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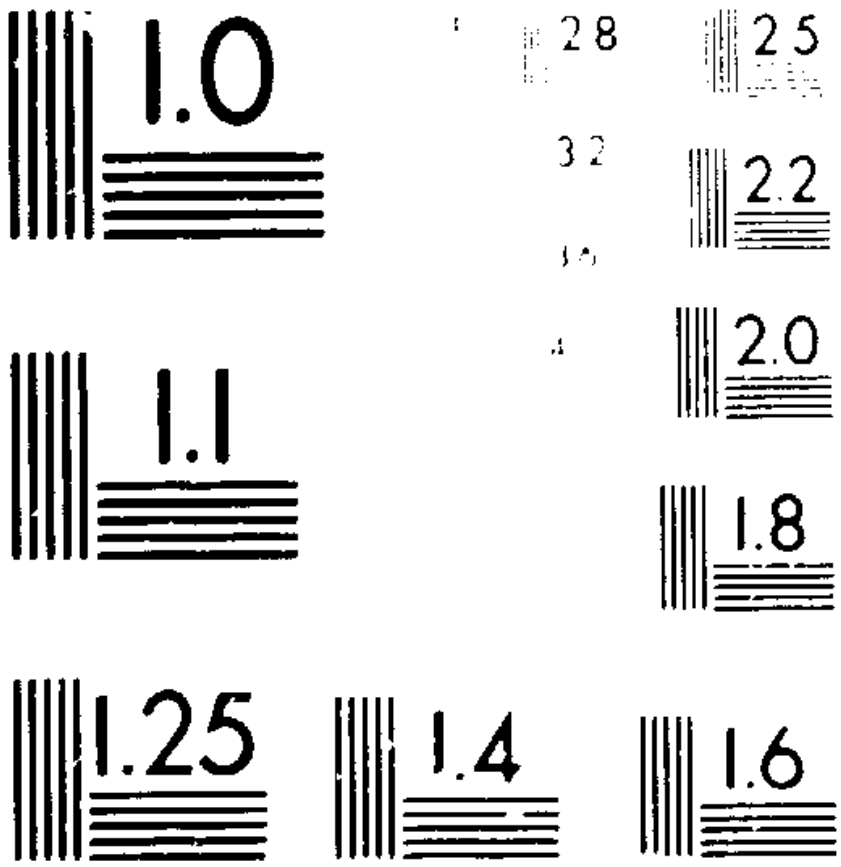

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Group Meeting on Promoting Appropriate Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) Technology in Developing Countries*

Cordoba, Argentina, 28 November - 2 December 1983

REPORT
AND
SUMMARY OF DOCUMENTS**

(Meeting on computer-aided design and computer-aided manufacturing).

* Organized by the United Nations Industrial Development Organization (UNIDO) in co-operation with the Province of Cordoba, Argentina and the Universidad Technologica Nacional Facultad Regional Cordoba

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PREFACE

Engineering industries, especially batch-type metalworking manufacturing ones, are very important to developing countries. Increasing the volume of production in such industries and improving the quality and reliability of their output can serve to alleviate some of their employment problems, as well as to ameliorate their foreign exchange positions.

Usually, developing countries have a large supply of relatively unskilled labour and, to varying degrees, a reasonable cadre of professional level engineering personnel. The problem that generally needs to be overcome in these countries centres around techniques and mechanisms involved in the transfer of applicable technology from developed to developing nations. In addition, technology must be diffused throughout the manufacturing industry once an initial transfer has taken place. It is in this area that the use of Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) can be most effectively applied.

Ideally, CAD and CAM are combined, the former feeding into the latter with a synergistic effect. However, both are also "stand-alone" technologies, and so are many of their subsets.

At present, it is possible to obtain appropriate mini-computer and micro-computer hardware and software that will permit the utilization of CAD/CAM technology with a reasonable investment of time and money. In the future, it should be possible to supplement and/or replace these resources in countries that are capable of absorbing more sophisticated and larger applications of CAD/CAM systems. At the same time, smaller systems, which are supported by less complex hardware, can be maintained successfully with a minimum of external assistance once initial implementations have taken place. Undoubtedly, the technological know-how necessary to initiate the implementation of such sophisticated equipment, policies that govern their use and the technical, economical and social aspects involved in the use of this equipment present a number of complex questions. To deal with them successfully, it is essential that sufficient information, technical and economic knowledge, relevant data

and knowledge of practical applications be gathered by countries wishing to establish CAD/CAM programmes.

Recently, in a number of developing countries, the application of CAD/CAM technology has been increasing at a relatively rapid rate. Various organizations have contributed to this development by helping these nations overcome problems associated with introducing CAD/CAM technology. Staffed by technically and administratively competent professionals, these organizations have been assessing the situation and have developed and implemented plans designed to cope with CAD/CAM technology transfer issues. Part of this work has been accomplished with UNDP/UNIDO assistance.

In September, 1977, UNIDO convened an Interregional Experts Group Meeting on Computer Applications and Modern Engineering in Machine Manufacturing Industry in Warsaw, where a number of developing countries were represented. Meeting in several sessions, the participants considered the need for and desirability of some form of CAD/CAM organization and concluded that:

1. there is a need to introduce CAD/CAM technology into their countries;

2. developing countries require assistance from institutions with a thorough knowledge of CAD/CAM technology; and

3. introducing CAD/CAM in manufacturing industries has important psychological and sociological implications.

Representatives at the Warsaw meeting recommended, inter alia, that:

1. UNIDO should locate and/or create international centres that can provide specific aspects of CAD/CAM technology training to personnel from developing countries;

2. a mechanism should be developed to facilitate the inter-change of CAD/CAM technology among developing countries in the form of information, personnel and software;

3. national organizations should be created within each country to introduce and disseminate CAD/CAM technology among the country's industrial base; and

4. an international association should be formed to promote appropriate CAD/CAM technology in developing countries.

Based upon these conclusions and recommendations, UNIDO established a focal point for CAD/CAM technology within the Engineering Industries Section (ENG) of its Industrial Operations Division. In order to support and promote the transfer of CAD/CAM technology within groups of countries with similar problems, a meeting was convened in Cordoba, Argentina, to discuss the merits of establishing an international CAD/CAM organization.

CONTENTS

INTRODUCTION

The underlying assumption of the meeting in Cordoba was that a group of developing countries with similar problems can mutually profit from forming an international organization that will assist them in addressing and solving problems inherent in the promotion and transfer of CAD/CAM technology from developed nations to developing ones. To this end, representatives from seven developing countries met in Cordoba, Argentina for five days and considered how best to achieve this goal. They presented papers which outlined their own nations' current status with regard to CAD/CAM and had general discussions related to problems and possible solutions to them. However, the heart of the meeting lay in the deliberations that took place regarding the establishment of some sort of an international CAD/CAM organization and the steps that must be taken in order to obtain that goal.

Agreeing that a need exists for developing countries to come together and establish an international CAD/CAM organization, these experts decided upon one basic Resolution, along with a number of Conclusions and Recommendations. These are reported in full in the following pages, as well as a brief summary of both the content of the meeting and of the papers presented in Cordoba.

RESOLUTION

Whereas the Experts Meeting on Computer Applications and Modern Engineering in the Machine and Manufacturing Industry, which took place in Warsaw in 1977, recommended that an international programme should be established to promote appropriate CAD/CAM technology in developing countries; and

Whereas the Experts Meeting on the Application of CAD/CAM to Developing Countries in Cordoba, Republic of Argentina, has thoroughly considered the many aspects of creating such an international CAD/CAM programme;

We, hereby, resolve to recommend to our respective countries that they support in assisting efforts to establish an international CAD/CAM programme and request UNIDO to provide a global technical assistance project to accomplish the following objectives, incorporating the listed functions.

CONCLUSIONS

1. The committee of representatives from developing countries concludes that an international programme responding to the CAD/CAM requirements of developing countries is needed.

2. .... that where national CAD/CAM centres exist, they should be strengthened; and where none exist in countries wishing to have a CAD/CAM centre, every effort should be made in assisting their development.

3. .... that developing countries have varying needs and are at varying stages in their knowledge and use of CAD/CAM technology.

4. .... that the introduction and use of CAD/CAM technology is highly desirable but must be accompanied by concomitant efforts on the part of the users of the technology to increase the awareness of the public, industry and governments as to their benefits.

RECOMMENDATIONS

The meeting of representatives of developing countties in Cordoba, Argentina, 28 November 1983 - 2 December 1983 on the Application of CAD/CAM to Developing Countries recommends:

1. that an international CAD/CAM programme be established;

2. that this programme be organized among those developing countries with existing CAD/CAM programmes or who desire to establish CAD/CAM programmes;

3. that UNIDO be requested to develop a suitable programme to be funded by an appropriate United Nations source;

4. that this international CAD/CAM programme provide basic services in such areas as direct support, information, publications and co-ordination types of activities; and

5. that a Committee be established as one of the programme's initial activities to consider an appropriate organizational structure, to achieve the programme's objectives and other pertinent administrative and technical details.

PART ONE

REPORT OF THE MEETING

The Group Meeting on Promoting Appropriate Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) Technology in Developing Countries was held in Carlos Paz, Argentina, Cordoba Province, Argentina, from 28 November through 2 December, 1983. Organized by UNIDO, in close co-operation with the Government of the Province of Cordoba and the Technical University of Cordoba, this meeting had as its primary objective to determine ways and methods of promoting the transfer of appropriate, current technology of CAD/CAM applications to, within and among developing countries. To this end, nine invited participants from nations with similar developmental backgrounds, as well as a keynote speaker and guests from the host country, deliberated for five days. The officially invited participants came from the Republic of Argentina, Brazil, the People's Republic of Bulgaria, the People's Republic of China, the Arab Republic of Egypt, the Republic of Korea, India, Mexico and the Philippines. Each of these countries possess some degree of CAD/CAM experience, and all of them have specific requirements in this area. Papers were presented by each of the participants, explaining the status of their countries with regard to CAD/CAM developments. In addition, a keynote address on "CAD/CAM Technology: A Survey" was given by a tenth invited participant. There were also several special case study papers read by invited guests of the host government, Argentina.

All of the sessions were plenary; and after general discussions and question/answer periods, the participants turned to the major item on the meeting's agenda: consideration of the establishment of an international organization for CAD/CAM. In this context, the representatives from the nine countries concentrated on the general concept of such an organization and ways and means of making it viable. In addition to arriving at a consensus, issuing a Resolution, several Conclusions and Recommendations, they agreed that further steps should be taken to make co-operation a reality.

The OBJECTIVES of an international CAD/CAM organization would be:

1. to introduce, promote and assist with the application of appropriate CAD/CAM technology within developing countries;

2. to encourage the development of CAD/CAM technology by developing countries themselves;

3. to facilitate the exchange of CAD/CAM information and experience among developing and developed countries;

4. to facilitate mutual assistance among developing countries in the CAD/CAM area;

5. to provide a mechanism whereby developing countries will be kept abreast of existing and emerging CAD/CAM services, hardware and software throughout the world; and

6. to promote the inter-changeability and compatability of CAD/CAM software and support the development of standards for CAD/CAM software.

The FUNCTIONS of an international CAD/CAM organization, listed in priority order within each category, would be:

1. DIRECT SUPPORT

Included under this would be:

A. responding to developmental assistance requests from countries wishing to establish CAD/CAM programmes and assisting with common CAD/CAM projects among member countries.

B. training and fellowship programmes;

C. interchanges of experts; and

D. providing information on other sources of funds for CAD/CAM activities.

2. INFORMATION AND PUBLICATIONS

Included among these services would be:

A. establishing and maintaining a CAD/CAM library and information service, which would provide such services as preparing and publishing guidelines for establishing CAD/CAM programmes, providing catalogues on software systems, and documenting case histories of countries that are using CAD/CAM;

B. providing evaluative reports on CAD/CAM systems that are available;

C. publishing a newsletter for members;

D. providing user reports on software availability as well as developments in the field;

E. promoting awareness of CAD/CAM within countries and encouraging interface with the public, industry and government;

F. conducting studies on the impact of CAD/CAM on sociological and economic conditions within member countries; and

G. supplying information on technological forecasts related to CAD/CAM.

3. CO-ORDINATION

Within this category, the following activities would occur:

A. technical conferences, seminars and tutorials;

B. responses to requests from national and regional members for information and programme support;

C. sponsoring inter-regional requests for technical exchanges amongst nations which are in similar stages of development; and

D. handling administrative matters within the organization.

4. ORGANIZATIONAL STRUCTURE

While agreeing upon the need for an international CAD/CAM organization, the participants did not define the actual structure that such a body would assume. They recommended that an Interim Committee be constituted as the next step in following up the meeting, and its task would be to develop guidelines and bases for the proposed organization. It was also recommended that the Interim Committee be composed of representatives from the countries that had delegates at the Cordoba meeting. When this Committee meets, it will have as its basic charge the development of an appropriate organizational structure which will ensure the implementation of the Objectives, Functions and Structure of the CAD/CAM international organization.

PART TWO

SUMMARY OF THE PAPERS

Altogether, ten official papers were presented at the Cordoba meeting. Following each presentation, general discussions, including question and answer periods as well as exchanges of experiences on related topics, ensued. In the following pages, brief summaries of these papers are given, beginning with the keynote speech and continuing in alphabetical order by country. Copies of the entire texts are available in the complete file for the meeting that is kept in the UNIDO, Vienna.

CAD/CAM TECHNOLOGY: A SURVEY

by

JOSEPH TULKOFF

Stating that the time for CAD/CAM has come, the keynote speaker at the meeting presented an overview of the current status of automation in world industries.

The author first described CAD/CAM, stating that the driving essence of CAD/CAM is the recognized fact that manufacturing is a single, indivisible activity. CAD/CAM represents "the integration of all management and control functions with all of the physical machinery and plant elements of the entire manufacturing and production spectrum .... All CAD/CAM aspects of control, machinery, manpower, materials, assembly, production, fabrication, handling and other support functions require a merger into an integrated system. CAD/CAM innovation entails a global, comprehensive, top-down look at the factory's characteristics .... Planning and implementing CAD/CAM must cover manufacturing goals, management, technological opportunities and technology control and management, including the anticipated procedures, schedules, labour requirements and costs involved."

There are four fields of CAD: geometric modelling, analysis, testing and drafting. There are also four main areas of CAM: numerical control, robotics, process planning and factory management. Because of their user-friendly characteristics, it is predicted that the 4,600 CAD/CAM systems in use in the United States today will swell to around 190,000 by 1985.

In addition to CAD/CAM systems, there are a number of others which will be important in the future. Included among them and described by the author are: computer integrated manufacturing (CIM); group technology (GT); computer aided process planning (CAPP); materials requirements planning (MRP); production and inventory optimization systems (PIOS); integrated computer aided manufacturing (ICAM); manufacturing control/material management (MCMM); automated storage and retrieval systems (ASRS); distributed numerical control (DNC); and flexible manufacturing systems (FMS).

Mr. Tulkoff writes also that "the robot revolution has begun". The use of robots is becoming more widespread, as they are accurate and consistent; their "up-time" averages about 98 percent; and new ones are being developed with increased flexibility and complexity of motion. Ultimately, this will lead to the automated factory, one run by computers with robots responding to them.

With specific attention to CAD/CAM technology, the author listed some advice for companies considering the use of CAD/CAM technology. Pitfalls to be avoided include: insufficient understanding by users, initial mis-applications, apprehension of the effect on labour and the lack of committed company champions to push for implementation. Any company needs to contain within it five functional positions that will spark innovation: an idea generator, an entrepreneur, a gatekeeper, a programme manager and a sponsor. Also, the company must decide wisely which new technology to innovate or install.

CAD/CAM must be viewed as a long-term investment. To apply it successfully, a company must be prepared to pay a high price and approach its application with careful planning. The author suggests four steps that will aid the initial implementation of CAD/CAM technology in any given industry: first, organise; second, evaluate; third, plan; and fourth, implement. If these steps are taken at the outset, the plan can be integrated and offer the company a systemic capability to judge CAD/CAM, not in isolation, but as a part of the total manufacturing system.

ARGENTINA

CAD/CAM ACTIVITIES IN ARGENTINA

by Roberto S. Apostoli and Edgardo Cohen

The authors presented an economic and social overview of the current situation in Argentina and pointed out areas of progress and problems. They stressed the need for more concentrated efforts in the field of technology and, more specifically, with CAD/CAM programmes.

The first CAD system was installed in Argentina in 1978 by a team of skilled engineers working for the Servicios Integrales de Computacion SRL (SIC) Argentina. Subsequently, in 1981, the SIC group launched G-SIC graphics - software which is wholly designed, programmed and supported in Argentina.

From this beginning, a number of other programmes and projects evolved, all of which are described by the authors. These have been and are taking place in six different centres, institutes and firms within Argentina.

Research and development also plays an important role in the country's industrial life, and four centres were cited as being deeply involved in these activities.

Finally, the authors pointed out that training and human resources are essential to CAD/CAM activities, as well as the future progress of the country, in its efforts to develop CAD/CAM programmes. Problems that persist in this connection have to do mainly with an inadequate supply of sufficiently trained and skilled personnel and the concomitant lack of training possibilities to rectify that situation. Progress is being made, however, in bringing together various skilled professionals from universities and industries. Post-graduate courses are also being offered by the Numerical Control Group, and there is now a CAD/CAM Association in Cordoba, whose objectives are to encourage co-operation and co-ordination of the CAD/CAM activities of industries and universities, as well as to educate the public, consumers, media and other interested groups as to the advantages of CAD/CAM and its potential in the further development of Argentina.

BRAZIL

CURRENT ACTIVITIES AND PROGRAMMES IN CAD/CAM TECHNOLOGY APPLICATION

by Manuel de Jesus Mendes

The author points out that there can sometimes be a significant gap between national and international levels within different sectors of Brazilian industries. This is due primarily to industrialization policies pursued by the country during the last 20 years. Primary national goals now are to service the national market with domestic products and to reduce dependence on imports. In order to accomplish this, six specific objectives have been set, including improving Brazil's competitive position, improving productivity, developing original technology, automating unattractive and dangerous jobs and conserving energy and raw materials.

To achieve these objectives, Brazil established in 1983 a Special Committee for Industrial Automation within the Special Secretariat for Information Processing. It works under the direct supervision of the President, and the Institute for Automation of the Centro Tecnologico para Informatica (CTI) co-ordinates its efforts. Scientists with expertise in different disciplines work together with representatives of Brazilian industries and universities and have received support from a number of international organizations and other governments. There are currently ten projects being carried out in the Institute, ones dealing with tools, methodology and basic system components and systems and applications. Interfaces in CAD/CAM systems, software development tools, robotics, geometric modelling, CNC programming and flexible manufacturing systems are all included in these projects.

The author concludes by stating that Brazil is in the beginning stages of a long-term programme which involves users, vendors, industries, universities, private and governmental institutions. It is hoped that combined efforts will provide Brazil with the tools for industrial modernization and self-sufficiency.

BULGARIA

THE DEVELOPMENT OF CAD/CAM TECHNOLOGY IN THE PEOPLE'S REPUBLIC OF BULGARIA

by Dimiter Penkov

Machine building, electronics, metallurgy, ore and mining industries are the fundamental basis of Bulgarian industry, with machine building and electronics leading the way in developmental technology. It has become an accepted fact that, in the future, the quality and cost of industrial production, as well as their efficiency will be determined by the extent of automation that exists in a country. In its 1970-71 decrees, the Bulgarian Government began the development of NC machine tools and established a programme for developing and producing families (groups) of machine tools. During the last few years, work has been underway that aims at creating a new generation of machine tools at the state-of-the-art technical level.

The UNDP/UNIDO assisted NC/CAM Centre in Sofia has been the focal point for most of Bulgaria's automation activities. This five year project, which began in 1978, has established a NC/CAM Centre, organized training programmes abroad, increased the efficiency of NC machine tool use in the country and established a continuous training and re-training programme in the country.

Recognizing the fact that NC/CAM cannot be separated from CAD in further development, Bulgaria is now concentrating on efforts to execute a follow-on project that emphasises CAD, with activities focussed primarily on the design and manufacture of machine tools, production cells and automated manufacturing lines. While a number of basic problems persist, Bulgaria is confident that it will be able to implement this project.

CHINA

THE GENERAL SITUATION OF THE MACHINE INDUSTRY AND CAD/CAM TECHNOLOGY

by Lei Weizong

The author addressed his paper to two specific subjects, as is evident in the title. He first gave an overview of the general situation of the machine industry and pointed out that in today's People's Republic of China, over 85 percent of the technical equipment installed in industries is made in China. The machine tool industry currently manufactures around 30,000 different products, some of which are of a very advanced nature - for example, artificial earth satellites and nuclear power stations. Other industries, such as the automotive, power and electrical machine, agriculture machine, scientific instruments and bearing industries, are all making progress as they strive to modernize and supply China's needs. Future planning in these areas call for improved product quality through total quality control (TQC), greater use of technology, scientific management and increased worker efficiency.

With respect to CAD/CAM technology, the author emphasised China's great interest in it, stating that the application of such technology, while still in its infancy, is very much under consideration. Already, in the 1960's the application of computer technology began, and there are now some 500 programmes in the country. Recently, China has imported some CAD systems - to assist in drafting and steam turbine design. It has also developed some of its own - such as large scale integrated circuits, combined machine tools, automobile, forging die and construction programmes.

Since 1973, there have been some CAM programmes and a few computer aided management systems. To date, CAD/CAM technology has been applied to some extent in the aviation, shipbuilding, hydro-electric generating, petroleum, chemical and light and heavy industries. Generally speaking, however, there are relatively few applications of CAD/CAM technology in China; few industries use it; and no integrated CAD/CAM network has been formed.

In its planning for the future, China is emphasising four points in order to achieve further industrial modernization: improving levels of design and quality; shortening design and manufacturing cycle time; enhancing market adaptability; and increasing competitiveness of machine products. To realise these goals, China recognises the need for CAD/CAM technology; the desirability of establishing a CAD/CAM centre, the need to improve some of its CAD/CAM systems and to utilise more fully those already in place; the necessity to collect data and establish a software library; the value of disseminating more widely existing CAD/CAM knowledge; and the importance of stressing its great economic benefits to the country.

EGYPT

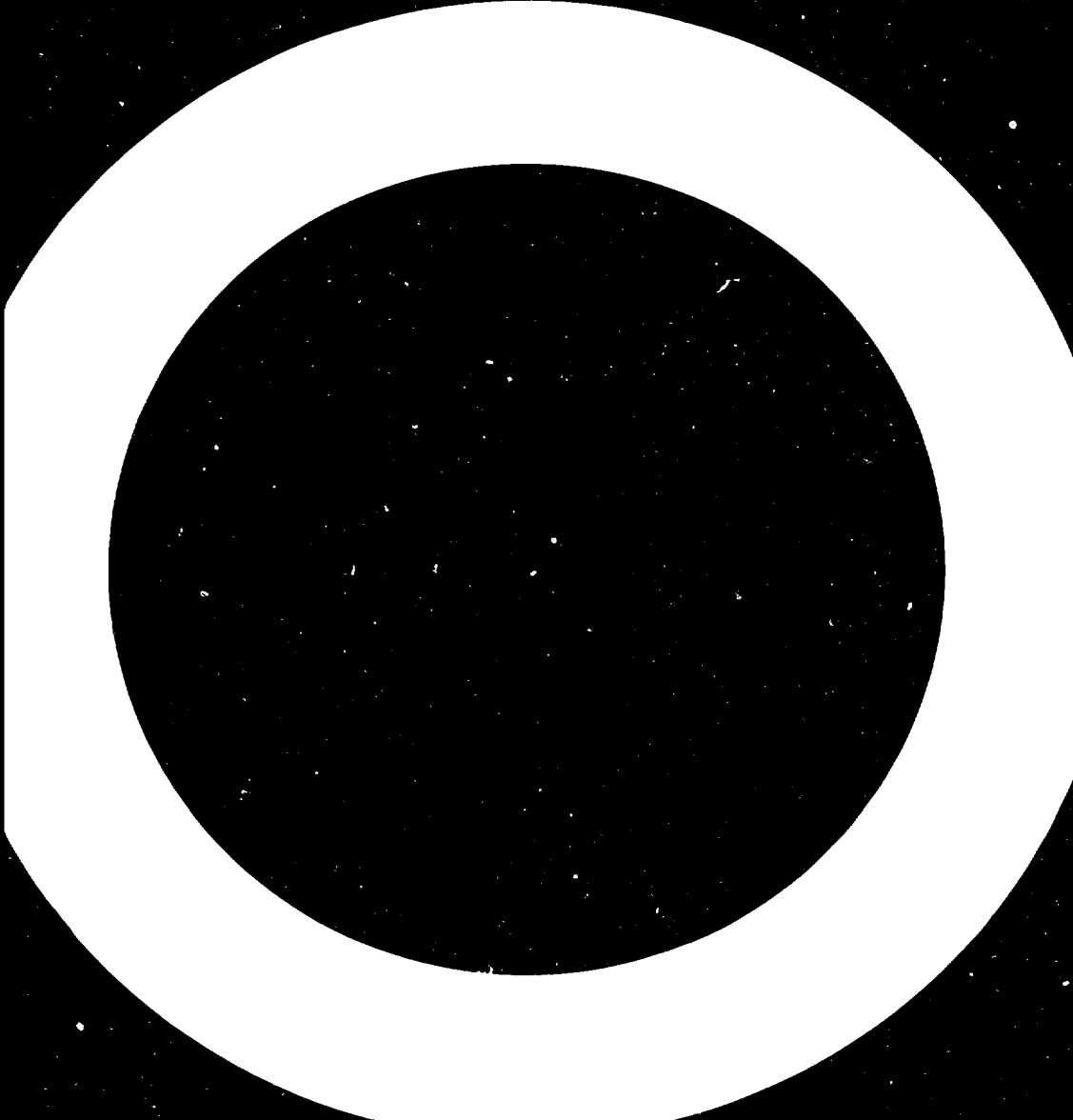
POTENTIALS OF CAD/CAM TECHNOLOGY FOR EGYPTIAN INDUSTRY

by Yusef Mazhar

The author began by pointing out the positive and negative aspects of using CAD/CAM technology in developing countries. He then described various applications of CAD and CAM, as well as CATIA, NC and CAE, and stated that thay can be beneficial if they are properly understood and efficiently employed.

Basically, CAD/CAM systems are new to Egypt. In some of the larger companies, CAM systems, using NC machines are in use; but CAD has been sparsely utilised.

In 1968, the Engineering and Industrial Design Development Centre (EIDDC) was established within the Ministry of Industry and Mineral Wealth. This was done with UNIDO assistance, and the Centre offers its technical services to both the public and private sectors. The Centre has a computer to be used in CAD/CAM application and has manipulated and applied a number of packages. It works closely with the Academy of Scientific Research and Technology (ASRT), which will also finance a CAD/CAM project in Egypt. The aim for the future is to increase industrial awareness and stress the importance of CAD/CAM's role in the continuing development of Egypt.



REPUBLIC OF KOREA

THE STATUS OF CAD/CAM TECHNOLOGY IN KOREA

by Hoyoun Kim

Over the past two decades, the Republic of Korea has made great strides in changing from a basically agricultural economy to one that is rapidly industrializing. The trend is to have less governmental involvement in industry and to emphasise small to medium scale industries. The metal working industry is of major importance and is also one of the industries where considerable improvements are needed. Major problems within the country include: shortages of skilled labour, low-level technology, low productivity combined with sharply increasing labour costs, dependence on imported raw materials and a foreign debt totalling almost one billion dollars.

In the past decade, most capital investment was used to purchase production machinery and plant equipment, but they have not always been used to capacity. Therefore, improvement and innovation in advanced technology, such as CAD/CAM, is essential.

Although computers were introduced into Korean industry 15 years ago, only one percent of all manufacturing companies use them today. A CAD/CAM system was introduced into shipbuilding in 1979; and since 1981, Korea has seen something of a boom in interest in such technology, primarily due to increased labour costs and growing needs for original product designs. Today the metalworking industry utilises approximately 170 of the existing 360 computers used in design and manufacturing in Korea. There are now 60 CAD/CAM systems in the country, with the machine industry, the metalworking industry and research and development institutes and universities making use of them.

The government has spent US$ 1.5 million on research into CAD/CAM application technology, and an estimated US$ 5 million more will be spent in the near future.

Present goals are: to convince industries of the need for CAD/CAM technology; to develop less expensive systems for small to medium size industries; to obtain appropriate software to develop more expertise and a larger number of competently trained engineers; and to have less dependence on foreign technology.

INDIA

CNC, CAD AND CAM IN INDIA

by S.J. Kumar

Developing countries have watched with keen interest over the past decade as developed countries became more and more involved with CNC, CAD and CAM systems. In the coming years, they will also be keenly watching the new developments of robots, laser machining and flexible manufacturing systems.

Machine tools, the backbone of the capital goods industry, have been manufactured in India since the beginning of this century and with considerable success since the 1940's. UNIDO has assisted in the establishment of a NC Centre at the Central Machine Tool Institute in Bangalore. Its mission is to diffuse NC technology throughout the metalworking industry of India, which today ranks twenty-first among the world's machine tool producing nations.

Since 1978, the use of computers in industries has been expanding, and today 38 manufacturers produce computers, mainly micro-computers, within the country. Altogether, around 5,000 computers of all types are in use throughout the country.

CNC, CAD and CAM activities are now beginning to take hold, as India recognises their great potential. These systems are currently being utilised in research and development activities, telephone and electronics industries, earth moving and conveying machine factories, the aircraft industry and the machine tool industry.

India's needs today, in priority order are: training in basic CAD/CAM applications; design and drafting; engineering analysis; design simulation and optimization; NC programming with graphics from a CAD data base; process planning; data base management; production planning and control; and integrated manufacturing systems.

MEXICO

CAD/CAM TECHNOLOGY AND INDUSTRIAL AUTOMATION IN MEXICO

by Victor H. Mucino

There is no doubt that the integration of CAD/CAM technology with industrial automation is one of the most important developments in modern industry for improving productivity and cost efficiency. With the adoption of CAE technology, industry has, in fact, entered the Third Industrial Revolution.

Presently, industrial automation in Mexico is in its infancy. The absence of a sufficiently well-trained cadre of engineers, as well as economic factors, have delayed Mexico's progress in this field. However, there are some CAD activities centered in the Graduate Division of the School of Engineering of the National University, where there is a CAD laboratory whose main purpose is to train highly skilled professionals in the CAE area and then to integrate them into the industrial field. Some private industries in Mexico also have CAD/CAM applications. For example, Fabricacion de Maquinaria, S.A. and PERRY are pioneers in the country; and a few universities and institutes have modest systems.

Mexico's present needs for modernization and automation require a many-pronged approach. Therefore, CAD/CAM applications can lend a strong and much-needed assist to the country. Universities, institutes, industry, research and development projects and international organizations should all work together to achieve Mexico's goals.

THE PHILIPPINES

CAD/CAM TECHNOLOGY IN THE PHILIPPINES

by William T. Torres

The seven top priority industries in the Philippines are: semi-conductors/electronics/electrical; food processing; textiles/garments; footwear/leathercrafts; furniture; construction; and handicrafts. However, the country remains predominantly rural, and introducing automation is still more on the drawing boards than a reality.

There are approximately 15 companies in the metalworking industry which are known to use some form of CAD/CAM technology. Data are insufficient to document the precise nature of these usages, however. On the other hand, there appears to be a strong interest in incorporating CAD/CAM systems into Philippine industry, and national planning presently being carried out by the Ministry of Trade and Industry undoubtedly recognises the need for this technology. Their findings, when they are made public, will shed more light on how future development steps will be implemented.

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RESULTS OF THE SURVEY QUESTIONNAIRE

Prior to convening the Cordoba meeting, the Engineering Industries Section of UNIDO's Industrial Operations Division sent out a questionnaire to the 9 country representatives. A one hundred percent response was obtained, and the responses were tabluated before the meeting and presented as a part of its documentation. These are summarised below:

COMPUTER TECHNOLOGY

1. 6 countries manufacture computers; 3 do not.

2. 3 manufacture large main frame computers; 3 produce mini-computers and 5 micro-computers.

3. 4 countries have between 101 - 1,000 computers; 5 over 1,000.

4. computer applications include: accounting (9); banking (9); product design (7); manufacturing control (8); management (9); numerical control machining (9); process simulation (7); statistics (9); manufacturing process control (7); medical (8); and education (8).

5. manufacturing industries within these countries which make significant use of computers are: automotive (7); agricultural machinery (1); general metalworking (7); shipbuilding (5); electronics (9); heavy machinery (4); steel (1); textiles (1); and sugar (1).

6. 6 countries said computer terminals are significantly used; 3 stated they were not. The same replies were received for a similar question on the use of personal computers.

7. 7 nations use telephone lines for data transmission to and from computers; 2 do not.

8. 7 countries believe that the quantity of computer programmers in their countries is insufficient; 2 "about right".

CURRENT STATUS OF CAD/CAM IN THE COUNTRY

1. In response to a question on present usage of CAD/CAM within their countries, 7 nations listed machine design; 5 shipbuilding; 7 construction design; 6 drafting; 6 simulation; 7 stress analy is; 6 civil engineering; 7 electronics; and one each for mapping, image processing, nuclear and aeronautics.

2. Existing CAM applications include: numerical control machining (9); materials handling (4); shipbuilding (5); production/inventory control (8); process planning (5); quality control (4); robots (4); and testing (4).

3. Answering a question regarding the number of organizations in their country involved in CAD/CAM education, research and development or consulting, 3 countries listed less than 5; one noted 5-10; 2 said 11-25; and 3 had more than 25.

CAD/CAM PLANS

1. 7 countries stated that their governments had plans to apply CAD/CAM technology in the future; 8 said that industries had such plans; 6 listed educational institutions; and 5 noted private institutions.

2. A similar response was elicited to a question regarding plans to develop or adapt CAD/CAM technology, with 9 countries saying their governments had such plans; 6 responding that industry and education intended to; and 3 stating private institutions had CAD/CAM plans.

3. 9 out of the 9 countries surveyed stated that their nations are interested in UN assistance in establishing and/or implementing CAD/CAM plans.