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ADVANCED MANUFACTURING AND ENGINEERING METHODS

DP/BUL/81/009

BULGARIA

Terminal report *

Prepared for the Government of Bulgaria
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of the project team of the
CAD Research and Development Laboratory at Sofia

Backstopping officer: J. Fürkus, Engineering Industries Branch

United Nations Industrial Development Organization
Vienna

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ABSTRACT

The project is titled "ADVANCED MANUFACTURING AND ENGINEERING METHODS", DP/BUL/81/009, and it is implemented at the CAD Research and Development Laboratory in Sofia, Bulgaria.

The objectives of the project were to improve the quality and raise the technical level of design activity in a number of areas, such as industrial design, building design, urban design, etc.

The major immediate - or short term - objective of this project was aimed at the consolidation and upgrading of the Bulgarian Centre for Co-ordination and Development of Computer-Aided Design Systems (BCCAD), that was to become a focal point and training ground for personnel of different design organizations in the country.

The project was associated with the developing and upgrading of technical skills and research capacity in the field of the computer-aided design in general, as well. As a result of this, the Centre is now in position to render a broad spectrum of information, services and technical assistance both in Bulgaria and in the developing countries in different fields of application of computer-aided design systems.

The duration of the project was planned for four years, starting September 1982.

The main conclusions and recommendations are as follows:

Experts recruitment has been a certain difficulty, especially in the beginning of project, although the Bulgarian counterpart has made a lot of efforts to find suitable candidates through other channels. However, 5 expert missions of 0.5 m/m each have been carried out so far and the 5th 2 weeks assignment is scheduled for the beginning of 1987 in accordance with the expert's availability.

37 specialists have been trained abroad for a total of 26.25 m/m and the last fellowship (for 1 m/m) is being processed at the moment, the fellow being expected to complete his training in accordance with the project termination schedule.

10 specialists have been sent for study tours abroad.

The total UNDP input for equipment has been fully utilized and all equipment items used for meeting project objectives.

The insufficient expert assistance was compensated by expert assistance of specialists recruited by the Government, as well as the conclusion of 3 subcontracts for dedicated educational subsystems. As a result, an Audio-Visual and Video Laboratory and a good library were equipped and became the basis for the production of training materials, including video films, textbooks, etc.

The project outputs are already achieved by the national project staff and they represent the basis for the future development in this field, as a part of the Fourth Programming Cycle Project called "ESTABLISHMENT OF A TRAINING AND CONSULTANCY CENTRE FOR ADVANCED MANUFACTURING TECHNOLOGIES".

The Centre established is capable to carry out consultancy on introduction of the integrated manufacturing systems that are a principally new approach to industry, based on the fact that all those concerned with manufacture should have the possibility to exchange information in order to perform their duties efficiently.

The successful implementation of the project, the objectives already reached, will provide the possibility to develop simulation systems for integrated manufacturing of tooling for a small-scale production enterprize and the results could be immediately multiplied and implemented in other similar enterprizes, thus leading to the quick upraisal of the technical level not only in the development and the implementation units in the country, but in the industry of the People's Republic of Bulgaria as well. This process is accompanied by training of specialists and workers from industry.

TABLE OF CONTENTS

1. INTRODUCTION

1.1. PROJECT BACKGROUND

The results of the scientific and technological progress in the People's Republic of Bulgaria, the intellectualization of production processes and the effective use of computers for industry automation require new, advanced technologies, state-of-the-art organization and methods of work in the field of the design, that is a major factor in industrial production. A logical solution to this problems was the establishment of a centralized unit for the development and implementation of computer-aided design systems and methods. Thus, in March 1982 the CAD Research and Development Laboratory was established as a structural link of "PROGRESS" Centre for Accelerated Implementation within the Committee for Science and Technical Progress of the People's Republic of Bulgaria.

The "PROGRESS" Centre for Accelerated Implementation is a unique organization within the People's Republic of Bulgaria. Its major objectives are:

- Organize and guide the complex research, selection, experimenting and accelerated implementation in production of Bulgarian inventions and foreign scientific and technical achievements that are not included in the branch plans for scientific and technological progress;

- Perform a detailed technical and economical analysis and evaluate the economic conditions for the purpose of overcoming temporary disadvantageous results, preventing from economic risk, decreasing the development costs, increasing the economic efficiency and achieving a multiple effect from innovations application;

- Establish and finance dynamic teams and laboratory units for accelerated development, experimenting and implementation of inventions and original technical solutions. This form allows to involve and unite the efforts of scientists, inventors and other specialists from different branches for a definite period of time;

- Establish associations for joint activities with other economic organizations with joint-stock formation of fixed capital and a corresponding participation in the distribution of the achieved economic results; run jointly or totally the economic risk in case of failure;

- Grant an additional salary fund to the organizations with which jointly performs contract jobs;

- Assist in the realization of results from the implementation of scientific and technological achievements on the domestic and foreign markets.

Thus, the activities of the "PROGRESS" Centre for Accelerated Implementation cover areas such as:

- Automation and Electronization of Industrial Branches;

- Intensive Crop Farming and Stock-Breeding;

- Non-Conventional Construction Methods;

- Bio-technologies and Waisteless Technologies;

- Energy and Raw Materials Economy;

- Environment Control (including Working Environment)

- Medicine and Health Care.

So, in order to meet both Project activities and the objectives of the "PROGRESS" Centre of Accelerated Implementation, CAD Research and Development Laboratory is involved in:

- Development of CAD System Modules;
- Implementation of These Modules in Different Enterprizes in the Country;
- Training and Consultancy in the field of Computer-Aided Design.

The following benefits have resulted, to one or another extent, from the Laboratory's activities:

- Improved Quality and Efficiency of Design Labour;
- Reduced Lead Time from Pre-Project Study to Design to Implementation;
- Increased Throughput and Capabilities;
- More Effective Optimization of Designs that Result in More Economic Use of Materials and Labour;
- Improved Design Environment.

1.2. PROJECT OBJECTIVES

The objectives of the project were as follows:

a) Development Objective

The development objective of this project is to improve the quality and raise the technical level of design activity in a number of areas, such as industrial design, building design, urban design, etc.

b) Immediate Objective

To consolidate and upgrade the Bulgarian Centre for Co-ordination and Development of Computer-Aided Design Systems (BCCAD), which is to become a focal point and training ground for personnel of different design organizations in the country.

c) Achievement of Immediate Objectives and Utilization of Project Results

The results achieved during Project are summarized as follows:

- The basis for software developments on mini computers, including 5 modules of the integrated system, as per the Work Plan, have been developed;

- This system has been multiplied to be used on microcomputers and completed with 3 additional modules, due to the quick invasion of microcomputers in industry;

- This multiplication made the Project outputs very popular within the country, due to the very low cost, the optimization of the designers'solutions, raising the quality and thus, leading to the increase of the efficiency of the design activities;

- The microprocessor systems are implemented in 5 technical universities of the country and used for training of students and post-graduates;

- The turnover of the more than 20 systems already implemented in the country, after one year of use, is estimated at 20%;

- At the moment of the Project completion, about 350 persons have undergone one or another type of training for the integrated CAD system.

1.3. OFFICIAL ARRANGEMENTS

The assistance was requested in 1982. The Project Document got approval and was signed on September 16, 1982, the UNDP input being US $ 300'000, Government Contribution of Leva 2,100'000 and the CAD Research and Development Laboratory as the Government implementing agency.

During the course of the Project the UNDP input was changed twice, as follows:

- Due to the decreased total amount of UNDP input for the country, the Project Budget had to be revised to US $ 259'500;
- At the end of the Project, in order to cover the complete training programme, the UNDP input was increased by US $ 23'250.

The initial Government contribution was increased during the course of the Project by Leva 300'000, used mainly for facilities and equipment.

It should be stated that at beginning the Project did not go very smoothly. As a result, in September 1984 the Project Director (and Director of the Laboratory) was changed. After that the Project activities was managed very efficiently by the Project Director jointly with the Decision-Making Group in excellent co-operation with UNDP and the Executive Agency UNIDO and the overall support of the Government authorities concerned.

The Government contribution was excellent both from the point of view of quality and timing of the required inputs.

2. PROJECT ACTIVITIES

The envisaged project activities were as follows:

Project Activities	Scheduled Starting Date	Actual Starting Date	Scheduled Completion Date	Actual Completion Date
1	2	3	4	5
1. Assignment of Management Team	10/82	10/82	03/83	03/83
2. Establishing and Documenting Work Plan and Network Timetable	11/82	11/82	03/83	03/83
3. Discussing and Approving the Detailed Work Plan and Network Timetable	01/83	04/83	06/83	06/83
4. Developing Specifications for the Complete Equipment (incl. software)	09/83	05/83	12/84	12/84
5. Training Bulgarian Specialists in CAD activities (Study Tours and Fellowships)	09/83	09/83	12/86	12/86
6. Delivery, Installation and Implementation of New Equipment (incl. Software) for the Bulgarian CAD Centre	10/83	03/83	09/86	09/86
7. Conducting Scientific Research and Development Activities to Produce an Integrated CAD System, Application Software, CAD Plans for Other Centres	10/83	03/83	12/86	12/86

1	2	3	4	5
8. Conducting Training Courses	10/83	05/83	12/86	12/86
9. Preparing Project Progress Reports	03/83	09/83	03/86	03/86
10. Preparation of a Draft Final Report	09/86	09/86	10/86	10/86
11. Preparation of a Project Final Report	09/86	09/86	10/86	10/86
12. Fielding of International Experts	10/83	10/84	12/86	....*
13. Establish the Possibility to Receive Trainees for Fellowships in CAD from Other Developing Countries	1986	06/84	Continuous	
14. Preparation of Promotional Brochures and Presentation of the Bulgarian Centre for CAD	1986	07/85	Continuous	

* The last expert mission is scheduled for the beginning of 1987 in accordance with expert's availability.

One could see from the dates, that although some of the Project Activities have been delayed in their beginning (Activities 3, 9, 12), they have been completed on schedule; some others - started earlier (Activities 4, 6, 7, 8, 13 ,14) and all this contributed to the meeting of Project objectives and achieving Project Outputs.

For this purpose the following inputs were needed:

A. GOVERNMENT INPUT

The total Government input for the establishment of the BCCAD was estimated to Leva 2,100'000.

It could be seen from the above description that the Government Input exceeds the initially planned amount by Leva 800'000.

B. UNDP INPUT

(i) Personnel

5 expert missions of 0.5 m/m duration each, or a total of 2.5 m/m have been carried out successfully during the Project, instead of the originally planned total of 10.0 m/m (Annex A.1).

Unfortunately, no assistance could be was given as per Post 11-05, Computer Graphics Programming Adviser, due to personal reasons of the only candidate appointed by the Laboratory.

However, the expertize provided was more intensive, than envisaged, and extra work was successfully carried out by the national project personnel and some nationally recruited experts, so the project outputs were achieved.

(ii) Subcontracts

This form of UNDP input was not originally envisaged in the Project Document. However, it was found a very efficient way to achieve some of the Project Outputs. Annex A.2. gives a description of the subcontracts concluded.

(iii) Training

37 specialists have been trained abroad for a total of 26.25 m/m and the last fellowship (for 1 m/m) is been processed in the moment the fellow being expected to leave till the end of 1986 (Annex A.3).

10 specialists have been sent for study tours abroad (Annex A.4).

(iv) Equipment

The total UNDP input for equipment is fully utilized.

(i) Counterpart Staff

The Project Document envisaged a total number of 35 employees at the BCCAD. The actual number of employees at the end of Project is 43 (Annex A.8).

In order to compensate lack of UNDP-recruited experts, the Government has provided expertize on certain problems concerning Project implementation.

(ii) Equipment

The locally procured equipment - both Bulgarian-made and foreign - within the framework of the Project amounts to the equivalent of about US $ 1,500'000.

(iii) Project Facilities

The Bulgarian Government provided 4 additional work rooms, 1 terminal room and the second computer room is being completed at the time this report is made.

(iv) Training

A complete programme for the training of the specialists from the BCCAD was made and carried out successfully.

Slide projections and video films for PDP 11/34 description, use and applications were provided.
Two persons were sent to the Educational Centre of DIGITAL EQUIPMENT Co. in the USA to undergo 3-weeks training each.
One specialist was sent on a 3-month fellowship in automation in France.
4 specialists attended tutorials, conferences and exhibitions during DECUS annual meetings. The members of the Project Decision-Making Group (6 specialists) were sent to a 1-week courses in Budapest, Hungary.

However, the major efforts were concentrated on self-training, since the subject was new for the country, excluding participation in general courses in operation systems, programming languages, hardware and video equipment maintenance in the country.

3. PROJECT OUTPUTS

The Project Outputs are produced as per the Work Plan. However, with some of them some new developments emerged, due to the experience gained and to the new trends in science and technology. The summary of the outputs achieved is as follows:

3.1. THE BULGARIAN CENTRE FOR COMPUTER-AIDED DESIGN

According to the formulation of output in the Project Document, the CAD R & D Laboratory should turn into a Bulgarian Centre for Computer-Aided Design as a centralized unit of all CAD research, development implementation and training activities, stating that the Centre will be fully established by Project completion, and that it will consist of a physical facility, housing Project resources of equipment and staff.

Project staff of 51 is already appointed and it is gaining more and more experience. Further, when necessary, specialists from other organizations passed training and participated in Project developments, thus assisting in dissemination of Project experience.

Centre's facilities are being additionally equipped with new devices and some new work rooms were provided by the Bulgarian Government, including a micro computer room, a second computer room for Bulgarian-made 32-bit mini-computer to be provided very soon at the Laboratory site by the Bulgarian Government.

The Centre participates very actively in the preparation of new standards in the field of the computer-aided design.

3.2. AN INTEGRATED CAD SYSTEM AND DEDICATED SUBSYSTEMS (HARDWARE AND SOFTWARE)

Initially this output was formulated as "A UNIVERSAL SYSTEM (HARDWARE AND SOFTWARE) APPLICABLE TO CAD AND DEDICATED SUBSYSTEMS. Later, at the end of 1984, taking into consideration the advise of Project Expert, Mr. KEITH SHAW, during his mission as Senior CAD Adviser, and bearing in mind the technical developments in the field, that make the concept of "A UNIVERSAL CAD SYSTEM" obsolete, it was changed to "AN INTEGRATED CAD SYSTEM AND DEDICATED SUBSYSTEMS (HARDWARE AND SOFTWARE)".

The hardware system provided at the beginning of Project and consisting of a PDP 11/34 mini computer with standard peripherals, graphic terminal "TEKTRONIX", plotter and digitizer was extended by additional graphic terminals, disc and tape peripherals, and controllers. Further, 4 IBM PC XT compatible microcomputer systems were provided by the Government. The major pieces of equipment provided for the Project execution are listed in Annexes A.1 (UNDP Financed Equipment) and A.2 (Equipment Supplied by the Government).

At the Project beginning the Bulgarian Government provided all the necessary software needed for the operation of the equipment, including a system for automated drafting - DOGS (Drafting Office Graphic System), a product of PAFEC LTD. England, that, besides being the kernel of the research and development activities of the Laboratory, became the basis for a co-operation with the company resulting in 5 fellowships at the company and two experts' missions.

Maybe at this point, the Project Teams should express their appreciation of the mutual work with PAFEC LTD. for the development purposes of the CAD R & D Laboratory and the Bulgaria in general, and recommend such a co-operation in similar projects as well.

3.3. APPLICATION SOFTWARE PACKAGES FOR CAD

In order to meet the country's needs in the field of the computer-aided design, the activities were concentrated on the development of application-oriented software modules of the integrated CAD system. The first developments included a 2-D minicomputer-based drafting system, a graphic data base and an interface to computing procedures.

Later, a 3-D microcomputer-based graphic system, data base and accounting modules were developed and the work of the fourth mini computer-based module - parametric inputs - started. At the same time pre-project studies for the development of solid modelling, finite-elements analysis, graphic input/output and NC-programming, both for mini and micro computers, has started.

These, latter developments, are now at the completion stage. The expected date for the presentation of these modules to the Scientific and Technical Council of the Project is 1 November 1986.

Besides all these modules, interfaces for their different applications in the field of machine-building, architecture, civil engineering, training, mapping, etc. are developed as well, including interfaces for Bulgarian-made hardware.

3.4. CAD PLANS FOR OTHER DESIGN CENTRES

At Project completion 10 design centres were established with the assistance of the Bulgarian Centre for Computer-Aided Design - the CAD Research and Development Laboratory. These Centres are equipped with similar computers, peripherals and software. However, the maximum possible amount of Bulgarian-made devices and software products were incorporated in their systems.

They are working on their own now and implement their own developments. The Laboratory is still providing consultancy on their problems when needed as well as on problems of other design and industrial organizations in the country.

3.5. A TRAINED CADRE OF CAD PROFESSIONALS AT THE BULGARIAN CENTRE FOR CAD

Bearing in mind the needs of the Centre's concrete users, a group for modelling of systems was established. When given a project, this group determines the technological and methodological principles of the designed system and controls its building on site.

The group also provides consultancy on separate problems in the design, development, implementation and maintenance of CAD systems to other organizations in the country and is ready to provide such consultancy to the developing countries as well.

The work of the group for modelling of systems for customers is going on very busy, and a flexible methodology for building of systems according to the end-users parameters is being established at the moment.

Since this group has a lot of customers standing in a queue to get its services, now the group was enlarged to 6 persons (previously 4).

3.6. TRAINING SERVICES

During the Project implementation a special team for the organization of training activities was formed and an Audio-Visual and Video Laboratory established, with the Project equipment and completed with the equipment of the UNIDO-financed project at the Research, Development and Implementation Association "SCIENTIFIC INSTRUMENTATION", belonging to the Bulgarian Academy of Science, thus forming a joint unit for production of video films.

As a result, a complete programme for training in the field of the computer-aided design was developed. The training is being carried-out on three levels - managers, customers' specialists (e.g. mechanical engineers, civil engineers, architects, teachers, etc.) and customers' programmers; and is organized into modules (Annex A.10). Curricula for 33 submodules of a total of 38. The curricula for the outstanding 5 submodules are being developed at the moment together with specialists from other organizations, since they concern the relation between the computer-aided design and computer-aided manufacturing, robotics and other aspects of automation.

At the moment of the Project completion, about 350 persons have undergone one or another type of training on different CAD subjects, including training-on-the-job. During the last year the interest to the micro computer-based developments was enormous, and the major part of the specialists trained, since the last reporting in April 1986 (150), were trained to work with these modules.

Due to the great interest and the turning of the Laboratory into the main training centre in the field of the computer-aided design in Bulgaria, the organizational procedures were taken over by the National Training Centre as per signed contract with the Laboratory.

Actually the training held at BCCAD represents transfer of the received during the fellowships and study tours knowledge and know-how, and as far as the time schedule is concerned, it usually goes after the implementation of the BCCAD developments, that also represent to a certain extent transfer of knowledge gained during the training of BCCAD's specialists abroad (See Annexes A.3 and A.4).

At the moment 14 specialists of the Laboratory are lecturers at "LENIN" Higher Institute of Mechanical and Electrical Engineering and the National Training Centre.

During the reporting period 3 subcontracts for Dedicated Educational Subsystems were concluded (ANNEX A.2), thus enabling the training specialists of the Laboratory to produce the first training film "DIGS - Drafting Interactive Graphic System", as well as some publicity video films and textbooks. Scipts for training films for all developments of the Laboratory are being prepared.

There is a certain interest to the Training Programme of the Laboratory, expressed by specialists from developing countries. However, there exist some problems related to trainee's travel and living expenses and the advise of the UN-agencies in this respect are most welcome.

4. CONCLUSIONS

4.1. UNDP/UNIDO Assistance is considered as an extremely significant factor for the establishment and the smooth operation of the Centre.

4.2. All the outputs designed by the Project Document were completely achieved.

4.3. The Centre is capable to carry out research, development, implementation and training in the field of the computer-aided design.

4.4. The Centre is ready to provide consultancy and training to specialists both from Bulgaria and the developing countries.

5. RECOMMENDATIONS

5.1. The established basis and possibilities of BCCAD should be utilized to the maximum in the following directions:

- To establish all necessary pre-requisites for further developments in the field;
- To further develop and multiply the results from the training, especially in the least developed developing countries;
- To maintain a feedback from industry through pilot implementation of the Project outputs in industry.

5.2. The development of general means of communication and their implementation, mainly through graphic standards and data bases, not only for automated drafting, but for computer-aided design in general, should be the main trends in the Centre's development.

5.3. The Centre's should go on with the training activities within the framework of the IV Cycle Project called "ESTABLISHMENT OF A TRAINING AND CONSULTANCY CENTRE FOR ADVANCED MANUFACTURING TECHNOLOGIES".

ANNEX A.1

LIST OF EXPERT MISSIONS HELD

Expert Post No. and Description	Expert Name	Duration of Mission	Period Mission Held
1	2	3	4
11-02 Senior CAD Adviser	Keith SHAW	0.5 m/m	3-16.10.1984
11-02 Senior CAD Adviser	Mark VANDERSLUIS	0.5 m/m	24.02.-3.03.1986
11-02 Senior CAD Adviser	Nikolaus POLLAK	0.5 m/m	******
11-03 CAD System Analyst	Einar SKJOERTEN	0.5 m/m	11-22.11.1986
11-04 CAD Programming Adviser	Wolfgang STRASSER	0.5 m/m	11-21.03.1986

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Scheduled for beginning of 1987 in accordance with expert's availability.

ANNEX A.2

LIST OF SUBCONTRACTS CONCLUDED

Item No.	Title of Subcontract	Subcontractor	Cost US $	Date Completed
1.	Dedicated Educational Subsystem for Design Application Data Processing and Presentation of Universal Design Information	Tillinger & Co. Austria	20'500	Febr. 1984
2.	Dedicated Educational Subsystem for Introduction to Interactive Computer Graphics, Computer-Aided Design and Manufacturing, and Advanced Computer Graphics and Computer-Aided Design	The Association for Media-Based Continuing Education for Engineers, Inc. (AMCEE), USA	18'850	Mar. 1986
3.	Dedicated Educational Subsystem for Design Application Data Processing, Presentation of Universal Design Information and Preparation of Educational Video Films	Semcotec, Austria	33'000	Oct. 1986
4.	Expansion of above system		10'647	Dec. 1986

ANNEX A.3

LIST OF FELLOWSHIPS AWARDED

Subject	Duration m/m	Recipient	Host Company/Country	Training Period
1	2	3	4	5
Research and Development of Automation in Drafting	0.5	Svetlozar GRANCHAROV	PAFEC LTD./UK	3 Sept.- 16 Sept.1983
Research and Development of Automation in Drafting	0.5	Zoya CHOBANOVA	PAFEC LTD./UK	3 Sept.- 16 Sept.1983
Research and Development of Automation in Drafting	0.5	Lyubomir KAMILAROV	PAFEC LTD./UK	23 Jan. 6 Feb. 1984
CAD/CAM in Electronics	0.25	Harutyun BEDROSSYAN	BECEEP/AMK/ West Berlin	3 Dec. - 7 Dec. 1984
CAD/CAM in Electronics	0.25	Yordan MINDOV	BECEEP/AMK/ West Berlin	3 Dec. - 7 Dec. 1984
CAD/CAM in Electronics	0.25	Vladimir GRIGOROV	BECEEP/AMK/ West Berlin	3 Dec. - 7 Dec. 1984
CAD/CAM in Electronics	0.25	Albena CHAMOVA	BECEEP/AMK/ West Berlin	3 Dec. - 7 Dec. 1984
CAD/CAM in Electronics	0.25	Malinka SAVOVA	BECEEP/AMK/ West Berlin	3 Dec. - 7 Dec. 1984

1	2	3	4	5
Interactive Computer Graphics and Data Structures	0.5	Kroum MANOILOV	BECEEP/AMK/ West Berlin	18 Mar. - 30 Mar. 1985
Interactive Computer Graphics and Data Structures	0.5	Nikola RAYNOV	BECEEP/AMK/ West Berlin	18 Mar. - 30 Mar .1985
Interactive Computer Graphics and Data Structures	0.5	Emilia GURKOVA-PAUNOVA	BECEEP/AMK/ West Berlin	18 Mar. - 30 Mar. 1985
Interactive Computer Graphics and Data Structures	0.5	Elena DOBREVA	BECEEP/AMK/ West Berlin	18 Mar. - 30 Mar. 1985
Interactive Computer Graphics and Data Structures	0.5	Boris TRENDAFILOV	BECEEP/AMK/ West Berlin	18 Mar. - 30 Mar. 1985
The Graphical View Station and Manufacturing Data Bases	1	Emilia GURKOVA-PAUNOVA	DATAGRAPHIC S.A./ France	29 June - 1 Aug. 1985
GKS in Display Graphics	0.5	Vladimir GRIGOROV	Graphic Data Products S.A./ Switzerland	18 Aug. - 30 Aug. 1985
Intelligent Computer Graphics Workstation	0.5	Rumen YOTOV	Graphic Data Products S.A./Switzerland	18 Aug. - 30 Aug. 1985

1	2	3	4	5
Selecting a CAD System: Technological Assessment Methods	1	Harutyun BEDROSSYAN	UMIST/UK	29 Aug. - 1 Oct. 1985
A Training Programme for the Introduction of the Computer-Aided Design in a Company	1	Rayna IVANOVA	IPK/ West Berlin	2 Sept.- 1 Oct. 1985
Graphical User Interface Management System	1	Zoya CHOBANOVA	UMIST/UK	28 Oct. - 30 Nov. 1985
Some Economic Aspects of Selecting CAD Systems	1	Elena DOBREVA	Technische Universitaet Graz/Austria	11 Nov. - 14 Dec. 1985
The Graphical View Station and Manufacturing Data Bases	1	Boris TRENDAFILOV	ISL GmbH/FRG	18 Nov. - 14 Dec. 1985
Drafting Automation Graphic System	0.5	Jordan MINDOV	PAFEC LTD./UK	3 Feb. - 19 Feb. 1986
Aplication-Oriented Adaptation of Integrated CAD/CAM Systems	1	Margarita DINEVA-VELIKOVA	Center of Manufacturing Technologies/ USA	6 Feb. - 9 Mar. 1986
Distributed Processing in CAD Systems	1	Alexander GANEV	Center for Manufacturing Technologies/ USA	6 Feb. - 9 Mar. 1986

4.

1	2	3	4	5
Computer-Aided Design and Computer-Integrated Manufacturing	0.5	Plamen MATEEV	Centre for Advanced Technologies Education/ Canada	3 May - 16 May 1986
Computer-Aided Design and Computer-Integrated Manufacturing	0.5	Alexander ALEXANDROV	Centre for Advanced Technologies Education/ Canada	3 May - 16 May 1986
Computer-Aided Design and Computer-Integrated Manufacturing	0.5	Petko BOGDANOV	Centre for Advanced Technologies Education/ Canada	3 May - 16 May 1986
Application-Oriented Adaptation of Integrated CAD/CAM Systems	1	Kroum MANOILOV	Georgia Institute of Technology/USA	29 July - 31 Aug. 1986
The Graphical View Station and Manufacturing Data Bases	1	Nikola RAYNOV	Georgia Institute of Technology/USA	29 July - 1 Aug. 1986
A System Simulation Technique for the Technical Evaluation and Economic Justification of a Computer Aided Design System	1	Malinka SAVOVA	Technische Universitaet Wien/Austria	4 Aug. - 6 Sept.1986
Distributed Processing in CAD Systems	1	Stoyan BOEV	NORCONSULT/Norway	10 Aug. - 12 Sept.1986
Distributed Processing in CAD Systems	1	Anton MADJAROV	ABACUS - University of Strathclyde/UK	11 Sept.- 10 Oct. 1986

1	2	3	4	5
Drafting Automation Graphic System	1	Jordan MINDOV	PAFEC LTD./UK	8 Oct. - 8 Nov. 1986
Linking Finite Elements Analysis and Solid Modelling	1	Darina MARKOVA	University of Leeds/ UK	18 Oct. - 18 Nov. 1986
A Method for the Analysis of System Requirements and the Concept of Systems	1	Albena CHAMOVA	University of Tuebingen/FRG	3 Nov. - 3 Dec. 1986
Linking Finite Elements Analysis and Solid Modelling	1	Georgi POPOV	IPK /West Berlin	3 Nov. - 3 Dec. 1986
Distributed Processing in CAD Systems	1	Emanuel IKONOMOV	***	

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Being arranged at the moment of drafting the Terminal Report

ANNEX A.4

LIST OF REALIZED STUDY TOURS

Event	Location and Time	No. of Participants	Duration m/d
1	2	3	4
9th World Computer Congress IFIP '83 and SICOB '83 Exhibition	Paris, France September 1983	4	40
European Study Tour (Royal Institute of Technology - Stockholm; RPK-Institut - Karlsruhe, WZL-Institut - Aachen; UMIST - Manchester, PAFEC LTD. - Nottingham, CAD Centre - Cambridge, D'ARCY RACE - Oxford, IMPERIAL and BADFORD COLLEGE - London)	Sweden, FRG, UK October/November 1983	3	75
12th Annual Conference on Computer Graphics and Interactive Techniques SIGGRAPH '85	San Francisco, USA July 1985	1	6
EUROGRAPHICS '85 European Computer Graphics Conference and Exhibition	Nice, France September 1985	1	10
CAMP '85 European Conference and Exhibition of Computer Graphics	West Berlin September 1985	1	7

ANNEX A.5

LIST OF MAJOR ITEMS OF UNDP FINANCED EQUIPMENT

Equipment	Manufacturer	Cost US $	Delivery
1	2	3	4
Copier 3450 c/w Bin Sorter and Spare Parts	RANK XEROX Ltd.	12'222,-	Apr. 1983
VOLKSWAGEN COMBI - 9-Seater 1900CC 44 kW Chassis No. 253551 Motor No. DF022300 WV 2ZZZ25ZDH047619	VOLKSWAGEN AG, FRG	8'500,-	Feb. 1984
INTERMAT System Type 4-10, Complete	Standard Elektrik Lorenz Aktiengesellschaf, FRG	4'378,-	Feb. 1984
Colour Videocassette Recorder AC Only VO-5630	SONY Corp. Japan	1'502,-	Mar. 1984
Portable Colour Video Cassette Recorder VO-4800PS	SONY Corp. Japan	1'773,-	Mar. 1984
Video Camera (Colour) AC/DC DXC-1640P	SONY Corp. Japan	1'764,-	Mar. 1984
SONY TRINITRON Colour Video Monitor PVM-2000PS	SONY Corp. Japan	747,-	Mar. 1984

Colour Monitor Television PVM-9C00ME	SONY Corp. Japan	604,-	Mar. 1984
Video Cassette Recorder, AC-Only SL-T30ME	SONY Corp. Japan	662,-	Mar. 1984
Colour Television Receiver/Monitor CKV-2760PSE	SONY Corp. Japan	882,-	Mar. 1984
KODAK CAROUSEL Slide Projectors S-AV 2050 and S-AV Presentation Unit	KODAK Gesell-schaft, FRG	2'650,-	Jan. 1985
3M Overhead Projectors, Model 213, Portable, with Accessories	3M, Austria	1'662,-	Apr. 1985
New CANON F-1 Photo-graphic Camera, with Accessories	CANON, Austria	2'800,-	June 1986

ANNEX A.6

LIST OF MAJOR EQUIPMENT ITEMS SUPPLIED BY THE GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BULGARIA

		Qty
1.	PDP 11/34 Computer System	1
2.	VT 52 Video Terminal	1
3.	LA 120 Printer	2
4.	VT 125 Video Terminal	2
5.	VT 100 Video Terminal	1
6.	CIFER Video Terminal	10
7.	Air-Conditioning Units OeKG	3
8.	CALCOMP 960/925 Plotter Subsystem	1
9.	CALCOMP 648 Digitizer Subsystem (with 2 Video Terminals)	1
10.	TEKTRONIX 4013 Graphic Terminal	1
11.	TEKTRONIX 4631 Hard Copy Unit	1
12.	Letter Printer 100	1
13.	TOPAZ Stabilized Power Supply	2
14.	DECPrinter I	1
15.	TEKTRONIX TM 504 Power Module	1
16.	TEKTRONIX 465 Oscilloscope	1
17.	Card Reader	1
18.	IBM PC/XT - Compatible Microcomputers with Graphic Peripherals (Tablet, Plotter, Fixed-Disc Unit and Cassette Recorder)	4
19.	ES 5061 S4 Disc Units	50
20.	ES 5061 S4 Disc Drives	4
21.	SM 5405 Disc Drive Controller	1
20.	Disc Drives for RL01 and RL02	35
21.	SM 5300.01 Magnetic Tape Units	2
22.	SM 5001 Magnetic Tape Unit Controller	1
23.	Magnetic Tapes for SM 5300.01	170
24.	Line Printer	1
25.	ISOT-8503 C Multiplexor	1
26.	SM 1604 M1 Video Terminal	5
27.	SM 1604 M3 Video Terminal	10
28.	Software Packages, including Operating Systems, Programming Languages Compilers, Functional Graphic Software, including DOGS - Drafting Automated Graphic System, and Other Utility Packages	
29.	IBM 82 and IBM 96 Type Writers (One Each Model)	2
30.	HEBROS 305 Type Writer	3
31.	HEBROS 1300 F Type Writers	2
32.	HITACHI VHS Video Recorder	1
33.	SHARP VHS Video Recorder	1
34.	AIWA Radio Recorder	1
35.	SHARP Radio Recorder	1
36.	Tools and Instruments	

ANNEX A.7

LIST OF MOST IMPORTANT BOOKS AND PERIODICALS PROVIDED DURING PROJECT

1. Local Area Networks and Distributed Office Systems - Network Systems Development
ONLINE Publications LTD.

2. The Locanetter Designer's Handbook
ONLINE Publications LTD.

3. MAIR, W.C., WOOD, D.R. and DAVIS, K.W.: Computer Control and Audit
ONLINE Publications LTD.

4. Computer Graphics '82
ONLINE Publications LTD.

5. The S. KLEIN Directory of Computer Graphics Suppliers

6. MANO, M.: Computer System Architecture

7. BAILEY, R.B. (Ed.): Human Performance Engineering. A Guide for System Designers

8. EADIE, D.: A User's Guide to Computer Peripherals

9. VETTER, M. and MADDISON, R.: Data Base Design Methodology

10. TEORY, T.J. and FRY, J.P.: Design of Data Base Structures

11. GIBSON, G.A. and LIN, Y.C.: Microcomputers for Engineers and Scientists

12. 12th Design Automation Conference'75, IEEE, New York

13. International Conference on Production Technology '74, Australia

14. YAMAMOTO, K.: Preparing a Contour-Map with a Line-Printer from Irregularly Spaced Data

15. DE REUS, C.E.C. and VAN DER ZEE, T.A.: The Computer as an Aid to Architectural or Townplanning

16. FEODOROV, S.I.: Computer-Aided Design of Unit-Construction Type Machine Tools and Automatic Lines

17. GAUSEMEIER, J. and MULLER, G.: COMPAC - A Facility for Computer-Aided Construction and Production Planning

18. SIMONOVSKI, D.L., BORSHCHEVSKII, V.M. and EUBIK, V.B.: Computer-Aided Design of Spindle Gearboxes for Unit-Construction Machines

19. OLIVA, L.A. and VIRGILIETTI, E.: Electronics in Ship Construction

20. Willey, D.S.: Approaches to Computer-Aided Architectural Sketch Design

21. WARNER, J.R.: Design Applications of the MIDAS Graphics System

22. BEEP-BEEP: Building Energy Estimating Program

23. Three-Dimensional Drawings of Objects Using a Microcomputer, Plotter and Software Package

24. HORII, M., ADJAJI, T., WAGA, A. and SUTO, F.: A CAD System for Building Structures in 'Building RC/SRC/S'

25. BRAID, I.C. and LANG, C.A.: Computer-Aided Design of Mechanical Components with Volume Building Bricks

26. SATA, T., OKUBO, N., SATO, N., TAKEUCHI, Y.: Computer-Controlled System for the Design of Machine Tools

27. HELLIWELL, G.: CAD/M/A System to Integrate the Functions of Design and Manufacture in the Production of Mechanical Equipment

28. EWERS, B.E.: Computerized Drafting

29. GERO, J.S.: An Interactive Site Feasibility Study for Architects and Designers

30. YOSHIDA, K. and NAKAYAMA, N.: On-Line Pattern Design System for Integrated Circuits

31. CIOPIPI, P., SIMONCINI, L., TOMLJANOVICH, M. and VALLE, G.: State-of-the-Art and Trends in Design Automation in Italy

32. VLIETSTRA, J. and WIELINGA, R.F.: Computer-Aided Design

33. Subscription to CAD (Computer-Aided Design) Magazine

34. Subscription to Computers and Graphics Magazine

35. Subscription to Design Studies Magazine

36. Subscription to CAD/CAM International Magazine

37. Subscription to Computer Graphics

38. BESANT, C.B.: Computer-Aided Design and Manufacturing

39. FAUX, I.D. and PRATT, M.J.: Computational Geometry for Design and Manufacture

40. HARRINGTON, S.: Computer Graphics. A Programming Approach

41. ROGERS, D.F. and ADAMS, J.A.: Mathematical Elements for Computer Graphics

42. RYAN, D.L.: Computer-Aide Graphics and Design

43. NEWMAN, W.M. and SPROULL, R.F.: Principles of Interactive Graphics

44. ENDERLE, G., KANSY, K. and PFAFF, G.: Computer Graphics Programming

45. PILOTY, R., BARBACCI, M., BORRIONE, D., DIETMEYR, D.: CONLAN Report

46. OVERMARS, M.H.: The Design of Dynamic Data Structures

47. CHANG, S.K. and FU, K.S. (Ed.): Pictorial Information Systems

48. FU, K.S. and KUNII, T.L. (Ed.): Picture Eginering

50. FISCHER, W.E.: Datenbank fuer CAD-Arbeitsplaetze

51. ARTHUR, P. (Ed.): CAD/CAM in Education and Training. Proceedings of the CAD ED'82 Conference

52. ARTHUR, P. (Ed.): CAD/CAM: Training and Education through the 80ies. Proceedings of the CAD ED'84 Conference

53. MICAD'84 Proceedings of the 3rd European Conference on CAD/CAM and Computer Graphics. 3 Volumes

54. BEGG, V.: Developing Expert CAD Systems

55. FELLOWS, J.: All About Computer-Aided Design and Manufacture. A Guide for Executives and Managers

56. Subscription to Business Computing Magazine

57. Subscription to Computer Graphics World Magazine

58. Subscription to CADalyst Magazine

59. CARTWRIGHT, S.R.: Developing Video Training Programs

60. PAO: Elements of Computer-Aided Design and Manufacturing, CAD/CAM

61. WOLFENDALE, E.(Ed.): Computer-Aided Design Techniques

62. HENDERSON, P.: Functional Programming, Application and Implementation

63. FOLLEY, J.D. and VAN DAM, A.: Fundamentals of Interactive Computer Graphics

64. Computer Graphics CAD and CAD/CAM, Product Guide and Suppliers' Directory 1982. Vol. 1: Hardware and Systems

64. Computer Graphics CAD and CAD/CAM, Product Guide and Suppliers' Directory 1982. Vol. 2: Software

65. CAMP'83 Proceedings

66. CAMP'84 Proceedings

67. CAMP'85 Proceedings

68. EUROGRPHIC'85 Proceedings

and many others.

ANNEX A.8

COUNTERPART STAFF OF PROJECT

1.	Project Director	- Arahangel KUZMANOV	(left Project in 1984)
2.	Project Director	- Plamen MATEEV	
3.	Project Deputy Director	- Emil NEDEV	(left Project in 1984)
4.	Project Officer	- Svetlozar GRANCHAROV	(left Project in 1984)
5.	Project Officer	- Rayna IVANOVA	
6.	Project Secretary	- Slavka MITOVA	
7.	Project Driver	- Vassil DINEV	

Project Decision-Making Group:

8.	Senior Specialist	- Harutyun BEDROSSYAN	
9.	Senior Specialist	- Yordan MINDOV	
10.	Senior Specialist	- Zoya CHOBANOVA	
11.	Senior Specialist	- Kroum Manoilov	
12.	Senior Specialist	- Vladimir GRIGOROV	
13.	R & D Specialist	- Lyubomir KAMILAROV	(left Project in 1985)
14.	Senior Specialist	- Nikola RAYNOV	(left Project in 1986)

Laboratory Staff:

15.	Senior Specialist	- Nedko YONKOV	(left Project in 1985)
16.	Senior Specialist	- Georgi POPOV	
17.	Senior Specialist	- Emilia GURKOVA-PAUNOVA	
18.	Senior Specialist	- Elena DOBREVA	
19.	Senior Specialist	- Ilcho HARIZANOV	
20.	Senior Specialist	- Lyubomir RADEV	
21.	Senior Specialist	- Zdravko BAYCHEV	
22.	R & D Specialist	- Malinka SAVOVA	
23.	R & D Specialist	- Albena CHAMOVA	
24.	R & D Specialist	- Boris TRENDAFILOV	
25.	R & D Specialist	- Margarita DINEVA-VELIKOVA	
26.	R & D Specialist	- Emanuel IKONOMOV	
27.	R & D Specialist	- Venelin TOMANOV	(left Project in 1985)

28.	R & D Specialist	- Stoyan BOEV
29.	R & D Specialist	- Anton MADJAROV
30.	R & D Specialist	- Darina MARKOVA
31.	R & D Specialist	- Lyudmil TULEV
32.	R & D Specialist	- Stephan KARKEV
33.	R & D Specialist	- Zhivko KOSTADINOV
34.	R & D Specialist	- Lyudmila IVANOVA
35.	R & D Specialist	- Margarita MARINOVA
36.	R & D Specialist	- Bisser VASSILEV
37.	R & D Specialist	- Petko BUKOV
38.	R & D Specialist	- Stephan VASSILEVSKI
39.	R & D Specialist	- Nikolay DJUKANOV
40.	R & D Specialist	- David AVISHAI
41.	Economist	- Lyubka MANOVA
42.	Economist	- Emilia PCHELAROVA-STANISHEVA
43.	Technician	- Rumen YOTOV
44.	Technician	- Georgi PAVLOV
45.	Technician	- Ralitza SHOSHEVA
46.	Technician	- Ilia Fabrikarov
47.	Technician	- Marin NIKOLOV
48.	Support Staff	- Vessela STOYANOVA
49.	Support Staff	- Valerina PANEVA
50.	Support Staff	- Pavel STOYNEV
51.	Support Staff	- Ivan DULOV

ANNEX A.9

LIST OF INTERNATIONAL SEMINARS HELD

Description	No. of Participants	Dates
1	2	3
1. Seminar and Demonstration of Romanian Products for Computer-Aided Design	50	31.11 - 1.12.1983
2. Interactive Computer Graphics	120	14.06.1984
3. Strategy in CAD Systems Development	50	11.10 -12.10.1984
4. Current Trends and Alternatives in the Development of CAD Systems and Application - in Sofia	30	18.11.1985
5. Current Trends and Alternatives in the Development of CAD Systems and Applications - in Varna	10	20.11.1985
6. Introduction into the Computer-Aided Design - in Varna	30	3.03.1986
7. Introduction into the Computer-Aided Design - in Sofia	60	5.03.1986
8. Graphic Standards - in Varna	15	17.03.1986
9. Graphic Standards - in Sofia	20	19.03.1986
10. Sollid Modelling and Data Base Modules for Computer-Aided Design	150	12.08 - 13.08.1986

ANNEX A.10

CAD/CAM TRAINING PROGRAMME

MODULE A: INFORMATION FOR MANAGERS

1. Computer Applications in Industry
2. Basic Concepts of Automation
3. Building of CAD/CAM Systems
4. Demonstration/Videofilm
5. CAD/CAM Hardware and Software
6. Strategy in CAD/CAM Implementation
7. Economic Aspects of CAD/CAM Implementations
8. Introduction to Integrated Manufacturing Systems
9. Practice with CAD/CAM Systems
10. Training-on-the-Job

MODULE B:

LEVEL I: INTRODUCTORY COURSE FOR CAD/CAM USERS

1. Computer Applications in Industry
2. Basic Concepts of CAD/CAM and Automated Management Systems
3. Building of CAD/CAM Systems
4. Demonstration/Videofilm
5. Practice with CAD/CAM Systems
6. Training-on-the-Job

LEVEL II: BASIC COURSE FOR CAD/CAM USERS

1. CAD/CAM Hardware and Software
2. Practice with CAD/CAM Systems
3. I Workshop: Drafting with Automated Graphic System
4. CAD/CAM Systematics
5. Information Flow in CAD/CAM Systems
6. II Workshop: Design with a CAD System
7. Training-on-the-Job

LEVEL III: EXTENDED COURSE FOR CAD/CAM SYSTEMS ENGINEERS

1. Formulation of the CAD/CAM System Specification
2. Operating Systems
3. Workshop
4. FORTRAN
5. Specifying of CAD/CAM Systems as per Customers' Requirements
6. CAD/CAM Methodology
7. Training-on-the-Job

MODULE C: COURSE FOR ORGANIZERS OF INTEGRATED MANUFACTURING SYSTEMS

1. Information Management Systems
2. Enterprizes Organization
3. Management of the Individual Projects
4. Design Systematics
5. Preparation of CAM
6. Process Flow
7. CAD/CAM Systems in Integrated Manufacturing
8. Practice in Industry

ANNEX A.11

ASPECTS OF CAD LAB DEVELOPMENT

Since the introduction of CAD/CAM systems in practice, the methods of work of the design organizations changed drastically.

However, there are still people, who hesitate - some, because of the great investments, others - because they are not aware of the multiple applications of these systems.

In other words, although the decision of the wide introduction of computers in data processing was made by certain organizations years ago, the selection of hardware and software for computer-aided design became more difficult and is obstructed by the great investments. Something more, the managers are afraid that the decision made today may concern expensive and, later, good for nothing system. In the long run, the rate of hardware innovations is quite high.

On the other hand, the requirement of the user is: A CAD/CAM SYSTEM WITHOUT PROBLEMS!

The two-year experience of the CAD Research and Development Laboratory results in the definition of the following problem areas in CAD decision-making:

1. The user's requirement is not to come to a dead-end when introducing new technology, i.e. he would like to use the equipment selected today for a longer period of time.

2. Efficiency, meaning small initial investments, short periods of turn-over, quick acceptance of the system by the users and good possibilities for its expansion, should be ensured.

3. The system should give solutions for the organizations' problems, according to its possibilities, and be easily adapted for the respective applications and the existing structure of operation.

IN RESPONSE TO THE CUSTOMERS' REQUIREMENTS, CAD LAB OFFERS:

A developed CAD/CAM COMPLEX, that could solve problems in many applications.

This complex comprises all basic possibilities that could be expected from CAD systems, as 2-D interactive graphics, design alternatives, models, inventory lists, symbol libraries, interfaces to the usual peripherals. The COMPLEX includes two system divisions:

1. The 3-D Interactive Graphic System - TIGS

   This is a flexible CAD system based on 16-bit personal computers that could be used in all areas of applications. Its main features are:

   - Easy work with the system;
   - No previous knowledge of computers and programming is required;
   - Short training period;
   - Quick and precise drafting;
   - Possibilities for expansion and connection with other systems.

2. The Interactive Integrated Graphic Design System - DIGSPE

   DIGSPE is a universal CAD/CAM system based on 32-bit super mini computers, applicable in all areas. It is:

   - Comfortable for the user;
   - Easily adapted;
   - Able to provide:

     i) Design alternatives and models as follows:

        * 3-D wireframe model
        * 3-D model on the basis of free boundary surfaces
        * 3-D solid model
        * Colour shaded pictures

     ii) A graphic data base

     iii) A programme for archive management

     iv) Numerical control programmes

     v) An interface for data input to the production planning system

The two systems build a comprehensive modular complex that offers to the customer solutions according to his specific requirements.

Both systems are turn-key ones, comprising one or several workstations - individual ones or connected to a main-frame computer.

The new in the offered CAD/CAM COMPLEX is, that it takes into account the existing files.

Even the files and drawings created by personal computers could be used by 32-bit computers without any changes.

A characteristic feature of the system is the possibility for exchange of information between all IBM PC XT or AT compatible 16-bit microcomputers and any 32-bit computer by means of IGES interface, i. e. the interface between TIGS and DIGSPE is available.

In other words,

The software packages possibilities range from the basic graphics and drawing tasks to the sophisticated presentations of 3-D colour-shaded solid models; to the computer-aided manufacturing (using numerical control), and to the provision of data for production planning system, thus giving a basis for transition to computer integrated manufacturing (CIM).

The modular structure of the systems and the interface between the 16-bit and 32-bit computers guarantee the high efficiency of the CAD/CAM COMPLEX.

The CAD/CAM systems developed by the CAD Research and Development Laboratory offer a lot of advantages for the designers' such as standardization, flexibility, conveniency by interaction in Bulgarian language, logically structured menus, easy selection of programmes and, most important, a full modular training programme taking into consideration the initial level of the customer.

4.

The Research and Development Laboratory works and implements jointly with:

- The Institute of Heavy Machine Building in Radomir
- "ANGUEL KANTCHEV" Higher Technical School in Rousse
- The Bulgarian-Hungarian Joint Venture "INTRANSMASH"
- ENERGOPROEKT Design Organization
- MACHINOEXPORT
- "BALKAN" Machine-building Plant in Lovech
- "ELPROM" Plant in Lovech
- "GLAVPROEKT" Design Institute
- "MASHPROEKT" Design Institute
- The State Committee for Science and Technology
- The City Council of Sofia
- NIPRORUDA Design Institute
- The National Training Centre on Informatics at the State Association "SOFTWARE PRODUCTS AND SYSTEMS"
- The Machine Tools Central Research and Development Institute
- "TECHNOINVEST" Computer-Aided Design Centre
- "CHIMSNAB" Design Organization
- "LENIN" Higher Institute of Mechanical and Electrical Engineering - Sofia
- The Higher Institute of Mechanical and Electrical Engineering in Plovdiv
- The Higher Institute of Mechanical and Electrical Engineering in Varna, etc.

A lot of factors should be taken into consideration when starting the implementation of a CAD/CAM system, the software being the most important one, since it should be able to give possibilities for the system's expansion and its adaptation to certain applications and organizational structures.

The success will be based on the versatility of the functions offered as well as on the simple and easy-to-learn work with the programme. All commands are entered via dialogue in Bulgarian either from a tablet menu or on the screen, or through the keyboard.

The 2-D Interactive Design System (DDESP) represents the nucleus of the 2-D design system that could be easily adapted, step-by-step, through additional modules expansions, to different requirements. The modules include programmes for 3-D design on the basis of different presentations of models within the computers, as well as a finite-element-methods analysis, all of these programmes including also the related data preparation and processing. Besides the different applications software packages, it is also possible to introduce into the system's configuration a date base and numerical control programming modules.

All packages are compatible with the data already input by using the 2-D Interactive Graphic System - DIGS for SM-4 minicomputers, since all software is developed by the same laboratory. Thus a complete system, that preserves the possibility for portability and that makes the introduction of new technologies easy, is provided.

Being developed by means of a high-level programming language, the system modules could be installed on different 32-bit computers. This provides for the long period of use of NILPKIT COMPLEX in future.

The information exchange with other producers' systems will be carried-out by IGES standard interface. This is a very important advantage of the system, that facilitates the communication with suppliers and end-users.

Other interfaces for output of non-graphic information, such as to the production planning system, as well as for use of already existing programmes, will make NILPKIT COMPLEX suitable for all applications within the enterprise.

The CAD Research and Development Laboratory offers CAD/CAM systems at different levels of sophistication, that could always be expanded in order to meet the needs of the enterprise implementing such a system. Thus the inexpedient investments will be avoided, no matter whether small, or rather large ones.

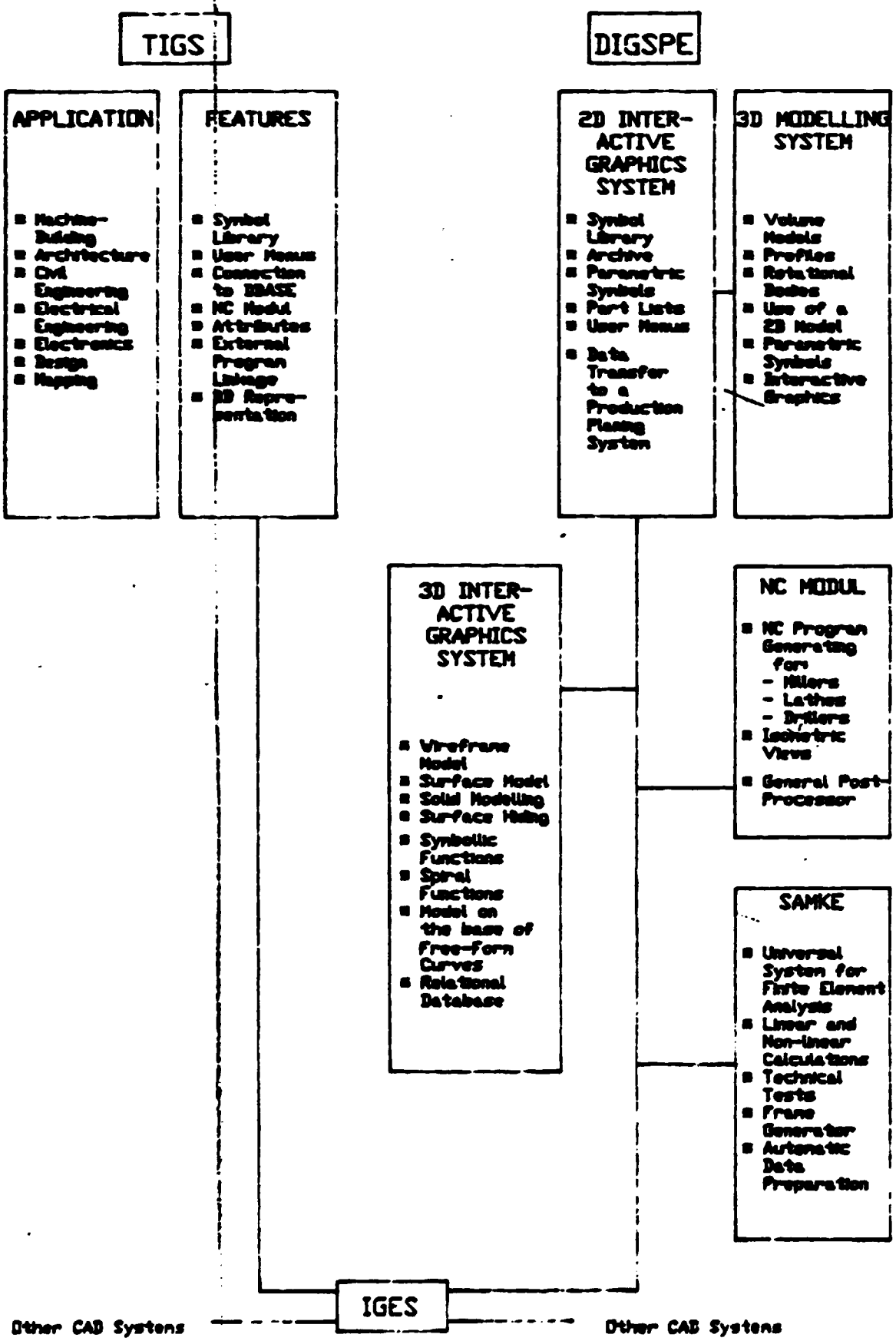
You could choose between turn-key systems on the basis of 16-bit microcomputer workstation and turn-key systems based on the 32-bit main-frame computer - the so-called super-mini computer.

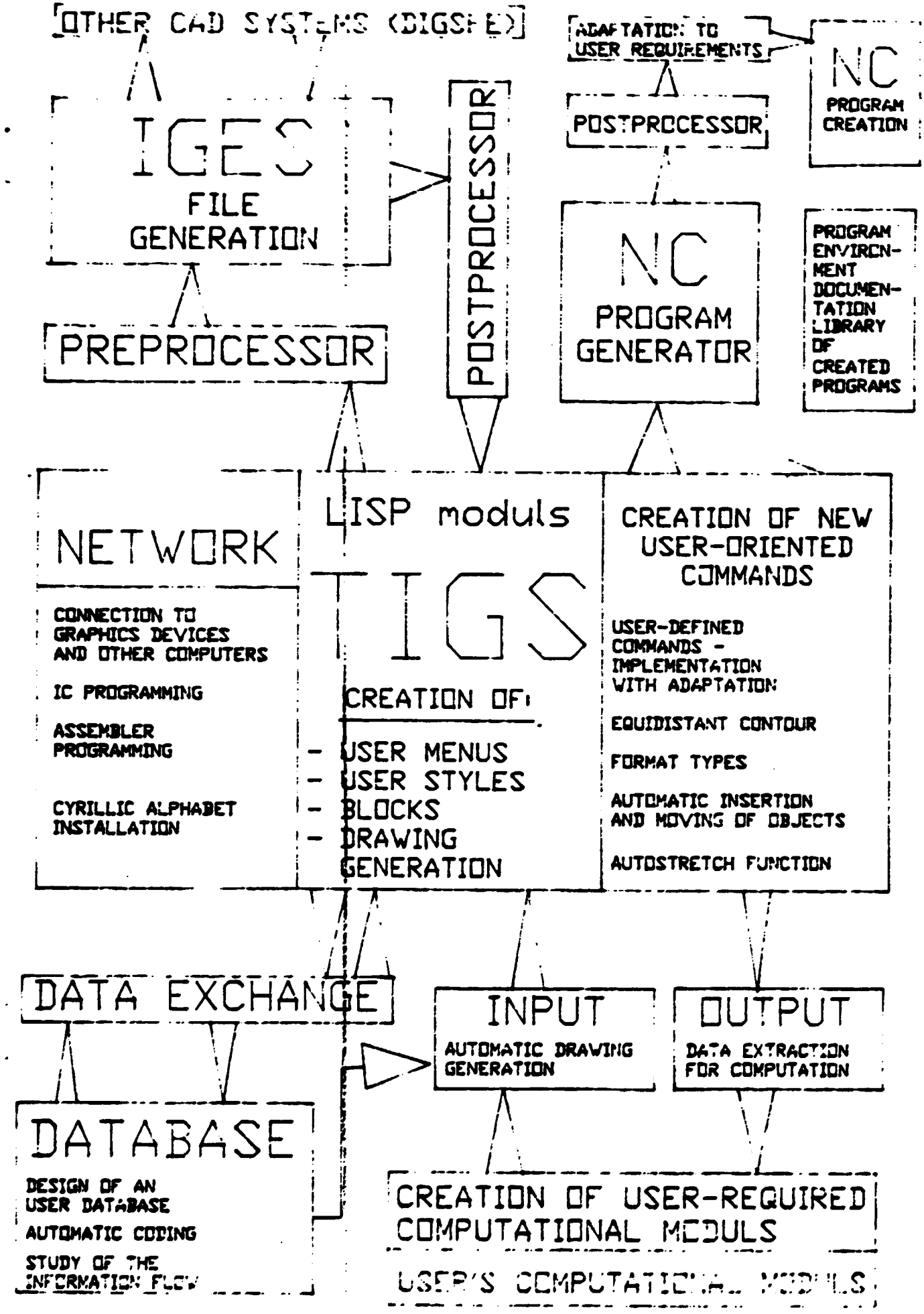
When one starts with small initial investments, with one workstation, later several such workstations are connected in a local network, so that they could use the same peripherals - plotter, printer, auxiliary memory of great capacity, etc. Thus, each workstation has an access to all data. Besides this, when every new computer is installed, the processing capacity of the system is increased preserving the same short-response time.

If one prefers the solution on the basis of a main-frame computer that, besides CAD/CAM, might be used for other applications, graphic workstations to be used with already installed main-frames are also offered. In this case either colour, or black-and-white high-resolution screens of different manufacturers could be selected.

Each of these two alternatives is offered by preserving the complete freedom of selecting the hardware as well as ensuring the same developer of the software.

CAD/CAM COMPLEX




OTHER CAD SYSTEMS (DIGSPEC)
IGES
FILE GENERATION
PREPROCESSOR
POSTPROCESSOR
ADAPTATION TO USER REQUIREMENTS
POSTPROCESSOR
NC
PROGRAM CREATION
NC
PROGRAM GENERATOR
PROGRAM ENVIRONMENT DOCUMENTATION LIBRARY OF CREATED PROGRAMS
NETWORK
CONNECTION TO GRAPHICS DEVICES AND OTHER COMPUTERS
IC PROGRAMMING
ASSEMBLER PROGRAMMING
CYRILLIC ALPHABET INSTALLATION
LISP moduls
TIGS
CREATION OF:
- USER MENUS
- USER STYLES
- BLOCKS
- DRAWING GENERATION
CREATION OF NEW USER-ORIENTED COMMANDS
USER-DEFINED COMMANDS - IMPLEMENTATION WITH ADAPTATION:
EQUIDISTANT CONTOUR
FORMAT TYPES
AUTOMATIC INSERTION AND MOVING OF OBJECTS
AUTOSTRETCH FUNCTION
DATA EXCHANGE
INPUT
AUTOMATIC DRAWING GENERATION
OUTPUT
DATA EXTRACTION FOR COMPUTATION
DATABASE
DESIGN OF AN USER DATABASE
AUTOMATIC CODING
STUDY OF THE INFORMATION FLOW
CREATION OF USER-REQUIRED COMPUTATIONAL MODULS
USER'S COMPUTATIONAL MODULS

HARDWARE CONFIGURATIONS

SUPPORTED PERIPHERALS AND NETWORK

1 - Digitizer

2 - Symbols Library

3 - Plotter

4 - Magnetic Tapes

5 - Mainframe Computer

6 - Auxiliary Memory of Great Capacity

7 - Printer

8 - Display Buffer

9 - Loop Connection

10 - Line Connection

11 - Star Connection

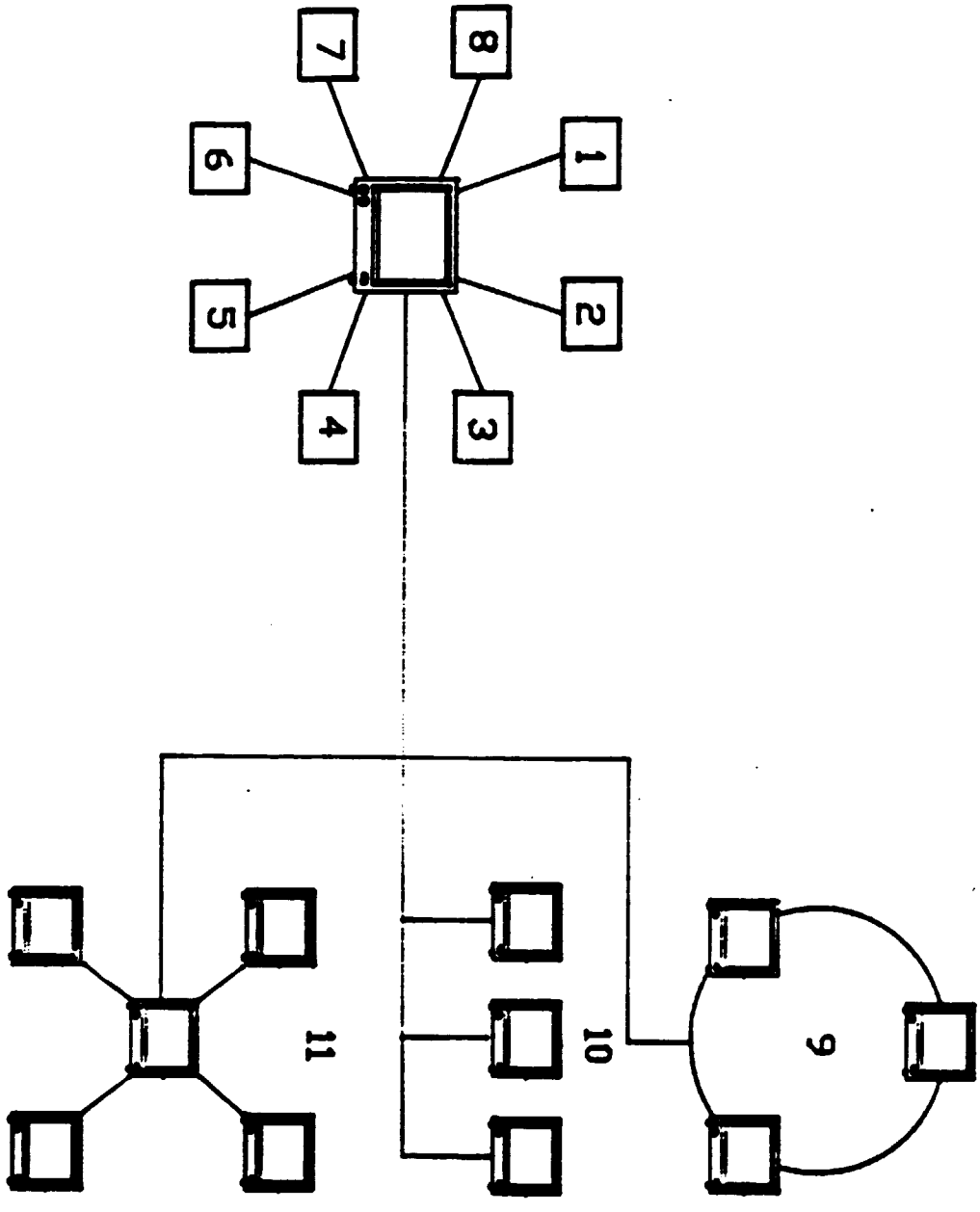
ALTERNATIVES

12 - One Workstation Alternative

13 - Mainframe Alternative

14 - One Station Alternative

15 - Several Workstations Alternative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DIGSPE BAR CHART

1 - 2-D Interactive Design System (DDSP)

2 - 3-D Modelling System (TCM)

3 - 3-D Interactive Design System (TDSP)

4 - Interactive Graphic System for NC-Programming

5 - NC - Interfaces

6 - COMPACT II

7 - GNC

8 - APT

9 - Finite Element Analysis System

10 - Graphic Input/Output System

11 - Programme for NC-Postprocesors Generation

12 - Relational Data Base

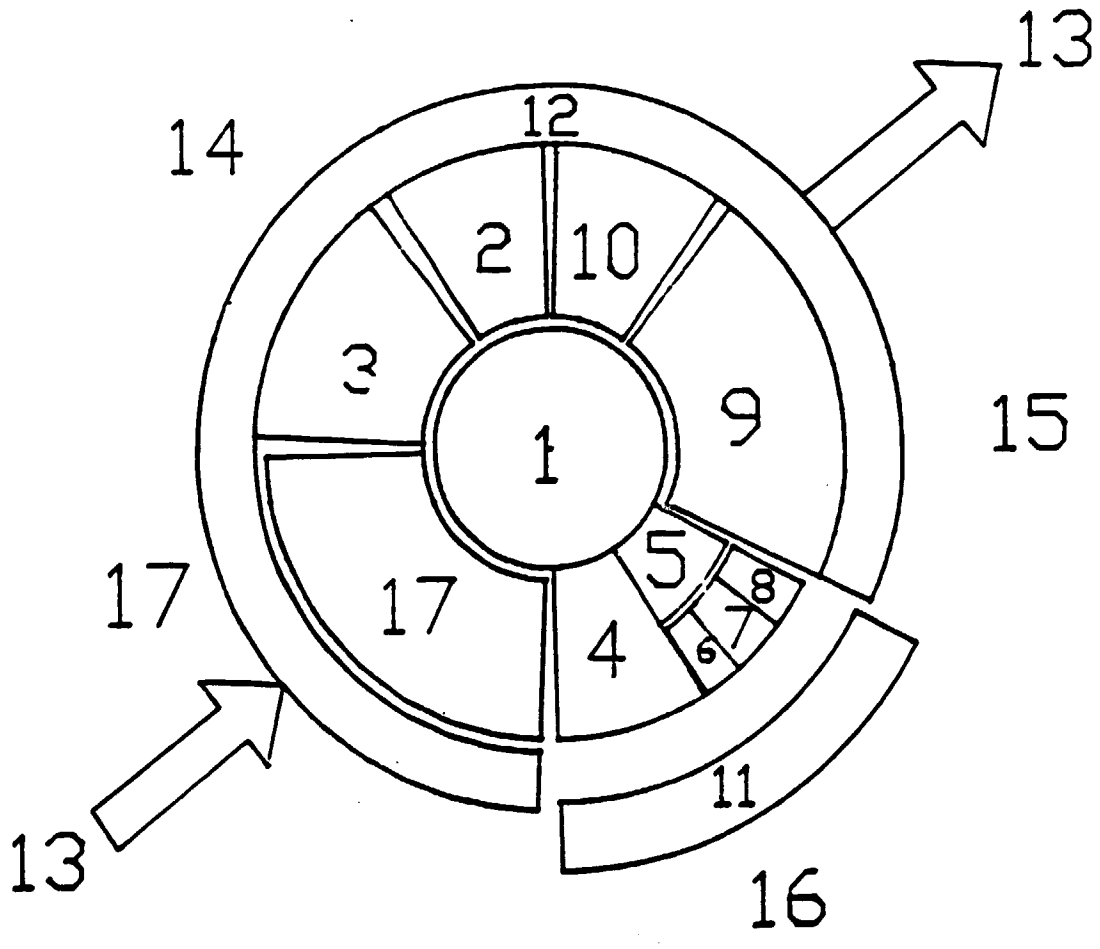
13 - Graphic Data Exchage Standard IGES

14 - Design

15 - Analysis

16 - Production

17 - Applications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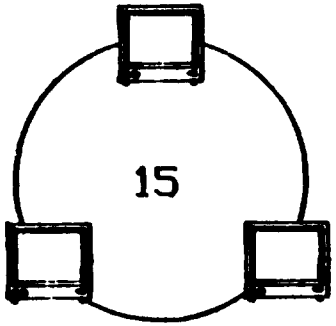

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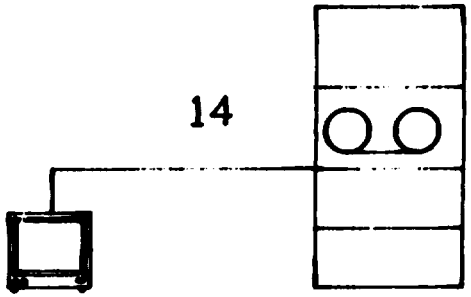

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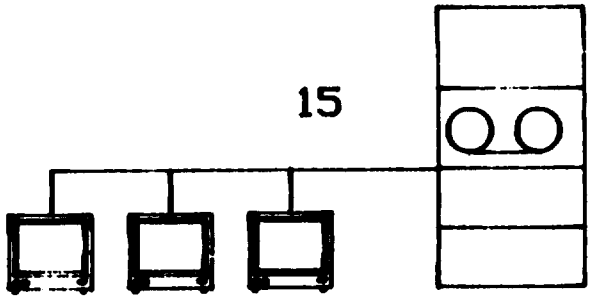

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