European workstation for the building industry

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Poste de travail européen destiné à l'industrie de la construction

Europäischer EDV – Arbeitsplatz für die Bauindustrie

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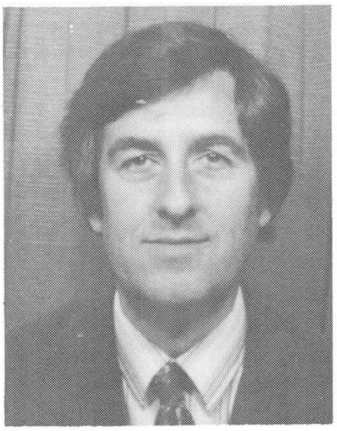

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SUMMARY

This paper presents the results of a study carried out for the European Community. It identifies three levels of computer workstation suited to the needs of architects, engineers and constructors, and provides a specification of the hardware components and software systems required to make use of new technology in the next five years and ensure portability of software. A possible design is presented and recommendations for further work which could be supported by the Community.

RESUME

Ce papier présente les résultats d'une étude faite à la demande de la Communauté Européenne. Trois catégories de postes de travail informatisés, adaptés aux besoins des architectes et des ingénieurs constructeurs, sont identifiés. Puis des spécifications concernant les composants matériels et logiciels de ces systèmes sont établies dans le but de mettre à profit les nouveautés technologiques prévisibles dans les cinq prochaines années et d'assurer le développement de logiciels transférables. Une esquisse de solution est présentée accompagnée de recommandations pour la poursuite de l'étude.

ZUSAMMENFASSUNG

Dieser Beitrag behandelt die Ergebnisse einer Studie für die europäische Gemeinschaft. Drei verschiedene EDV-Arbeitsplätze werden vorgestellt, die den jeweiligen Bedürfnissen von Architekten, Bauingenieuren und Konstrukteuren angepasst sind. Zusätzlich werden die für die nächsten fünf Jahre benötigten Hardware – und Software Komponente spezifiziert. Eine mögliche Lösung wird vorgestellt und Vorschläge für weitere Arbeiten auf diesem Gebiet werden gegeben.

1. SYNOPSIS

1.1 Local processing

Computing power, even for large analyses and computer-aided design, is rapidly becoming economic to locate at the engineer's workplace. At the same time good programs and reliable data remain expensive, and good systems of communication and widely accepted standards are also needed to provide all the computer facilities required by the engineer.

1.2 Three levels of workstation

A workstation includes all the computer equipment used by one person at one time. Its specification was the basis for a project sponsored by the European Community and managed by the Construction Industry Computing Association. Three levels of workstation were identified to meet the range of needs of building industry offices from word processing to interactive graphics.

1.3 Recommendations in the report

The Report produced in May 1982, was published to influence those designing workstations and to indicate the needs of, and size of market represented by, the European Building Industry. Recommendations for further work emphasised the need for further studies of some technical developments and, particularly, development of systems software and software tools to make best use of multi-processing. A permanent exhibition of linked workstations in national centres was seen as the best means of providing a living demonstration of the potential benefits of computers to the building industry.

2 INTRODUCTION

2.1 Scale of the construction industry

While one aim of the project was to stimulate the European computer industry, the European Construction industry is about ten times as large and the economic benefits of making it more efficient are potentially greater. The project therefore studied user requirements to see how these were being met and whether the needs of construction were different to those of other industries.

2.2 A previous EC Study

This project resulted from one of the recommendations of a previous study "The effective use of computers within the building industries of the European Community' published in 1979. This was based on a survey of applications and data processed by different types of organisation in the industry.

2.3 The Project Team

A smaller study formed the first part of this project and selected organisations in computing and construction in the various countries were questioned by the following:

R W Howard	CICA	UK and Ireland
J Amkreutz	I3P Systems	Holland and Denmark (with C Grau)
T von Verschuer	Tech U. of Munich	Germany
Dr G Deprez	Univ. of Liege	Belgium & Luxembourg
M Louf, M Theron	Matra, Datavision	France
A Lagattolla	Systems consultant	Italy & Greece (with J Dominos)

The first three of these carried out the analysis of this data and produced the final report 'The specification of a building industry computer workstation' published by the EC and available from centres in the main EC countries.

2.4 Construction and Computing

While the study started from the needs of architects, engineers and contractors, a specification looking five years ahead was likely to be affected more by developments in computing than by a rather static building industry. Studies were made of several aspects of computing particularly displays, multiprocessing and software tools and the project was concerned with merging these developments with building industry needs to produce a broad specification allowing a response by computer system suppliers. To explore the ergonomic aspects one possible design solution was developed in detail but this should not be taken as an ideal.

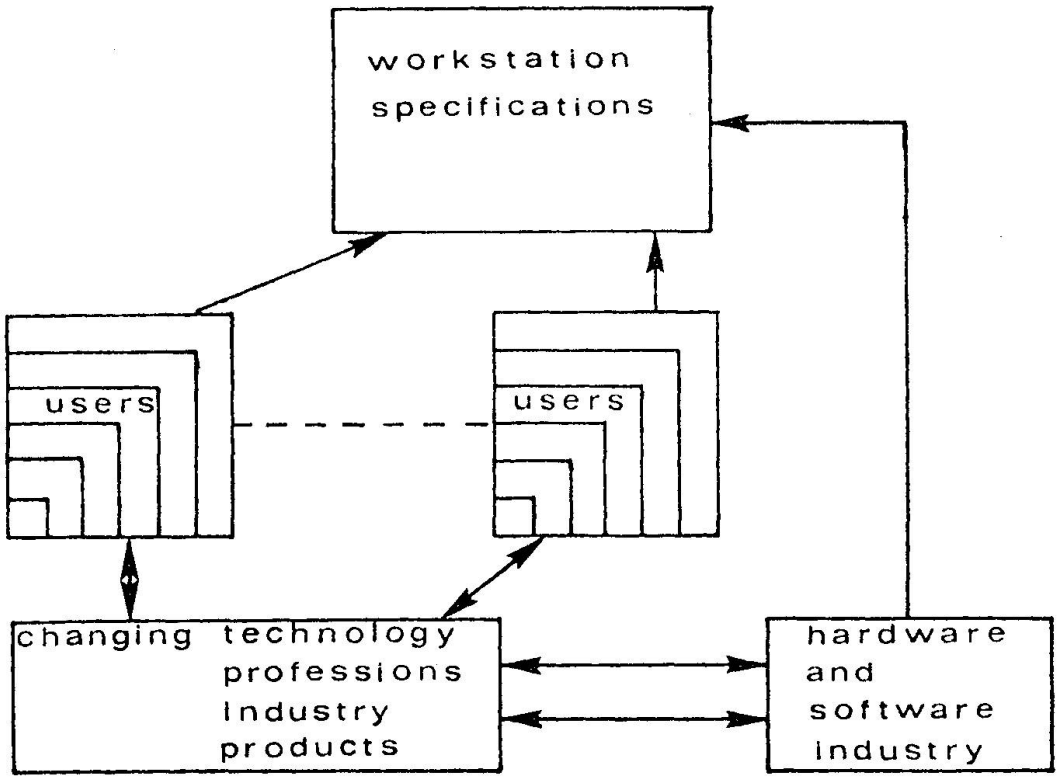

Fig 1. Relationships between users and a changing technology

3 DATA COLLECTED AND DERIVATION OF LEVELS

3.1 Application used

Although the project was not concerned with applications, any changes in the type of program being used would indicate trends in user requirements. The data for the previous study gathered in 1978 was compared with that collected from different companies in 1981 and indicated a general increase in design calculations, draughting, management and data banks. Architects use of computers appeared to have increased in the period while that of engineers had merely continued at their previous high level of usage and it was assumed that they were waiting for more powerful 16 bit micros.

3.2 CAD usage

Various studies of CAD systems were referrred to since CAD was likely to have the greatest effect on the workstation design. The trend towards lower cost systems based on raster graphics displays with greater use of colour was detected. The need for easier integration of CAD systems into smaller offices was also noted and for better ergonomics.

3.3 Analysis of applications

It was obvious from an early stage that, to serve the needs of building industry offices engaged in word and data processing, structural design and analysis, data base management and 2D and 3D graphics, a series of modular components would be necessary to provide a series of related workstations.

By grouping applications into those requiring common facilities, three levels were identified.

FACILITIES FOR:	Input/Output		Disktype	Precision	Language
	Alpha	Graphic	Floppy /Hard	8/16/32/ bit word	Business Scientfc
LEVEL 1 Budgetting	*		F	8	B
External info	*		F	8	B
Word process	*		F	8	B
LEVEL 2 Job costing	*		H	8	B
Project man.	*		H	8	B
Internal info	*		H	8	B
Tenders/Bills	*		H	8	B
Schedules	*		F/H	8	B
Data banks	*		F/H	16	S
Design calcs	*		H	16/32	S
LEVEL 3 Drawings	*	*	H	16/32	S
Concept design	*	*	F/H	16/32	S

Fig 2. Applications grouped by common facilities

3.4 Relationships between the levels

The three levels needed to relate in the following ways:

* Having common components for upgrading and maintenance

* Standard interfaces, storage media and communications protocols to allow linking on public and area networks.

* Standard systems software for transfer of applications

* Using similar commands and Input/Output conventions to avoid the need for retraining when moving from one level to another.

The development of networks means that noisy or unique peripherals can be located away from a workstation and shared between several, but standards become even more vital for linking them.

4. TECHNICAL SOLUTIONS

4.1 General developments

The following are some of the general trends which were considered over the next five years, while three areas were investigated in greater detail and are summarised in 4.2 - 4.4.

Input devices - keyboards will still remain necessary although character recognition and voice recognition of some commands are likely to be useful.

Displays - A4 upright bit-mapped screens are proving very flexible and the 19" diagonal screen with high resolution seems to be the optimum for graphics.

Output devices - dot matrix printers are becoming more precise and can combine text and graphics. Cheap colour hard copy is still a problem and will limit the use of colour for the present.

Intelligence and communications - Distribution of intelligence by multi-processing and intelligent peripherals will increase the response of systems.

Storage and software - hard disks are now widely available and video disks will be able to provide fast back up. Standard systems software and tools to aid the development of applications are essential to making best use of new hardware technology.

4.2 Raster and other types of display

In spite of reservations by some users about the quality of line, raster displays are expected to take 95% of the market by 1985. But, by then, resolutions of 4000 x 4000 points would be available. New screen technologies continue to be explored and a large, flat, interactive screen replacing display and digitiser, would solve a number of ergonomic problems. Within the five years being studied such screens using liquid crystal or plasma techniques were unlikely to be economical, however.

4.3 Multiprocessing

This is one of the new developments most difficult to grasp but likely to have a major effect on the response of systems. It will enable the following:

* Systems to be upgraded more easily
* Provide access to a system for several users
* Improve the response of overloaded systems
* Help upgrade systems to meet new requirements

As yet, those developing software are not used to these facilities and there is a need for greater awareness and better software tools.

4.4 Software tools

Conventions for input and output to allow transfer of data between programs were the subject of a parallel report to the EC by RIB Stuttgart. These would be relatively cheap to develop but would need wide promotion.

Some of the software tools proposed for the workstation were:

* Screen editing and forms handling
* Printer special functions management
* Network control
* Software implementation tools
* Printed output formatter
* Editing of plotting data
* Multiprocessor control
* Graphics macro definition
* Graphical objects data base
* Zooming
* Fetch nearest point and highlight

5. THE SPECIFICATION

5.1 Distributed systems

Recent developments of computer systems have included timesharing and dedicated mini computers. The advantages of these are now being combined in distributed systems providing powerful word processing and good communications to other processors, data storage and peripherals.

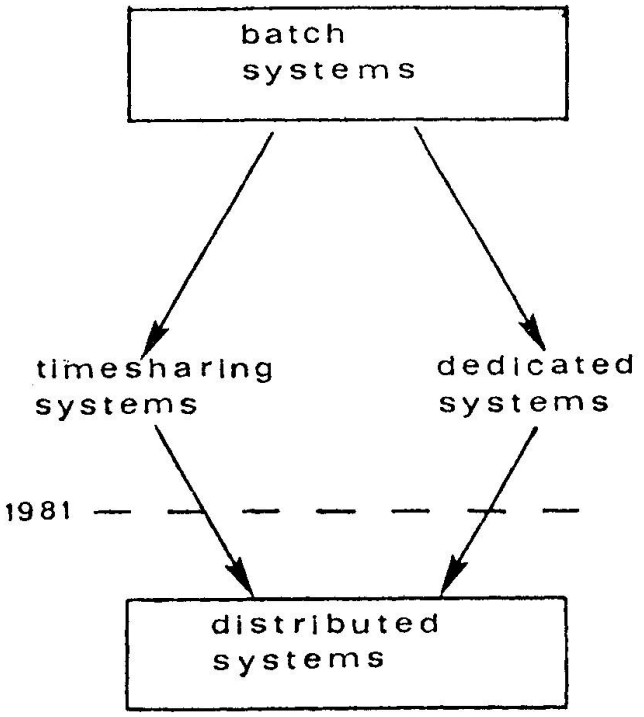

Fig 3. Development of computing from batch to distributed systems

The workstation specified is based on this architecture and provides the following advantages:

* Expandibility by adding extra nodes on the network
* Linear increase in performance with investment
* Response times do not increase with number of users
* Tasks can be executed concurrently

5.2 Portability

The ability to exchange software between systems is essential for the speed of computing in a specialist field like building. Standard operating systems were felt to be the best means of ensuring this with CP/M for 8 bit systems at level 1 and UNIX for 16 bit systems at levels 2 and 3. The ADA language may provide the optimum solution ultimately but this is not likely in the five year period considered. It should be evaluated for its suitability for CAD.

5.3 The Specification

Although the original aim was to provide a performance specification only, it was necessary to specify some components in detail. Manufacturers putting forward designs providing a similar performance would be acceptable.
The specification is summarised in the following diagram:

COMPONENTS	LEVEL 1	LEVEL 2	LEVEL 3
INPUT	Keyboard Funct keys	Keyboard Funct keys Cursor A3 Tablet	Keyboard Funct keys Cursor A2 Tablet
DISPLAY	Raster A4 vertical 80 char.wide	Raster A3 horizontal 132 char.wide 800x400 pts 8 colours	1.Raster A4 vertical 80 char.wide 2.Poss.Vector A3 horizontal 1024x780 pts Full colour
OUTPUT	Matrix printer or Daisywheel	Matrix or Electrostatic printer A3 250 char/sec	Electrostatic printer A3 A0 plotter available
INTELLIGENCE	1 OR 2 8-bit CPU 64K Memory	Several 16-bit CPU 256-512 KB	Multi CPU 16/32-bit 1 MByte +
STORAGE	Floppy disk 1 MByte or hard 10 MByte	Hard disk 30 MByte or floppy 5 MByte	Hard disk 80 MByte Back-up
SYSTEMS SOFTWARE Min language requirement	Standard Op. system CP/M Enhanced BASIC	Standard Op. system UNIX like FORTRAN, Pascal,ADA	Standard Op. system UNIX like FORTRAN, C Pascal,ADA GKS Graphics standard

Fig 4 Summary of the levels of workstation and their components

6. A POSSIBLE WORKSTATION DESIGN

6.1 Ergonomic considerations

Consultants CCD Ltd were asked to illustrate a possible design based on the specification above, conforming to good ergonomic practice and allowing easy integration into the office of modular configurations.

They recommended the use of standard furniture with separately supported displays and tiltable layout space. Displays were of two sizes; A4 vertical for alphanumerics and A3 horizontal for graphics and these were combined differently for each level. Noisy components such as large disks, plotters and printers could be located remotely but the simplest workstation at level 1 is assumed to be self contained and portable.

6.2 Level 3

Design concentrated on Level 3, the CAD workstation, which posed the greatest ergonomic problems. Levels 2 and 1 were developed from this.

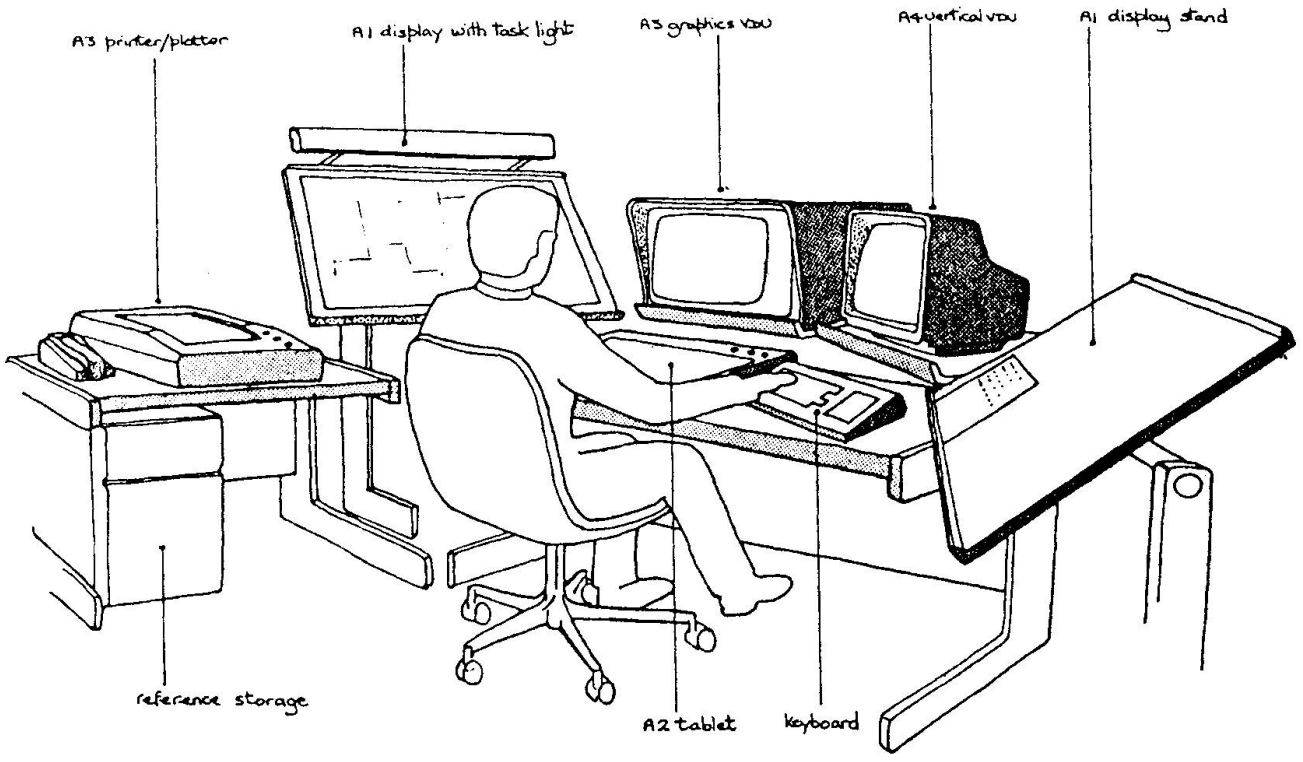

Fig 5 Sample workstation layout for Level 3

6.3 Level 2

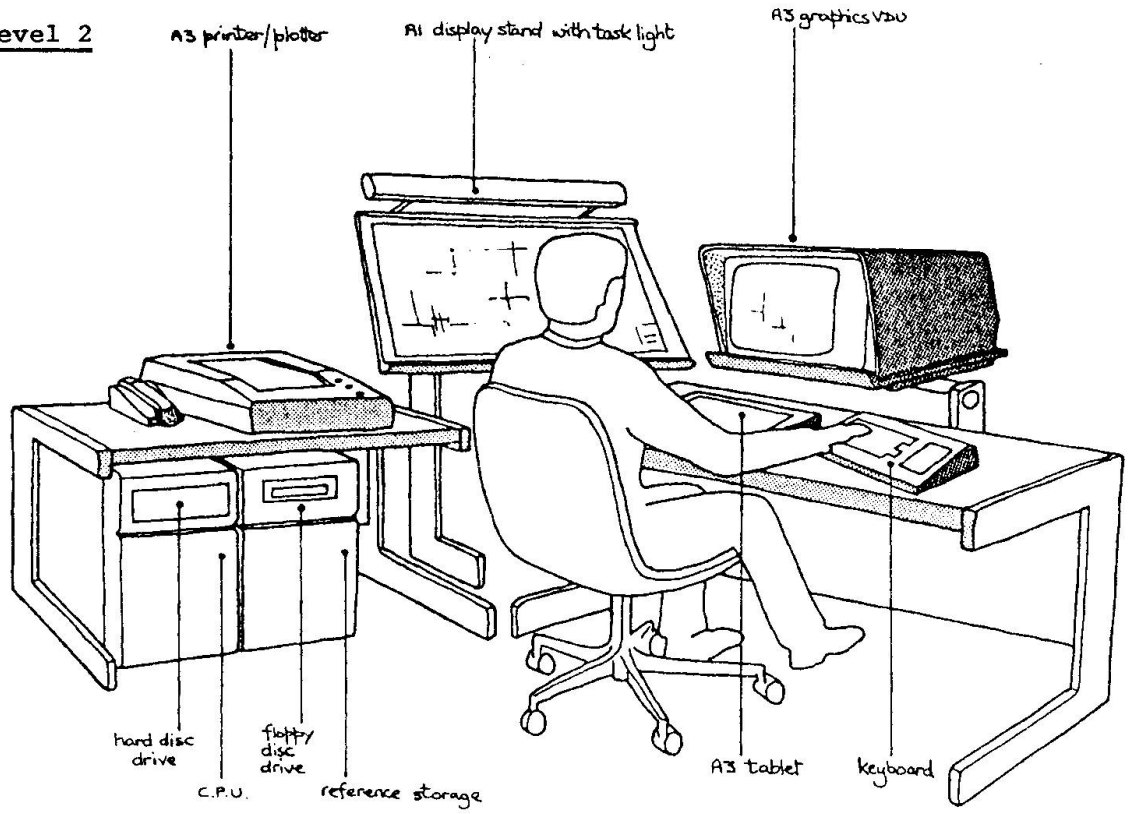

Fig 6 Sample workstation layout for Level 2

6.4 Level 1

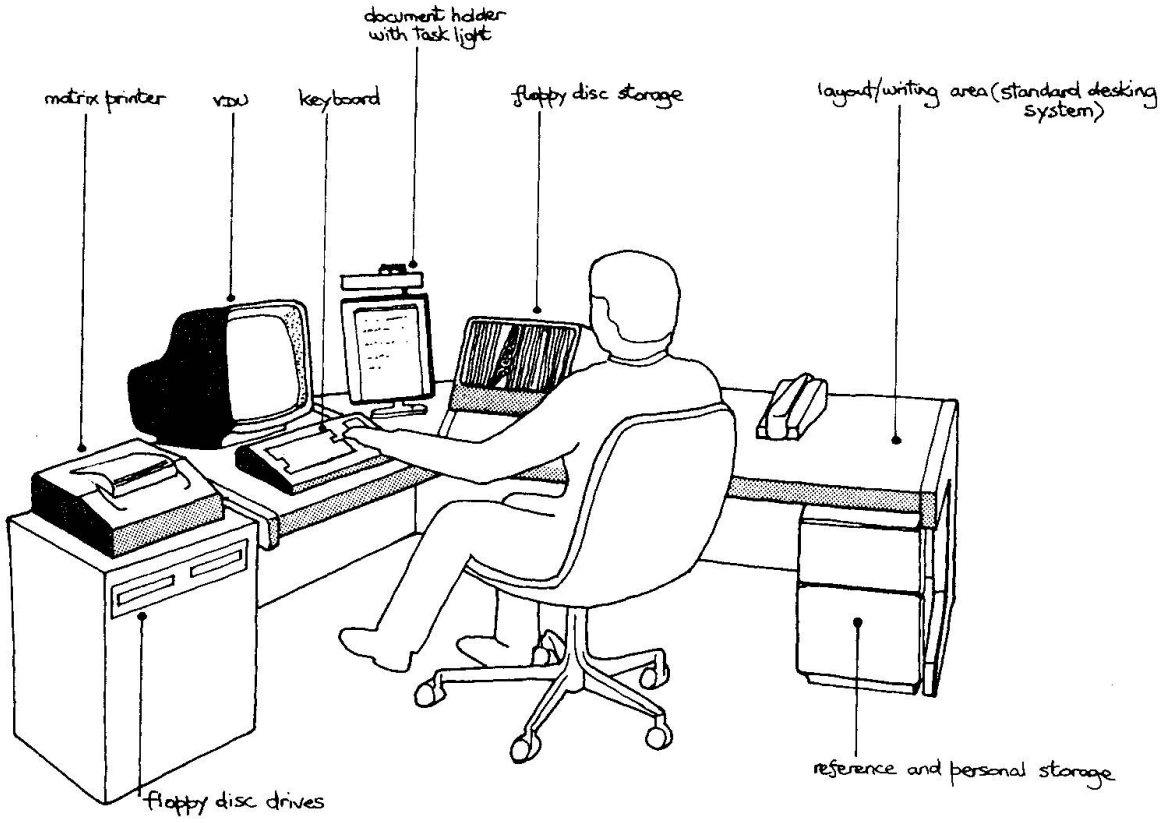

Fig 7 Sample workstation layout for Level 1

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

One of the main objectives was to indicate the size of the potential market represented by the European building industry. The number of firms capable of justifying the purchase of one or more systems like those specified by 1986 was estimated at 600,000 for Level 1 and 100,000 for Level 3.

Workstations will continue to be used by suppliers as a means of marketing software but they must be encouraged to develop open systems allowing greater portability of programs and data.

In order to benefit the European building industry and take advantage of new technical developments in the USA and Japan, Europe must use the new technology from wherever it comes.

European needs and those of construction are more specialist with regard to applications but the European computer industry could benefit from export of complete systems. The combination of workstation hardware assembled if not wholly manufactured in Europe, systems software and tools conforming to international standards and locally produced applications, could provide great benefit to European users and suppliers alike.

7.2 Recommendations

The following recommendations were made to the European Commission:

That the report should be published and distributed widely.

That a response from systems suppliers should be stimulated by mounting an exhibition of workstations conforming to the specification.

That the EC should not try to certify such workstations but concentrate on providing the right environment for use of the best systems.

Studies should be carried out on particular areas of hardware technology.

Specifications should be sponsored for systems software and software tools and an evaluation of ADA for CAD applications is needed.

A permanent, living exhibition of linked workstations in national centres should be mounted to demonstrate the potential of communications.

To support these main recommendations user groups could be used to promote awareness and training in the use of computers, to help distribute data and standards and to collect better statistics on levels of computer usage.

REFERENCES

1. The specification of a building industry computer workstation. CICA, I3P and Technical University of Munich for the European Community. May 1982

2. Feasibility study of common Input/Output conventions for the building industry. RIB, Stuttgart for the European Community. December 1981

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