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INSTITUTING COMPUTERIZED WOVEN OR PRINTED TEXTILE DESIGNS WITH ADDED ADVANTAGE OF SHADE MATCHING

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INDIA

Technical report: Survey of CAD systems at ITMA*

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

Based on the work of Robert Hirschler and András Siegler
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United Nations Industrial Development Organization
Vienna

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ABSTRACT

The purpose of the mission (11 to 24 October 1987) was to give technical assistance in the selection of a suitable Computer Aided Design [CAD] system for the Bombay Textile Research Association [BTRA].

A survey of CAD systems was conducted at the International Textile Machinery Exhibition [ITMA] in Paris. Implications of the latest technical developments have been determined, and the characteristic features of up-to-date CAD systems analysed. Neutral specifications for the ordering of the equipment have been prepared.

It has been concluded, that for the project a CAD system with the following features is to be recommended:

- full package of textile-oriented application software supported by suitable hardware;
- more than one work-stations to facilitate services offered for the industry and simultaneous software development work;
- preferably PPC based to ensure operational safety, cost-effectivness and eventual expansion.

With the selection of a suitable system the services of BTRA for the industry can be started right after the installation of the equipment, and the training of the project team.

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I PURPOSE OF MISSION

The purpose of the mission was to give technical assistance in the selection of a suitable Computer Aided Design [CAD] system for the Bombay Textile Research Association [BTRA]. In particular the experts - in close cooperation with the Principal Investigator of the project - had to

- survey the CAD systems exhibited at ITMA in Paris;
- advise on the selection of a suitable system;
- prepare neutral specifications for the ordering of the equipment.

II FINDINGS

A. ITMA: the state-of-the-art and its implications

The International Textile Machinery Exhibition [ITMA] organized every fourth year is the major show for new developments in all fields of textile manufacturing. This year one of the main attractions was the spectacular breakthrough in CAD/CAM applications in weaving, knitting and printing, illustrated by the fact that over 60 companies exhibited such systems (see Annex 1.)

This abundence of new developments necessitates the more accurate definition of the realizable objectives within the terms of reference of the BTRA project.

Services

The services to be conducted by BTRA after the installation of the CAD system will include:

- customers (mills) using/renting the system;
- BTRA designers working for customers;
- the BTRA design library:
  - collecting motifs from drawings, paintings and natural objects indoors and outdoors,
  - creating new patterns resp. designs,
  - building up library;
- education and training:
  - teaching prospective users how to think in terms of CAD,
  - training users in the application of CAD,
  - training designers in special techniques in the design of patterns, structures, colouring etc.

Selecting a system with a comprehensive textile application software is of primary importance, because this would enable BTRA to start with practically all of the above services right after the installation of the equipment, and these services can thus be well established with the industry in a relatively short time. Starting with a system equipped with only a general CAD program package would on the other hand mean, that these services cannot be started - even in a simplified way - in less than 2 or 3 years after installation.

The educational and training activities make it necessary to think in terms of a system with at least 3 or 4 workstations, which can be used simultaneously. This can be achieved with some of the available systems either in a master/slave configuration with graphic workstations or with systems based on professional personal computers which can be connected into a network (see later in section Hardware).

Software development and technical training

There are three basic approaches to software development at BTRA:

(a) Starting from scratch, i.e. creating entirely new textile application programs making use of only the most basic software facilities delivered with the system (operating system, compilers, assembler, basic graphics interface etc.)

Taking this approach considerable time and effort would be needed to create the textile application software package necessary for performing the industrial services contemplated (at least 4 - 6 man-years of experienced software engineers / system programmers working on a familiar computer).

(b) Buying a system together with the SOURCE code of the textile oriented application software of the manufacturer.

On this basis further software development could be very effective: one could make use of many of the very sophisticated, ready-made solutions (e.g. user interfaces, ways of using the graphics library, drivers of peripheral devices etc.). Manufacturers of specialized systems however do not seem to be willing to make the source codes available, or only at exorbitant prices. In our opinion manufacturers should be asked for this possibility, but it shouldn't be a decisive factor in system selection.

(c) Provision of "hooks" to connect own software to that of the manufacturer.

A number of manufacturers seemed to be willing to sell their system with textile oriented CAD packages and provide BTRA with 'hooks" to their software. It means, that besides delivering the software package in the usual form, they would deliver a library of routines in object format (an intermediate format between readable source and runnable binary code). This would enable BTRA to start software development at a much higher level than in case (a), by

- improving existing programs, adding new features;
- writing new programs for new applications;
- replacing existing programs by newly developed, improved ones

The other advantage of this approach over (a) would be the possibility (with a system having more than one workstation) to start services for the industry and do the development simultaneously, as discussed in the previous section.

Since software development is going to be an important part of the project-team's activity it's not only the designers who need [application] training, but also the system/application programmers, who must receive thorough [technical] training by the manufacturer. Careful selection of qualified personnal going through the training is a decisive factor in the success of the project and in the best utilization of the equipment to be purchased.

By the end of the technical training all bottlenecks, limitations, accidental "bugs" in the system should also have been discovered and rectified.

B. Features of the available CAD systems

Hardware

All the professional systems today use either a 32 (maybe 16) bit micro- or mini-computer as a master, and intelligent graphics terminals as slave devices (Category A), or 16 (eventually 32) bit professional personal computers which can be connected into a network (Category B). Dedicated systems using low performance personal computers, special purpose 8 bit computers or home computers will not be considered.

A. High performance 32 bit master/slave systems

Features:

Advanced hardware (typically 32 bit computer, at least 1024*1024/8 bit frame buffer, intelligent graphics terminal, several alfa-numeric terminals, interfaces to various input/output devices);

extensive graphics library, driver programs for various I/O devices;
advanced systems software giving good environment for program development (e.g. UNIX-like operating system, several compilers [Pascal, C etc.];
application packages for one or more fields (weaving, printing etc.), library of highly developed software modules enabling the user to create application software in new fields. Source code availability preferred, minimum object code program libraries + well defined interfaces ("hooks") + linking facilities required.

Advantages:

Immediate utilization of CAD in some fields, immediate service to industry in some fields, possibilities for further development may be given.

Disadvantages:

Fairly high price may prevent the purchase of more than one work-station with no possibility of simultaneous designing and program development work; local technical back-up may be problematic, most manufacturers are unwilling to supply open-ended system.

Systems for further consideration:

BONAS:CAPS 3; DAINIPPON:PASTEC 4000; EAT:DesignScope; GROSSE:Jac-Art/Jac-CAD; IAM/NINO:CAD CAM TWEED; M&S: IGOS; MAUTOM:Abyssa; SILICON GRAPHICS:IRIS; SOPHIS: Unified Design Concept; VIABLE:Weavette; WILCOM: Embroidery CAD/CAM.

(For technical specifications see Annex 2.)

B. 16 or 32 bit PPC (network) based systems

Features:

Processing unit is a 16 or 32 bit micro, typically an 80286 with advanced graphics board; possibility of connecting several units into a local network with shared I/O peripherals and large capacity storage;
extensive graphics library, driver programs for various I/O devices;
packages for several textile application fields, open structure required.

Advantages:

More than one work-station and simultaneous programming can be realized cost-effectively;
well suited to the existing environment at BTRA (familiarity with IBM compatibles), possibility for further expansion given;
software "hooks" available with possibility of getting part of the programs even in source code; software development possible;
parallel systems give operational safety.

Disadvantages:

There is no serious disadvantage from the project's point of view.

Systems for further consideration:

CDL:Textile Design Station; DINEMA:Digraph; GV:High-Tex; MITSUBISHI:Checkmaker/Tex-Sim; PRAGMA:Scotweave; TCS: Desitex IV; VAN DITMAR:CAD/Color Composer.

(For technical specifications see Annex 2.)

Basic software and graphics firmware

A. High performance 32 bit master/slave systems

Manufacturers give only scarce information on the software background and graphics library (firmware) of their systems. Therefore only some general remarks can be made here based on the impressions collected at ITMA.

High-end systems are running under a multiuser operating system, typically UNIX System V. or VMS 4.x. Application programs are typically written in the "C" language, but some manufacturers work in PASCAL or even in ADA.

Practically all systems in this category can be operated in multi-user mode (2 to 8 work-stations). EAT and VIABLE however gave no information on that. On UNIX-based systems (e.g. SOPHIS, WILCOM, SILICONE GRAPHICS) multitasking enables each workstation to perform several tasks independently and simultaneously. Work-stations can share not only the host computer but also auxilliary equipment (cameras, scanners, printers, plotters etc.), thus reducing the cost of equipment per work-station. M&S demonstrated the operation of their system in multi-user mode.

User interfaces are in many cases definitely "artist-friendly", M&S, EAT, WILCOM, and BONAS illustrated this point very convincingly, while the otherwise remarkable SOPHIS appeared to be somewhat clumsy as compared to the other systems. This is a very important feature in system selection, because it contributes significantly to the speed and efficiency of both training and operation: a good graphic user interface will always guide the designer in what to do next.

Another crucial point in the selection of a system is its graphics library. Basic graphic commands are usually microcoded and run by the graphics coprocessor sitting in each work-station (e.g. M&S), but sometimes they are used at host level (e.g. BONAS). The power and efficiency of the graphics library can only be guessed by looking at the application programs. All the systems in this category made a very good impression in this respect. SILICON GRAPHICS has an extrememly strong graphics package making use of its 12 geometry engines (which may be much more than needed in textile applications, since these are mainly used for 3D engineering).

Concerning further conditions of software development (compilers, assembler, linker, text-processor, file management etc.) no information was available at ITMA, so these will have to be cleared during the final stage of equipment selection. A detailed list of device interface programs (drivers) should also be asked for in each quotation. This is important for the eventual purchase of some auxilliary equipment in a later stage.

B. 16 or 32 bit PPC (network) based systems

PC-based systems are usually operated by the MS-DOS operating system, which is single-user. If there are more than one users (designers and programmers), there have to be one host machine (typically an IBM AT), alphanumeric and graphics monitor, graphics controller and digitising tablet for each work-station. Most of the manufacturers offer fairly significant discounts for the second and further work-stations (e.g. TCS). The host machines can then be connected into a network making the common (shared) use of large capacity disks, I/O devices (e.g. camera, scanner, printer, plotter etc.) possible.

Typical programming languages are C and PASCAL. The performance of the application software depends to a great extend on the built-in graphics controller. TCS demonstrated not only a very powerful graphics hardware and firmware package but also an ingenious design software, which was able to fully utilize all the features of the graphics background, and incorporated a high-performance user interface as well. DINEMA were showing multiple workstations in connection with different textile machines.

Application software

One of the surprises of ITMA was the wide variety of textile-specific application software packages available. Since systems in both hardware categories A and B are fully capable of performing the operations necessary for the end-use, in the following discussion the features will be classified by end-use capabilities, irrespective of which category they fall into.

(a) Yarn design

Some of the more advanced systems (IAM/NINO, SOPHIS, VAN DITMAR, MITSUBISHI) start fabric design by designing individual yarns, and not only by setting twist and count but also by depicting effect yarns, multicoloured yarns, ply yarns etc. and then showing these effects in the fabric structure. Yarn colours can be defined visually or by spectrophotometer (see later).

(b) Design & display of woven or knitted structures

This is probably the most textile-specific feature of these systems: woven or knitted fabric structures can be simulated both on the screen and in hard copy.

Particularly lifelike prints can be obtained e.g. by the EAT, HIGH-TEX, IAM/NINO, MITSUBISHI and SOPHIS systems.

(c) Technical planning of woven or knitted structure

Most of the systems go on from mere representation of the fabric structure to the technical planning (fabric construction), i.e. the calculation of drafting, reed stitch, peg plan, warp&weft sequence, warp&weft density etc. In addition to numerical data the technical drawings (weave, warp&weft sequence etc.) are also made.

In our opinion this is how far the system at BTRA should go: offering the customers design work, hard copies and technical instructions upto technical drawings, but not punching the dobby or jacquard cards themselves, of which some of the CAD/CAM systems are also capable.

For dobby weaving GV-HIGH-TEX, IAM/NINO, MITSUBISHI and SOPHIS offered comprehensive programs; for jacquards BONAS, EAT, GROSSE, SOPHIS, TCS and VIABLE appeared to be the bests.

Most systems offered for knitting were specific CAD/CAM systems for a given type or make of knitting machine, with the DINEMA system being perhaps the most versatile. The Shimatronic Design System by SHIMA SEIKI is in a class of its own: way ahead of everybody else in covering everything from yarn and fabric design to cutting, but since the manufacturer doesn't consider yet selling the system outside of Japan and the USA, we shall not discuss it.

(d) Design for fabric printing

A CAD system for textile printing must have good free-hand drawing facilities, a versatile paint program, pattern fitting, step and repeat features and some means of colour separation. With DAINIPPON, HELL and SCITEX missing (somewhat inexplicably) from ITMA, only a handful of manufacturers offered software for textile printing, EIKONIX being perhaps at the highest level on the input side, while M&S, SOPHIS, TCS and VAN DITMAR offered the most comprehensive program packages.

(e) CAD and colour measurement

Colour measurement and colour matching can play an important supporting role in textile CAD. Some systems utilize colour measuring instruments at the input side for reading in the reflectance data (which are then reduced to RGB) for palette colours. CDL uses a HUNTER-LAB ColorQuest, EIKONIX an ACS SpectroSensor, HIGH-TEX and IAM/NINO a DATACOLOR spectrophotometer.

For this function all types of colour measuring spectrophotometers may be used, (e.g. the DIANO Match-Scan), only the data formats have to be agreed on.

The other important application of colour measurement is at the output side: recipes can be formulated with existing dyes on the required substrates. The problem here is the transformation of RGB values into reflectance data; the abovementioned manufacturers claim to have solved even that.

There is also another way of using computerized colour matching: that of measuring the colours of the hard copy, and predicting recipes on this basis. This is of course not as sophisticated as the direct method, but much simpler, and can be done with any colour matching system.

It follows that the connection between the DIANO MatchScan spectrophotometer of BTRA and any CAD system can fairly simply be established. Many of the manufacturers (e.g. GV-High-Tex Systems, IAM/NINO) said there would be no problem in connecting any spectrophotometer to their system provided it sends the measurement data in a standard format. These CAD systems however are not suitable yet to be used for solving colour matching tasks of a general nature.

It is recommended therefore, that the selection of the CAD system be not tied to the question of colour measurement. Having selected a CAD system on the principles to be discussed later, the course of action regarding the connection between CAD and CCM can be decided: the possibility will be there whatever host computer comes with the CAD system.

III NEUTRAL SPECIFICATIONS

In the "neutral specifications" we listed the most important technical data characterizing a CAD system suitable for the purposes of the project. These are minimum requirements, and therefore lower, in many cases much lower, than the corresponding values of the best systems available today.

These specifications are recommended to be sent to the manufacturers as cheklists in order to receive comparable quotations.

HARDWARE

Host computer:

- 16 or 32 bit CPU with possibility for either master/slave or parallel connection between work-stations;
- min. 512 Kbyte core memory
  + min. 4 Mbyte RAM extension;
- min. 8 MHz clock rate.

Data storage:

- floppy: min. 1.2 Mbyte;
- hard disk: min. 70 Mbyte;
- tape back-up unit: min. 40 Mbyte.

Graphics board resp. graphics terminal:

- in memory pixel res.: min. 512*512,
  preferably 1024*1024 or over
- # of available colours: 16,7 million;
- # of simultaneous colours: 256
- frame grab availability.

Colour monitor:

- 20 inch, flicker free.

Input devices:

- camera: full colour, res. min. 512*512;
- scanner: res. min. 0.1 mm;
  capture area min. A3;
- digitising tablet: res. min. 0.1 mm;
  size min. A1;
- free ports to further external devices.

Output devices:

- colour printer: size min. A3;
  res. min. 0.1 mm;
  palette: min. 4000 colours;
- B/W plotter (for paper and film):
  size min. A1;
  res. min. 0.1 mm;
- slide producer/video printer.

Additional information on hardware:

- type and manufacturer of each device;
- max. number of graphics work-stations;
- networking facilities;
- possibility of later expansion of system;
- physical layout (furniture);
- other hardware features, options.

SOFTWARE

- operating system, compilers (if any);
- graphics library;
- program library;
- software interfaces to user's programs
  ("hooks: how open is the system);
- text editors, file management;
- pixel and/or vector based packages, rasterization;
- software interfaces to I/O devices;
- other software features, options.

APPLICATION SOFTWARE

(These are options, please confirm availability and indicate additional features.)

Yarn design:

- yarn editing, structure/texture library;
- colouring of yarn, special effects;
- fancy yarns, ply yarns;
- palette planning, palette library;
- spectrophotometric input of yarn colours;
- instrumental colour matching, recipe predicition.

Weaving/knitting:

- woven/knitted pattern design;
- pattern/design library;
- warp and weft planning, colour planning;
- shadow effects, lifelike fabric structure (please illustrate on hard copy);
- yarn consumption calculation;
- pattern generation;
- dobby and jacquard commands, technical planning;
- production of technical drawings;
- colour matching for plain fabrics.

Textile printing:

- pattern design, drawing and painting;
- pattern fitting, step and repeat;
- colour separation, transparencies;
- colour matching, recipe prediction;
- hard copy (please illustrate).

IV EQUIPMENT SELECTION

There were 59 manufacturers at ITMA exhibiting CAD systems for textile applications, a full address list is given in Annex 1. There are three further companies listed (DAINIPPON, MAUTOM and SILICON GRAPHICS) who were not present at ITMA, but are important enough to be considered.

In addition to the companies previously contacted by UNIDO we only discuss those systems, which are either at the high end of technical possibilities (regarding both hardware and graphics software), or have a sufficiently high level hardware, and application software for more than one field. Some remarks on the systems recommended for further consideration will follow, technical details are given in Annex 2.

Systems for further consideration
(in alphabetical order)

BONAS: CAPS 3

Very good basic (graphics) software capable of fully utilizing the possibilities given by the highly developed hardware (including an excellent camera input). The application software appears to be fairly specific to jacquard design, serving as a CAD station for the sophisticated CAM system.

CDL: Textile Design Station

Limited to dobby design, rather poor graphics hardware, incorporates colour measurement input (HUNTERLAB).

DAINIPPON: PASTEC 4000

One of the most expensive colour separation systems for textile printing.

DINEMA: Digraph

One of the few systems where a fairly large number of workstations were exhibited at ITMA, in conjunction with CAM systems for a variety of knitting machines.

EAT: DesignScope

Excellent fabric and carpet representation on screen and ink-jet printer, utilizing a high-performance graphics board. Application software limited to woven and knitted design, with jacquard card punch capability. Not enough information is available on technical data.

EIKONIX: Designmaster 9000

Strongly printing-oriented system built around a very high quality line scanner (CCD line-array "camera"). No woven or knitted design capability yet.

GV: High-Tex-Systems

One of the best colour presentation systems using colour measurement (DATACOLOR) input. Limited to woven (dobby) design.

GROSSE: Jac-Art/Jac-CAD

A good choice of I/O devices, very strongly jacquard oriented, going all the way to direct loom control.

IAM/NINO: CAD CAM TWEED

One of the best hardware configurations (graphics workstation as well). Advanced application software, but so far only for dobby design. Input is a weak point: only through keyboard (i.e. there is no freehand drawing).

M&S: IGOS

Comprehensive hardware: all the necessary input/output devices available. Advanced CPU and graphics subsystems, and well designed work-stations. Graphics software based on both vector and pixel manipulation. The manufacturer showed willingness to provide software interfaces ("hooks") for further development work. Wide range of application software available.

This is one of the systems which can be recommended on the basis of the available information.

MAUTOM: Abyssa

One of the companies not present at ITMA, but they claim to have a comprehensive application software package including dobby and jacquard weaving, knitting and printing (with colour separation etc.). With a 32 bit computer (M 68020/68881) and a graphics board with enhanced colour capabilities it is definitely worth to contact the manufacturer for further information.

MITSUBISHI: Checkmaker/Tex-Sim

Weaving oriented system with good graphics capabilities and one of the best fabric simulation prints. Limited yet to dobby design.

PRAGMA: Scotweave

One of the best known systems, originally for dobby, now also for jacquard design. Further technical information is needed on the input/output possibilities.

SILICON GRAPHICS: IRIS

Probably the best hardware available, with capabilities way beyond those needed for textile CAD (export licence may be a problem). There is no information on textile application software (the company was not present at ITMA), but it is claimed to be available. If the system is to be seriously considered, further information is needed on this point.

SOPHIS: Unified Design Concept

Highly advanced system covering all fields of textile applications of CAD. Very strong (but not widely known) hardware and graphics software, excellent fabric structure representation. The user interface is not upto the technical level of the system (unlike most of the other systems this is not "designer-friendly").

TCS: DESITEX IV

Full choice of input/output devices. Host computer normally 16 bit PC, but manufacturer showed willingness to supply the latest (32 bit) IBM PS/2. There is a range of graphics boards offered including those at the high end. The software fully utilizes the capabilities offered by the hardware. The application software covers all major fields in textile CAD, showing a very strong development team behind it. The manufacturer showed willingness to provide software interfaces.

On the basis of our visit to ITMA (and also some other available information) this system is our recommendation for the project.

VAN DITMAR: CAD/Color Composer

One of the few systems offering application software for dobby and jacquard weaving, knitting and also textile printing. More information would be needed to seriously consider this system.

VIABLE: Weavette

Powerful system based on a very high quality hardware with I/O devices also at the high end. No information is available on the application software other than jacquard CAD/CAM.

WILCOM: Embroidery CAD/CAM

A system dedicated (with its present software) to embroidery, based on an excellent albeit somewhat limited hardware configuration. A very intelligent vector based graphics software with excellent user interface. The company showed much interest in the project, and willingness to supply a system according to requirements.

Selection process

In order to make sure that the system best suited for the project be selected, the following steps are recommended:

1. neutral specifications be sent to the manufacturers listed above for updated and comparable quotations;
2. systems be ranked on the basis of a combination of:
   - offering the most comprehensive application software package,
   - meeting the minimum requirements of hardware and basic software,
   - giving the best price;
3. to test the selected system (or the "best" 2 or 3 sytems) and clear all the technical details, one or two members of the BTRA project team (a technical expert and a designer) should visit the manufacturers, run trials for a week (on each system), and make the final decision.

We consider this procedure essential for a careful decision to be made.

Should, however a selection have to be made solely on the basis of the now available information (including our impressions gained at ITMA) our recommendation would be the TCS DESITEX IV system, and the M&S IGOS as second, for the reasons explained in the previous section.

RECOMMENDATIONS

1. To comply with the immediate objectives listed in the Project Document, the CAD system to be set up at BTRA should be capable of performing as many of the textile-oriented functions as possible. The selection of a complete system with full application software, supported by suitable hardware is therefore recommended. To ensure full system compatibility all the components (hardware and software) must come from the same supplier, who must take full responsibility for the complete system.

2. The selection steps listed on page 24 of this report are recommended to be followed.

3. To increase the efficiency of the CAD services and the simultaneous software development work by BTRA it is recommended, that a system with more than one workstations be set up.

4. For the sake of operational safety, cost-effectivness and ease of eventual expansion it is recommended that the selection of a PPC network based system be seriously considered.

5. To facilitate software development by BTRA the supplier should be pressed to give access to a library of modules linkable to BTRA's own programs.

6. The connection of the DIANO MatchScan to the CAD system can be solved in a very flexible manner, it is therefore recommended, that the decision on the upgrading of the instrument be postponed untill the CAD system will have been selected.

Annex 1.

CAD systems for textile applications

** highly recommended systems
* systems for further consideration

M: multi-purpose
W: SW for weaving
D: dobby
J: jacquard
K: SW for knitting
P: SW for printing
E: SW for embroidery

ABACO: CAD-TEX (W/D)

ABACO Informatica, Via Alessandria, 7/7A, 50047 Prato (FI), ITALY

ABRIL: Design Unit (K)

J. Abril, s.a., Pol. Ind. Mata-Rocafonda, s/n. 08304 Mataro (Barcelona), SPAIN

APM: Miniterm II (K)

APM, Via Circondaria Ovest n. 38, 40019 S. Agata Bolognese (Bologna), ITALY

ASAÏS: Penelope (W)

ASAÏS, 58, Boulevard de Strasbourg - 75010 Paris, FRANCE

AVL: Textile Design Station (W/D)

AVL UK, 3 St. Georges Str., Macclesfield, Cheshire SK11 6TG, ENGLAND

BENTLEY: CAD/CAM SYSTEM (K)

The Bentley Engineering Co. Ltd.
P.O. Box 3, Komet Works, New Bridge Str., Leicester, LE2 7JS, ENGLAND

BERNARD: Automa (K)

Bernard & Co., Strada Statale per Carpi, 31, Carpi-Correggio, ITALY

Annex 1. (2)

BONAS: CAPS 3 (W/J)*

Bonas Machine Co. Ltd., Pallion Industrial Estate, Sunderland SR4 6SX, ENGLAND

CABO: Graphic Computer (K)

CABO s.r.l., Via A. De Gasperi, 25060 Collebeato, Brescia, ITALY

CAIPO: CAD System (W)

CAIPO Engineering Sytem s.r.l.,
Frazione Violetto 33, 13060 Campore di Vallemosso (VC), ITALY

CAPITAL: WDS-1000 Graphics Editor (W/J)

CAPITAL Automation Co. Ltd., P.O. Box 94 Tsuen Wan, N.T., HONG KONG

CDL: Textile Design Station (W/D)*

CDL, 11203 Waples Mill Road, Suite 113, Fairfax, Va. 22030, USA

CERIT: CAD System (W)

CERIT S.p.A., Via Villanova Di Sotto 9/A, 33170 Pordenone, ITALY

CGS: Carpet-Design (P)

CGS-Computer Graphic System, BahnhofstraBe 31, A-6300 Wörgl, AUSTRIA

DAINIPPON: PASTEC 4000 (P)*

DAINIPPON Screen Mfg. Co. Ltd.,
5F, Sunshine Bldg., 1-1, Koyama Nishihanaike-cho, Kita-ku, Kyoto 603, JAPAN

DAPLUX: GAMMA Grafic Unit (K)

DAPLUX snc, Via F. Perotti, 33 Brescia, ITALY

DATATEX: JCAD (W/J)

DATATEX S.A., CH-6901 Lugano, Via Dufour 2, SWITZERLAND

DATEC: CATS (W/J&K)

DATEC, Steenweg op Merchtem 18 - B-1890 Opwijk, BELGIUM

DINEMA: Digraph (K)*

DINEMA s.r.l., 25010 Brescia, via S. Polo 183, ITALY

DUBIED: DUCAD II (K)

Edouard Dubied & Cie S.A., CH-2108 Couvet/Neuchâtel, SWITZERLAND

Annex 1. (3)

EAT GmbH: DesignScope (W/J&K)*

EAT Elektronische Ateliertechnik Textil GmbH, D-1450 Krefeld, FRG

EIKONIX: Designmaster 9000 (P)*

EIKONIX Corp., 23 Crosby Drive, Bedford, MA 01730, USA

ELLERE TECHNOLOGIE: CAD System (W)

Ellere/Lanerossi S.p.A. 36015 Schio (VI), ITALY

FIB: CAD System (K)

FIB s.a.r.l., 30, Avenue Chomedy de Maisonneuve, 10000 Troyes, FRANCE

GV: HIGH-TEX-SYSTEMS (W/D)*

Gaenslen + Völter GmbH & Co. KG, P.O. Box 1165, D-7430 Metzingen, FRG

GEMINI 2000 (E)

Gemini Elettronica sas, via Tintoretto 8, 31015 Conegliano (TV), ITALY

GIXI: RADIANCE (W/J)

GIXI Image, Les Mercuriales, 40 rue Jean-Jaurès 93176 Bagnolet, FRANCE

GUNOLD&STIGMA: Professional Designer (E)

Gunold&Stigma, D-8751 Stockstadt, FRG

GROSSE: JAC-ART/JAC-CAD (W/J&K)*

Grosse Webereimaschinen GmbH, Pf. 1520, D-7910 Neu-Ulm/Burlafingen, FRG

HATRA: Microknit III (K)

HATRA, 7 Gregory Boulevard, Nottingham NG7 6LD, ENGLAND

IAM/NINO: CAD CAM TWEED (W/D)*

Zellweger USTER AG, Pf. CH-8610, Uster, SWITZERLAND

INFO DESIGN: VISION SYSTEM (W/D)

Info Design, BP 52 - 75661 Paris Cedex 14, FRANCE

ISHIZAKA SHOJI: MATRIX DESIGN II (W/D)
CREATE DESIGN EX (P)

Ernst BENZ AG, CH-8153 Rümlang-Zürich, Ifangstrasse 93

JUMBERCA: CAD System (K)

JUMBERCA S.A., Jacinto Benavente, 32, 08911 Badalona, SPAIN

M&S: IGOS (M)**

M&S INTERNATIONAL, Zonnebaan 36, 3606 CB Maarsen, THE NETHERLANDS

MELCO: CAD Sysytem (E)

MELCO Industries Inc., 7000 Broadway, Bldg. 4, Denver, Colorado 80221, USA

MITSUBISHI: CHECKMAKER/TEX-SIM (W/D)*

I.D.V. S.A., Tour de Bureaux de Rosny 2, 93118 Rosny Sous Bois Cedex, FRANCE

MÜLLER: MÜCOMP III (K)

MASCHINENFABRIK JAKOB MÜLLER AG, Schulstrasse 14, 5262 Frick, SWITZERLAND

NEW TECHNOLOGIES: BETA 3 (K)

NEW TECHNOLOGIES s.r.l., 21055 Gorla Minore (VA), Via Colombo, 130, ITALY

O.MA.TEX.: CAD System (K)

O.MA.TEX RIMACH S.p.A., Via XXV Aprile 85/87, 25038 Rovato (BS), ITALY

ORINTEX: CTD (W/D)

ORINTEX s.r.l., Viale della Republica, 102, 50047 Prato, ITALY

PRAGMA: SCOTWEAVE (W/D+J)*

PRAGMA Ltd., Pragma House, Radlett Road, Colney Str., St. Albans, Herts AL2 2EP, UK

PROTTI: PTV90/PTV SUPER (K)

PROTTI S.p.A., 20010 Cornaredo, Milano, ITALY

RUMI: CADMAX 2 (K)

RUMI F.LLI S.p.A., Via E. Salgari #11, 25082 Botticino S. (BS), ITALY

HIGH PERFORMANCE 32 BIT MASTER-SLAVE SYSTEMS

	EAT	MIND/IAM	WILCOM	SOPHIS	M & S	BONAS	VIABLE	Silicon Graphics
CENTRAL COMPUTER								
Type		MICROVAX II	MICROVAX II	GOULD Power Node 6000	MICROVAX II "MASTER"	Motorola 68020	MICROVAX II	Motorola 68020
RAM	6 Mbyte	5-16 Mbyte		4 Mbyte	1 Mbyte			4 Mbyte
additional RAM		up to 4 Gbyte (virtual)			4 Mbyte			available
Networking		available		ETHERNET				ETHERNET
Operating system		VMS 4.x	UNIX V.	UNIX V.	VMS 4.4			UNIX V.
multiuser mode		up to 8	up to 5	up to 8	up to 4	up to 2	up to 8	available
GRAPHICS SUBSYSTEM		Tektronix 4125						
type of CPU		80286		80386/387	Motorola 68020			
onboard pr. memory					1 Mbyte			
graphic coprocessor		bit-slice			HD-63484			independent microcoded proc.
other coprocessors	float. point	80287			Motorola 68881 HW floating p.			12 coco. engines float. point coo.
simult. colors (optionally)	256	256		256	16 to 256	256	256	256 to 16.7 mil.
available colors		16.7 million		16.7 million	16.7 million	64 million	16.7 million	16.7 million
in-memory resolution	1024x1024	1280x1024		1280x1024	8 Mbit	1440x1280	1024x960	1024x1024
command/design display		single or separate		separate	separate	single		
color monitor	high res.	19" or 16"		BARCO CDCT 6351	19" high res.			19"
DATA STORAGE								
floppy	8"		available	available	5 1/4" or 8"	available	5 1/4"	
winchester (optionally)	27 Mbyte	71 Mbyte (to several GB)	available	337 Mbyte	70 Mbyte (140 to 500 Mb)	available	up to 1000 patterns	
streamer/cassette		95 Mbyte (to 140 Gbyte)	available		95 Mbyte			1/2" tape drive
optical disc	800 Mbyte					available		
INPUT DEVICES		keyboard operated						
Camera					CCD	CCD or Video	CCD array	
resolution					512x512	up to 4096x8299		
colors					full color (24 bit)			
Digit. tablet	available		available	available		available	available	available
size					24"x36"			
resolution					0.001"			
Manual scanner (draw. board)						available	Viaread 1000	
Aut. scanner	Petroscan		expected	available			Viascan 1000/4000	
principle	drum			drum	platter/drum		array	
size				200x60x120 cm	A0-A4/A3-A4		23x43 to 92x118 cm	
resolution				1/20 mm	0.1mm/50micron		rgb separation	
colors				max. 256	16.7 million			
Spect-photom. connection		available		available				
Card reader (jacquard)						available		

PROFESSIONAL PERSONAL COMPUTER BASED SYSTEMS (PPC)

	MITSUBISHI	PRAGMA	GROSSE	TCS	DIMENA	EIKONIX	COL-AVL	Von Ditzer
HOST COMPUTER	16 bit	IBM XT/AT	16 bit	Victor V286	IBM AT or COMPAQ 286	PDP 11/84	IBM AT	IBM PC AT
CPU	80286							80286
Networking	available	available	possible	available	available		available	
RAM memory		512 Kbyte	256 Kbyte	640 Kbyte	640 Kbyte	4 Mbyte	640 Kbyte	3 to 16 Mbyte
RAM extension			available	4 to 16 Mbute				
Clock rate				6 to 12 MHz			8 MHz	
Operating system						RSX-11M		MS/DOS
DATA STORAGE								
Winchester	available	20 Mbyte	20 Mbyte	20 to 70 Mbyte	20 Mbyte	available	available	free 20 Mbyte
Floppy	available	two drives	1.2 Mbyte, 8"	1.2 MB, 5 or 8"	1.2 Mbyte		available	8"
Tape drive or streamer	available		available	20 Mbyte, 3.5"	3.5"	available		
Optical disc								800 Mbyte
GRAPHICS BOARD		Chromatics CX 1400 or Plute II.					Tecmar, Vectrix	HITACHI 63484
pixel resolution	1120x750	1024x768	1344x1510 or 2688x3020	1024x1024 to 4096x4096	512x512	640x512		512x512 1024x1024
simult. colors		32 or 256	64	32 to 256	256	2048		256
avail. colors	2128	16.7 million	256.000	4096 to 16.7 million	16.7 million	16.7 million		16.7 million
Color monitor		14" or 20"	20"	50 cm	13" or 20"	MITSUBISHI VC3922LP		12" or 14"
INPUT DEVICES								
Camera type		B/W video	color video	color CCD	color video			
resolution			512x512	512x512				
colors		256	64 pseudo					
Digit. tablet	available	available	available	available	available	available	Summagraphics	available
size		11"x11"	28x28 or 50x50 cm	A0 to A4				
resolution				0.125, 0.25 mm				
Manual scanner (drawing board)			available					
Automatic scanner			JAC-SCAN			EIKONIX78/99	available	
principle			drum	flat-bed		line array		
size			1150x1140 mm	17"x11" (A3)		2048 elements		
resolution			0.1 mm	30-300 dpi		200 lines/inch		
colors			32			256		
Spectrophotom. connection							Hunter COLORGUEST	
Card reader			JAC-READ					
OUTPUT DEVICES								
Color printer	available	MITSUBISHI6500	JAC-PRINT	MITSUB./XEROX	available	IRIS 2044	available	
principle		thermal	ink-jet	transfer/ ink-jet		drum ink-jet		thermotransfer
resolution						240 dpi		300 dpi
size		A4		A3		34"x48"		A3
colors			8 to 256	4000		88		

HIGH PERFORMANCE 32 BIT MASTER-SLAVE SYSTEMS

	EAT	NIND/IAN	WILCOM	SOPHIS	N & S	BONAS	VIABLE	Silicon Graphics
OUTPUT DEVICES					TCP412/EBP	B/W and color		Tektronix 4692 color hard copy
Pattern printer/plotter	Patroprint	Tektronix 4692 or Bensen 1200						
principle	ink jet		ink jet + monochrome	thermo-transfer	therm./el.static			
resolution				300 dpi	200 /200-400 dpi			
size				max A3	A3 /24"-44" wide			
colors					4192 / B/W			
media					paper / film			
Card punch	Patropunch		available	available	available	Hard or fine pitch	Viapunch	
Floppy				available			Staubli/Verdol/Bonas/ Grosse format	
Streamer/cassette								
						4 x 512 Kbyte		
EPROM					available	electronic Jacquard	available	
Direct link		EEP Delta/ Staubli 18 DEC LN03 Plus laser printer Honeywell PCR/OCR 4096 dots/line						
Worksheet printer								
File recorder					available			
Screen engraver								