligence and robots
- Trends in robot development
- Robot education and training
- Tests and test equipments

Five copies of extended abstracts (2 to 3 pages) in English are required by February 1, 1986. Only unpublished papers may be submitted. English will be the official language of the symposium.

Contact: Dr. P. Kopacek  
P.O. Box 131  
A - 1014  
Vienna, Austria

8. CAD/CAM Abstracts

(See section attached.)

9. Recent CAD/CAM Quotes

"The "most glaring deficiency" in America's technological capabilities has been the Nation's "failure" to devote enough attention to manufacturing technology."

Robotics World, April 1985, page 8, concerning conclusions in the final report "Global Competition: The New Reality" of the President's Commission on Industrial Competitiveness.

10. This newsletter may be reproduced in whole or in part. Reprinting in other Canadian publications is encouraged. Acknowledgement to the CAD/CAM Technology Advancement Council would be appreciated.

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