COMMISSION OF THE EUROPEAN COMMUNITIES

Electronic Document Delivery — IV

User Requirements and Product Availability of Terminals for Use in Electronic Document Delivery — The DOCTERM Study

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Preface

The Commission of the European Communities is encouraging the development of an information market in Europe and has in particular supported the creation of Euronet, a packet-switching network, and Euronet-DIANE, the information services offered through Euronet. References to documents can now be found by online access to bibliographic databases within a few minutes. However, it takes days or, mostly weeks to receive the corresponding full text document from a library.

In order to shorten this delay the Commission is carrying out an Action Programme which centres upon experiments (with more than $1 million support by the Commission) for electronic document delivery and electronic publishing. The experiments, for which a call for proposals has already been published will begin in 1984. A number of problems will be common to the experiments, such as extended character sets; choice of distribution channels; document ordering, identification and location; and terminal requirements. They have been dealt with by separate studies.

The present report deals with terminal requirements, in particular with user requirements for and product availability of printing devices for use in electronic document delivery systems. The study shows that terminals appropriate for electronic document delivery and meeting user requirements were recently made or will shortly be commercially available.

In its draft forms the report was made available for comments to experts convened by the Commission. Their feedback has further improved the report which has now become an indispensible tool for all those who are interested in electronic document delivery.

The Commission intends to continue to monitor the terminal market. The Commission further considers to take up the consultants' recommendations on follow-up actions such as the development of a 'black box print server'. Any comments from readers would be welcome.

C. VERNIMB

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1 Introduction

This report documents the results of a study of user requirements for, and product availability of, printing devices for use in electronic document delivery systems. This study, entitled DOCTERM, was one of a series of studies commissioned by the Commission of the European Communities under its document delivery action plan (DOCDEL). It was undertaken by Logica, with the assistance of the UK Paper and Board, Printing and Packaging Industries Research Association (PIRA), during the period April to November 1982.

The main body of the report provides a *Management Summary* (section 2), together with a discussion of the relationship between *User Needs* and the *State of Art* of printer technology (section 3). It then goes on, in section 4, to discuss the *European Supply Situation* and to relate this to the Commission's intention to encourage the conduct of document delivery pilot experiments. Finally, section 5 describes the main *Conclusions and Recommendations*.

While the main report is intended to be readable as a separate document, it has been kept as brief as possible in order to concentrate on the main conclusions of the study. It therefore contains no details of the approach taken, or of the detailed data which were collected.

This detailed information is reproduced in eight appendices, which contain respectively:

A a report on the conduct and findings of Phase I of the study, which resulted in the specification of *User Requirements for a Fax- and Text-Terminal* which is summarised in section 3. This report was prepared for Logica by PIRA;

B a report of the conduct and findings of Phase II of the study, in which the supply of printing devices capable of answering the user needs was investigated. This report, on the *Availability of Terminals Suitable for Document Delivery,* is an updated version of an interim report produced during the course of the study. It details the available supplier offerings and justifies a number of the recommendations made in the main report;

C an initial outline specification of a common interface device, the *Print Handling Black Box,* which the report recommends should be developed as the basis for ensuring compatibility between the DOCDEL pilot experiments and as a possible means for enabling devices other than the Agfa-Gevaert or CIT-Alcatel products to be used in DOCDEL experiments;

D a *Print Device Test Specification*, prepared under an extension to the DOCTERM study, which it is intended should be used as the basis for verifying proposed printer equipment's suitability for DOCDEL use;

E *Terminal Characteristics Tables,* containing comparative information on the different document output devices identified during the study;

F the *Supplier Interview Questionnaire*, which was used as the basis for discussion with suppliers during Phase II of the study;

G *Supplier Visit Notes*, providing supplier information which supplements the details given in Appendix E;

1 *Samples of Document Features* which were identified during Phase I (the user enquiry) of the study.

Logica is grateful for the opportunity, provided by the Commission, of being able to conduct this study and would like to express its thanks for the considerable assistance and co-operation provided by the Commission, and especially Mr C. Vernimb, by PIRA and the user organisations contacted by them, and by the many suppliers who contributed time and product development information to us.

2 Management Summary

A high-resolution print device, able to print significantly expanded character and symbol sets, with a very flexible range of graphic images, and costing in the range 10,000 - 15,000 ECUS, now seems a distinct commercial possibility within the timeframe of the DOCDEL pilots.

Even in the short half-year of DOCTERM investigation and reporting (April–November 1982), the outlook has become decidedly more promising, for three principal reasons:

(a) Two major European suppliers have committed to an integrated coded-character/facsimile delivery solution close to the central requirements found in DOCTERM, whose basic elements are due to be delivered as *products* in the first half of 1983 (Agfa-Gevaert P400 and CIT-Alcatel 5520, with associated low-cost input scanner digitisers)

(b) Other suppliers (e.g. Fuji/ICL and Hitachi) have launched sophisticated new laser-based products to compete in the same 20,000–25,000 ECU price range as these two European companies. In the United States, desktop laser printers with progressively upgradable speed and resolution have been offered (Autumn 1982) from $US 4,000 upwards

(c) Market pressures centering upon the trend-setting Japanese CANON laser printer, at about $US 20,000, will undoubtedly force prices of all such devices down and their performance up quite quickly. Manufacturers expect this and several privately admit they have sufficient margin to significantly reduce prices in response to market pressure.

It is also heartening that European suppliers appear to be maintaining and enhancing their recent resurgence in the advanced-technology terminal print device market.

A good example is the French company Thomson/CSF, which recently sold 30,000 of its new Group II and III facsimile transceivers to be badge-engineered and factored by the U.S. giant 3M.

Among the research communities of the Community it is still probable that the great majority of end users will need to *share* one fairly expensive print device, for the simple reason that anything less intelligent, or based on other than laser technology, will probably be unable to do what they want.

This report nonetheless suggests intensive DOCDEL pre-pilot experimentation with a number of possibly more economical or partial solutions, including raster-generating code converters to drive Group

III facsimile machines in printer mode (by Muirheads), and trials of the most basic printers (e.g. Epson) attached to microcomputers with highly personalised print control software.

As a possibly broader and longer-term shared-resource solution, the design is also suggested of an intelligent 'black box', to handle nested sets of expanded character and symbol fonts, with reasonably complex graphics, and to front-end network telecommunications for a wide variety of print devices. An outline functional specification for such a device is attached as Appendix C.

To cope with a rapidly-changing scene on the technology, commercial and standards fronts, the action plan also strongly recommends continued monitoring of the situation up to and proceeding in parallel with the DOCDEL pilots exercise.

The development of communication control procedures to cope with a shared-resource printer service is also counselled.

All the European print device suppliers short-listed in the DOCTERM Terminal Availability report (Appendix B) and the one European and two multi-nationals represented on the DOCDEL Industry Forum, have expressed readiness to collaborate with the Commission in DOCDEL testing and implementation, providing their terms of reference and commercial conditions are made clear.

Timing and Technology would thus appear at present convergent in a promising and decidedly pro-European way which was far from evident even six months ago.

But the third and fourth 'T'S' — Telecommunications services and their Tariffication by the PTT's — will likely prove the deciding factor as to when or whether electronic document delivery really takes off.

3 User Needs vs. State of the Art

3.1 User Needs

User needs for document delivery for expanded character sets, special symbols and graphics are well set out in table 3.1 below, with the following comments:

3.1.1 Office Users

Most office users do not have the breadth of need of the scientific, technical and medical users generally addressed in other DOCDEL studies.

For general European use, the character set envisaged for international Teletex, including simple graphic elements and special symbols (e.g. copyright, trade mark logos), will suffice for most office requirements.

3.1.2 Resolution

Most users are likely to be satisfied with 300 lines per inch resolution, but high resolution half-tones would ideally provide 400 lines per inch each way = 16 × 16 pixels per sqmm, giving the opportunity for very fine shading of options in 16 grey shades.

3.1.3 Communications Speed

It will be some time before a telecommunications solution is fixed on for DOCDEL, indeed it looks as though there may be a range of options.

It is difficult to exaggerate the importance of three points:

- the bulk of users appear satisfied with any delivery which is better than conventional mail, within twenty-four hours, and effected with an unmanned terminal
- a decision must be reached as to whether DOCDEL will allow batch delivery or online browsing, or a mixture of both
- datapost-type delivery of electronic or optical recording media such as magnetic disks or videodiscs will be a very valid option for major documents, especially where cost-effective browsing is required.

Table 3.1: *Summary of user requirements*

Essential features	*Desirable features*	*Features needed for specialist use*
A4 size	Russian	larger than A4
European diacritics	italics	colour halftones
Greek (mainly for mathematics)	regular diagrams	switch between text and graphics
	irregular diagrams	unusual character sets
scientific/mathematical	high resolution halftones	quality equivalent to original
underlining/ vertical lining	adhere to original layout	delivery within 4 hours
unmanned terminal	maintain confidentiality	
plain paper printout	simultaneous delivery to different geographical locations	
cost equivalent to BLLD* charges	delivery within 24 hours	
high print quality	high transmission speed (to keep transmission costs low)	

* British Library Lending Department

3.2 State of the Art

3.2.1. Paper Format

All the print devices examined in the DOCTERM project can handle A4 portrait format, the bulk can or will be able to deliver A4 landscape; smaller sizes can also be handled, although in many devices this means a wastage of paper area.

This is fortunate, since all requirements in the *essential* and *desirable* category are met by A4. *Specialist* paper sizes above A4 are likely to be a problem.

3.2.2 Print Quality

- needle matrix printers will be unlikely to achieve, even with multiple overstrike, print quality better than 200 lpi, and will pay a penalty in communication speed for achieving even this
- thermal printers, except for (possibly) multi-element devices of the recently announced RICOH type, will probably be too *slow* and of dubious resolution beyond 200 lpi
- laser beam printers or facsimile transceivers will probably be the only plain-paper devices able to deliver resolution much above 200 lpi.

3.2.3 Expanded Character Sets

For handling the *essential* user needs depicted in Table 3.1, with the resolution and telecommunication requirements commented upon above:

- any print device will necessarily be intelligent
- single-element impact printers may be regarded as inadequate in font capability, twin-element (double daisy) as too expensive and cumbersome.

Judging from technology currently available in the market-place, any device capable of handling the requirements expressed as essential will also be able to meet those seen as *desirable.*

Such devices are also likely to be able to handle (but possibly after considerable customising of fonts) most *specialist* needs.

3.2.4 Graphic Capability

Flexible graphics will be properly handled by two types of device:

- facsimile transceivers eventually having a resolution of 300 lpi or better
- laser-based printers currently priced (November 1982) at around 20,000 ECUS or above.

Full colour will be difficult, and resolution not good, since laser-based printers will not be available. Colour will be addressable in the future by:

- multi-colour ribbons for needle printers, with a considerable time penalty for multiple overstrike (four separations) and/or resolution
- multiple-nozzle ink-jet
- resurrection of 15-year-old wirephoto technology, abandoned because news media need cyan, saffron, magenta and black separations rather than integrated colour, for printing purposes
- eventual adaptation of some of the new colour print facilities developed in Japan and the USA for printing colour tv stills from electronic recording media.

3.2.5 Communications

Most devices *can* communicate at 2400 bps or upwards, and all devices examined have the ability to work unattended, with satisfactory user-oriented feedback and failure diagnostics.

However, some suppliers have yet to deliver all-round network communications capability.

3.2.6 Cost-effectiveness

Until the communications arrangements (and they may operate at complex and multiple tariff levels) are established for DOCDEL, it will be impossible to calculate the cost-effectiveness of electronic document delivery against the conventional criteria (standard British Library Document Delivery Service) established in the DOCTERM user survey.

It may, however, be asserted with virtual certainty that, if these criteria are to be met:

- delivery *must* be in batch form, ideally with documents being transmitted in off-peak reduced-tariff hours (assuming such arrangements to be available)
- print devices *must* be shared, since those able to meet even bare essential requirements will be much too expensive to be used on a 1 : 1 user to device ratio.

4 The European Supply Situation

4.1 European Solutions

The re-emergence of advanced European capability in printer technology, discerned at the outset of the DOCTERM exercise at the Hannover Fair (April 1982) has become even more marked during the remaining months of the year.

The Commission is thus in a convenient position to encourage rapid development of sophisticated European document delivery terminals while at the same time, as a user in the DOCDEL pilots, leap-frogging earlier generations of largely Japanese and North American solutions.

All five of the printer/facsimile suppliers shortlisted in the DOCTERM interim report (Appendix B) are European:

Agfa-Gevaert	(B)
CIT-Alcatel	(F)
Muirheads	(GB)
Olympia	(D)
Philips	(NL)

In the facsimile field Thomson/CSF (F) have scored a notable business coup in selling an initial batch of 30,000 of their new Group II (III-compatible) and Group III devices to a major U.S. systems factor, 3M.

4.2 Bidding for DOCDEL Pilots

All five of the European suppliers listed in 4.1 have expressed serious interest

(a) in collaborating in development with the Commission

(b) in bidding their printer products for DOCDEL pilots

(c) in taking part in preliminary testing of their devices (as envisaged in Appendix D).

In addition, the three major suppliers represented on the DOCDEL Industry Forum — Siemens (D) and the European interfaces of two multi-nationals (IBM Europe and Rank Xerox) — have expressed similar willingness to cooperate.

5 Conclusions and Recommendations

5.1 Conclusions

The broad technical and commercial conclusions to be drawn from the DOCTERM exercise are:

- no suitable hybrid facsimile transceiver/coded character solution exists under 20,000 ECUS as a product
- DOCDEL print devices must, therefore, be shared operationally among many users
- the forthcoming Distributed Document Processing, laser-based scanner-printer solutions from two European suppliers, Agfa-Gevaert (B) and CIT-Alcatel (F) appear the most cost-effective all-round solutions, both at around 20,000 ECUS
- a possibly cheaper option from a third European supplier (Muirhead) exists, consisting in using a raster-generating convertor to print coded character streams in selectable typefonts on standard facsimile transceivers. This would need development work from Group II to Group III resolution standards
- a price war among a number of European, Japanese and North American suppliers, with similar offerings currently in the $20,000 price range, appears imminent and could substantially affect cost-effectiveness calculations *before* the first DOCDEL pilots are implemented
- colour printing and paper sizes greater than A4 will pose considerable problems for some time.

5.2 Recommendations

Following conclusion of the main DOCTERM study, this action plan is recommended for immediate implementation:

5.2.1 Shared-resource Printing

A firm decision should be taken that DOCDEL pilots will be structured so that the print device(s) involved in each pilot constitute a shared resource among the user department(s).

5.2.2 DDP Philosophy

The Distributed Document Processing philosophy now being adopted by Agfa-Gevaert and CIT-Alcatel should be actively pursued, with extensive interaction between representatives of the DOCDEL Task Force and these two manufacturers.

5.2.3 Coded-Character/OCR/Facsimile Hybrid Devices

Muirheads should be actively encouraged to:

(a) develop a Group III (or possibly IV) version of their coded-character to facsimile convertor product

(b) bring their hybrid OCR/Facsimile transmission system (see DOCTERM interim report, Appendix B to this document) off the shelf.

5.2.4 Black Box Print Server

A detailed technical design study for a multi-purpose print server, as outlined in Appendix C, should be commissioned and an independent systems house asked to construct a prototype for demonstration with the Agfa-Gevaert, CIT-Alcatel and Muirheads products.

5.2.5 Cheap Printer Experiment

An EPSON or similar cheap printer, oriented towards personal computer users, should be purchased and used in conjunction with a personal computer to test the range and flexibility of such a device as a simple printer which might (either with added intelligence or using a shared print server (see 5.2.4) prove cost-effective for single users or small user departments in delivering perhaps a limited range of complex text with simple graphics.

A systems house could possibly be asked to effect such tests using its own equipment.

5.2.6 Standards

DOCDEL Task Force observers should immediately be appointed to work with those committees evolving:

— ECMA Office Document Architecture

— ISO/DIS 6937

and the Commission should actively support the adoption of a 400 lpi resolution for facsimile group IV purposes.

Any print device supplier wishing to bid for a DOCDEL pilot should pre-qualify by submitting his machine to the test specification attached as Appendix D to this document.

5.2.7 Shared-resource Printing Procedures

In the light of the fact that print devices of the necessary technical competence will have to be shared to be cost-effective for the foreseeable future, operational procedures and user guidelines for soliciting and controlling document traffic need to be prepared and reviewed with potential users well in advance of the launch of the first pilot system.

Arrangements for the physical distribution, within sites and departments, of documents received in the pilot trials must also be coordinated and structured.

5.2.8 Continued DOCTERM Monitoring

Because of the relative criticality of ongoing, probably rapid evolution of print devices, sub-systems and complete delivery systems of the DDP type (e.g. Agfa-Gevaert and CIT-Alcatel) and intense price competition, monitoring of technology and prices should continue at close and regular intervals throughout 1983 while DOCDEL pilots are building up to implementation.

APPENDIX A

USER REQUIREMENTS FOR A FAX- AND TEXT-TERMINAL

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Management Summary

Euronet Diane, the European network of online information retrieval services, has been established for over a year. However, the majority of the information provided is in the form of bibliographic references so that the user has to make a further search for the full document. The Commission of the European Communities wishes to encourage the development of new electronic document delivery services to meet this need and has launched a programme of actions, including this study of user requirements for terminals.

The study commenced by examining a range of documents — periodicals, text-books, reports, patents and standards — in order to establish the different features which can appear in this material. The features identified included full-width text, text in columns, running heads/feet, footnotes, multiple fonts, display types, special characters and symbols, mathematical equations, chemical notation, diagrams of various kinds, tables, halftones and colour.

An attempt was then made to correlate the document features with document types, and hence with different types of users, to see whether particular groups of users might have differing requirements for terminals. Quantified data were obtained for over 400 documents, but few distinctions could be drawn between different document types and, hence, different classes of document users. Certain features, notably (1) diagrams with more than one colour and (2) colour halftones, occurred infrequently in most document types.

A survey of user needs was undertaken by means of a postal questionnaire sent to selected librarians and information officers. The purpose of the questionnaire was to establish a picture of the physical characteristics and features of documents required by the user, obtain an overview of the delivery environment and elicit views on print quality and transmission speed. Some of the respondents were subsequently interviewed.

Although the sample used for the survey was small, the respondents were considered to be well informed on the topic of document delivery. The survey indicated that there were a number of features which it was essential or desirable for the terminal to handle and some features which were required for specialist use only. These categories of features are given as an indication of user requirements for a fax- and text-terminal for document delivery purposes.

Introduction

In an electronic document delivery system it will be desirable for end-users or their intermediaries to receive document copies on their own terminals. Different classes of users may have different needs in terms of the complexity of types of documents in which they are interested, ranging from plain typescript to illustrated texts. Part of the requirement may be met by terminals receiving coded characters (e.g. Teletex), but others require page image techniques (Facsimile). Terminals capable of receiving both of these modes are in development but few are on the market. It is unlikely that manufacturers will find it economic to develop special terminals meeting the full spectrum of needs for all potential users of electronic document delivery systems. However, a relatively large proportion of this spectrum might be met by modifications to terminals being developed for other purposes. Convergent studies of user requirements on the one hand and the characteristics of terminals available and under development on the other could therefore provide a basis for solution of these problems.

This report describes a study of user requirements.

1 Objectives

The general objective of the project was:

— to specify a spectrum of user requirements for terminals (capable of receiving text and/or graphics) for electronic document delivery by reference to a defined range of standard types of documents.

Specific objectives were:

— to define a standard range of document features, for example, from simple typescript, typescript plus mathematical or other symbols, text plus the inclusion of simple graphics etc., to fully illustrated (black and white and coloured) texts including documents displaying a variety of types of different layouts, fonts, character sizes and page formats.

— to determine the kinds of users whose demands could mostly be met by one or other level of complexity of text.

— if possible, to give some quantitative indication of the percentage demand per user class which could be met at each level of complexity.

Note: It was not anticipated that in-depth user surveys involving direct contact with a large user sample would be necessary.

2. Methodology

2.1 Definition of Standard Range of Document Features

Features of a document include various degrees of typographic complexity, from simple text to highly structured material, including different fonts and type sizes, as well as line drawings, diagrams, halftone illustrations of different qualities and colour. A range of documents was examined and appropriate samples of different features were extracted. Comments are included explaining the significance of the different features in relation to the characteristics of terminals, e.g. character sets, formats, dot resolution and so on.

2.2 Correlation of Standard Range of Document Features with Document Types

To obtain some quantified data, a number of documents of various types (books, articles, reports, patents, standards, etc.) were examined and their features recorded. Over four hundred documents were examined. An analysis of document type versus feature was undertaken.

2.3 Survey of User Needs

A questionnaire designed by PIRA in consultation with Logica was sent to a small, selected group of users. Thirty-five questionnaires were returned and eighteen of the completed questionnaires were followed up by personal or telephone interviews.

3 Definition of Standard Range of Document Features

Documents to be published electronically will be of various levels of textual complexity. Examples are:

— simple text containing standard characters only
— text containing special characters or symbols
— text containing structured passages such as tables and columnar material
— text containing different fonts and type sizes
— text with an inherent page structure (an example might be a page with footnotes)
— text containing complex typesetting such as mathematical equations or structured chemical formulae

Some documents will also contain line rules, graphs and diagrams, line drawings, halftone illustrations of various qualities and colour. There will also be many different page layouts and sizes.

A range of documents — periodicals, text-books, reports, patents and standards — were examined to establish the different features which can appear in this material. Twenty different features were identified. These features are listed below together with comments on the significance of the different features in relation to the characteristics of terminals, e.g. character sets, formats, dot resolution. etc.

Samples of these features appear in Appendix 1.

3.1 Features of Documents

1. Straight text
   Text with one full-width column to a page. (See sample 1)
   This is the simplest form of document and can be handled by the most basic form of printer.

2. Text in columns
   Text arranged into a number of columns (usually two, three or four) across the page. (See sample 2)
   The terminal must be able to print out text in columns.

3. Running heads/feet
   These include lines of text that repeat on every page, such as titles of journals, titles of chapters, dates of publication, etc. Page numbers are assumed to be an integral part of a page, so have not been included as running heads or feet. (See sample 3)
   These do not need any special printer requirements unless a different size is called for.

4. Footnotes

Footnotes contain material related to the main text. They are often in a smaller type size and separated from the main body of the text by a space or a line. Superior figures are usually associated with them as the means of reference. It is important that as far as possible they always occur on the same page. (See sample 4)

These are desirable features rather than essential, but their significance for terminals is that superior figures and a smaller size may be needed. If text is not being transmitted in a strict page format, it will also be necessary for the terminal to be able to relate text with the footnotes.

5. Multiple fonts

The occurrence of variation of type style within a typeface is regarded as the use of multiple fonts. This includes differences in sizes, and the use of bold, italic, and small capitals. (See sample 5)

This is highly significant for terminals because a different character set is needed for each variation.

6. Display types

These are usually headings which are large (above 18–24 pt) and of a different style to the body text, particularly a style which has been designed to create a special effect. (See sample 6)

The significance of these is that the variations are random. This means that characters must be drawn specially for at least the first time they are used.

7. Dropped initials

These occur as display devices at the beginning of articles, chapters and sections. They are usually the first letter which is aligned with the top of the first line and ranges at the foot with two or more lines. (See sample 7)

They may be considered to be decorative features and not to be very significant for terminals, although if they were essential they would cause the same problems as 5 and 6.

8. Superiors/inferiors

These are small letters or figures above or below the line of type. They are used as references to footnotes, and in chemical and mathematical notation. (See sample 8)

They are significant for two reasons: smaller characters than the body text are desirable; and they must be placed above or below the line of type, either by having two character sets or by a code to indicate position. Hence the terminal needs to cope with extended character sets and positioning commands.

9. Unusual characters

These include accents, linguistic variations, phonetics, etc. These are highly significant for terminals which are to be used with most other languages than English. (See sample 9)

They require either an extended character set to cope with all the accents called for or the ability to combine characters to form special characters, such as floating accents on to the basic character set. In some cases, for example, Greek or phonetics, a completely different range of characters is required.

10. Mathematics/Greek

A Greek alphabet is required for mathematics, plus an extensive range of other symbols. The requirements for this have not been analysed, only the number of occurrences of the use of mathematics and Greek. (See sample 10)

The requirement of the terminal is that a larger character set than standard is needed, plus the ability to range characters over several lines, insert rules and deal with inferior and superior figures.

11. Chemical notation

This particularly refers to special requirements such as benzene rings. (See sample 11)

This is another instance where the character set needs to be extended to cope with specialised requirements. The character set extension need not be all that large.

12. Regular diagrams

These are simple diagrams made up of straight lines, usually horizontal or vertical, with perhaps a limited number of lines at angles or curved shapes. They may also require various weights and solid shapes. (See sample 12)

The significance of these is that they should be made up of a limited number of standard elements. They could, in theory, be composed from a standard 'diagram' character set. Examples are simple block diagrams and histograms.

13. Irregular diagrams

These are all other diagrams, i.e. those with complex shapes, varieties of weights, tones and overlaid text. They would be currently drawn as artwork. (See sample 13)

Because they comprise irregular elements they would need to be dealt with as facsimiles of the original.

14. Regular diagrams with more than one colour

These have the addition of an extra solid or tint colour to No. 12 above.

This is a significant change to the requirements of the terminals mentioned so far in that a colour display is required, albeit one without high resolution. A printer with the capability of printing at least one extra colour, which may not be predetermined by the publisher, would be required.

15. Irregular diagrams with more than one colour

Addition of an extra solid or tint colour to No. 13 above. The requirements are as for No. 14 above.

16. Special symbols

These are symbols which are specific to the publication or a highly specialised subject area or which have very special meanings. At least some of them are likely to have been specially created. (See sample 16)

The significance of these is that they are unlikely to be available in the terminal as a standard item.

17. Tables

This is matter set in columns, with or without rules. Important characteristics are vertical alignment, completion on one page if possible, possibly landscape format and possibly a different type size. (See sample 17)

They should not impose major problems, except where they are very large or when they require a landscape format.

18. Halftones, low resolution

These are tone pictures which provide limited detail, for example, a picture in a newspaper or a trade journal. In terms of halftone screen ruling, it is likely to be below 100 lines/inch (4 lines/mm). (See sample 18)

These require terminals capable of producing not only fairly high resolution but also a grey scale or its equivalent.

19. Halftones, high resolution

These are tone pictures which provide detail, for example a photomicrograph. In terms of halftone screen ruling, it is likely to be above 100 lines/inch (4 lines/mm) and probably 133 or 150 lines/inch (5.4–6 lines/mm). (See sample 19)

The same considerations apply as above, but the demands for resolution are much greater.

20. Colour halftones

These are full colour pictures with a high resolution.

The same considerations apply as for No. 19, but in order for full colour to be incorporated probably four high resolution pictures will have to be combined.

4 Correlation of Standard Range of Document Features with Document Types

To obtain some quantified data, over four hundred documents, periodicals, books, reports, standards, patents etc. were examined and their features recorded.

The documents were divided into ten different types:

periodicals — STM
periodicals — social sciences
periodicals — popular/trade press
reports — STM
reports — social sciences
books — STM
books — social sciences
conferences
patents
standards

In selecting the documents to be examined, an attempt was made to cover as many disciplines as possible; thus the material was not selected from one library only. A number of libraries was visited to carry out the exercise.

Each document was examined page by page and a record made when an example of an identified feature appeared. No attempt was made to indicate the number of times a feature appeared in a document or where a number of features appeared together on one page.

Table 1 indicates, in percentage terms, the number of times a particular feature was found in the different categories of documents.

While STM publications tended to have non-standard characters occurring more frequently in them than social science publications, the latter still contained a number of non-standard characters. The principal exception was chemical notation. Likewise, STM publications tended to have more monochrome (black and white) diagrams, but social science publications still had a significant number. Patents and standards had few special symbols.

Whilst, therefore, few distinctions could be drawn between different document types and, hence, different document users, certain types of document feature occurred infrequently in most document types — display types (except in popular/trade press periodicals), regular and irregular diagrams with more than one colour, and colour halftones.

FEATURES OF DOCUMENTS	DOCUMENT TYPES									
	Periodicals STM	Periodicals Social Sciences	Periodicals Popular/trade press	Reports STM	Reports Social Sciences	Books STM	Books Social Sciences	Conferences	Patents	Standards
	%	%	%	%	%	%	%	%	%	%
Straight text	67	56	17	84	85	94	100	80	38	72
Text in columns	67	78	98	20	15	9	0	30	69	39
Running heads/feet	97	94	94	9	15	90	81	30	94	89
Footnotes	81	84	38	64	55	76	44	63	6	94
Multiple fonts	100	100	100	56	60	92	100	87	100	72
Display types	11	12	38	4	10	6	0	7	13	0
Dropped initials	3	12	17	2	0	0	0	0	0	0
Superiors/inferiors	99	81	35	76	45	92	31	87	81	94
Unusual characters, eg phonetics, accents	87	69	25	51	30	41	13	70	6	11
Mathematics/Greek	91	50	25	38	0	92	25	73	44	78
Chemical notation	45	0	8	7	0	31	0	20	13	0
Regular diagrams	84	53	42	31	20	80	69	73	25	50
Irregular diagrams	97	66	52	60	20	94	56	83	69	67
Regular diagrams with more than one colour	3	6	13	2	0	2	0	0	0	6
Irregular diagrams with more than one colour	3	6	13	9	0	6	0	0	0	6
Special symbols	83	41	33	42	25	63	25	80	19	17
Tables	97	97	67	73	65	92	88	87	31	89
Halftones, low resolution	35	38	87	51	5	45	6	60	0	6
Halftones, high resolution	60	9	19	18	5	55	0	43	0	6
Colour halftones	1	0	27	4	0	9	0	0	0	0
TOTAL NUMBER OF DOCUMENTS IN EACH CATEGORY	150	32	52	45	20	51	16	30	16	18

Table 1

5 Survey of User Needs

A questionnaire was devised by PIRA in consultation with Logica. The purpose of the questionnaire was to attempt to establish a picture of the physical characteristics and features of documents required by the user, obtain an overview of the delivery environment and elicit views on print quality and transmission speed.

The questionnaire was sent to a selected group of librarians and information officers. The purpose of this selection was to cover as wide a variety of subjects as possible and also a range of different types of organisations, i.e. industry, government, academic, consultants, professional institutes.

The recipients were requested to complete and return the questionnaire and as many as possible of the returned questionnaires were to be followed up with a personal or telephone interview in an effort to obtain subjective comments. Thirty questionnaires were originally sent out and the DOCDEL Task Force also agreed to ask organisations known to them in Europe to complete and return questionnaires. A total of thirty-five questionnaires were returned and eighteen interviews were conducted.

Of the eighteen respondents interviewed, all either had, or were actively considering, online facilities. All those interviewed were mainly acting as intermediaries and passing documents to third parties. Where information officers were involved a proportion of their work involved them using the material themselves. Most of the final users of the material were on-site but in some cases the material was for delivery to users at different geographical locations. Some of the interviewees were also involved in database production.

All the interviewees went to great pains to stress the fact that figures given were very much 'guesstimates', but it is interesting that many of the 'guesstimates' were fairly consistent, if not right across the board, certainly between like establishments.

An analysis of the answers to the questionnaire follows, together with pertinent subjective comments made by the interviewees.

5.1 Physical Characteristics of Documents

5.1.1 Size

The questionnaire asked what percentage of documents needed would fall into the following categories:

A4 and smaller
larger than A4

A breakdown of the responses is presented in table 2. One respondent did not express any views.

Percentage of documents A4 and smaller	*no. of respondents*	*Percentage of documents larger than A4*
10%	1	90%
80%	6	20%
85%	1	15%
90%	5	10%
95%	12	5%
98%	2	2%
99%	3	1%
100%	4	0%

Table 2

When carrying out the interviews an attempt was made to obtain an indication of the type of material that the interviewees considered would be larger than A4. By far the largest proportion of this material appeared to be periodicals which were produced in newspaper format. This type of periodical was practically always from the trade press. One respondent made the observation that in these instances they would often find that only part of the page was required.

Other types of material mentioned by the interviewees as being over A4 in size were:

the larger type books (for example, biological texts)
old reports (often on foolscap)
maps
geographical material
music
wall charts
conference papers (some preprints seemed to come in odd sizes)

One of the interviewees suggested that double spread graphics could possibly give problems.

The questionnaire further asked if a reduction in size would be acceptable:

always — often — sometimes — never

Two respondents felt that a reduction in size would *always* be acceptable.

Twenty-two respondents felt that a reduction in size would *often* be acceptable.

Seven respondents felt that a reduction in size would *sometimes* be acceptable. One of these however stipulated that if the documents were larger than A4 then a reduction in size would never be acceptable. Although this was not stated it seemed probable that they were engineering drawings.

Two respondents felt that a reduction in size would *never* be acceptable.

All the respondents interviewed agreed that they would accept a reduction in size to some degree. Without exception this was prefaced by the remark that it was assumed that the document would still remain legible! Several of the interviewees commented that they already receive material which was reduced in size for some reason or the other and that their users seemed to be quite happy to use it. One suggestion was made that if the reproduction was really too small than it could be put on an enlarging photocopying machine. One librarian felt that his users who were in the electrical and electronic engineering field accepted quite small and poor quality prints of, for instance, circuit diagrams with little or no comment.

One area where it was considered that a reduction in size could be a problem was where there were a number of graphs and the detail was really essential to the understanding of the text. Where electron micrographs appeared a reduction could affect clarity. One interviewee pointed out that in some scientific journals some of the graphics will have been reduced in size already and that in those instances a further reduction could be unacceptable.

A final comment came from one librarian who said 'inevitably there is always the odd human who must have everything the same!'.

5.1.2 Length

The questionnaire asked what percentage of documents needed would fall into the following categories:

up to 5,000 words long
over 5,000 words long

A breakdown of the responses is shown in table 3. Two respondents did not answer the question.

Percentage of documents up to 5,000 words long	*no. of respondents*	*Percentage of documents over 5,000 words long*
20%	1	80%
30%	3	70%
40%	3	60%
50%	8	50%
60%	3	40%
65%	2	35%
70%	4	30%
75%	4	25%
80%	2	20%
90%	1	10%
95%	1	5%
98%	1	2%

Table 3

Whilst carrying out the interviews it became obvious that in organisations mainly involved in applied technology the material used had a higher percentage of shorter items.

5.2 Features of Documents

5.2.1 Character Sets and Symbols

The questionnaire asked what character sets in addition to the normal alpha/numeric character sets would be required.

Twenty-three respondents said that *European diacritics* were required.

Eleven respondents said that *European diacritics* were not required.

One respondent did not answer the question.

Interviewees who said that they required European diacritics fell into the category of organisations who had regular translation services or where languages were taught.

The majority of the respondents who said that European diacritics were not required were UK interviewees. The feeling appeared to be that whilst they might use European material they would not find difficulty in interpreting it if the diacritics were missing. One interviewee pointed out that in their role as database publishers they did not use diacritics and had found no problems.

Sixteen respondents said that *Greek and Russian* were required.

Eighteen respondents said that *Greek and Russian* were not required.

One respondent did not answer the question.

The respondents interviewed who said that Greek and Russian were required indicated that Russian periodicals were used to some extent but, with the exception of one academic institution where Greek was taught, the use of Greek was purely for mathematical purposes.

However, the respondents interviewed who said that Greek and Russian were not required as languages, all indicated that Greek was important for mathematics.

Fourteen respondents said that *italics* were required.

Twenty respondents said that *italics* were not required.

One respondent did not answer the question.

Where interviewees said that italics were required, the main use was considered to be in the biology and pharmacology areas.

Of the interviewees who said that italics were not required, several said that if the facility were available it would be useful to have it but that they could do without.

Three respondents expressed a need for Japanese. One interviewee commented that a reduction in size with Japanese characters could cause problems because detail could be lost. Chinese and Hebrew were needed by one respondent.

Thirty-four respondents said that *scientific and mathematical symbols* were required.

One respondent did not answer the question.

All the interviewees indicated that scientific and mathematical symbols were either important or very important. One interviewee pointed out that as database publishers they did not use either structured formulae or subscripts.

Very few of the respondents indicated any other special characters that were required. One respondent, however, did attach two character coding grids to illustrate the type of characters that could be required. One suggested £ and #. Two of the interviewees suggested that maps could have special characters or symbols.

5.2.2 Graphics

The questionnaire asked what percentage of the requests would carry:

underlining and vertical lining
regular diagrams
irregular diagrams

Breakdowns of the responses are presented in tables 4, 5 and 6. Four respondents did not answer this question.

Percentage of requests carrying underlining and vertical lining	*no. of respondents*
0%	4
2%	1
5%	3
10%	4
20%	1
25%	1
30%	2
40%	1
50%	3
70%	1
75%	2
80%	5
90%	2

Table 4

Three of the respondents interviewed and who expected a high percentage of requests would carry underlining and vertical lining indicated that tables in particular were very important for their needs.

Percentage of requests carrying regular diagrams	*no. of respondents*
0%	1
4%	1
5%	2
10%	4
15%	1
20%	5
30%	1
50%	3
60%	3
70%	3
75%	2
80%	2
90%	3

Table 5

Two of the interviewees stressed that diagrams were of great importance to them.

Percentage of requests carrying irregular diagrams	*no. of respondents*
0%	4
5%	2
10%	3
15%	1
20%	3
30%	5
40%	2
50%	5
65%	1
75%	2
80%	1
90%	2

Table 6

Three interviewees stressed that irregular diagrams were of great importance to them and one of them said that these diagrams would be mainly architectural drawings and thus vital to the text.

5.2.3 Halftones/Colour

The questionnaire asked what percentage of requests would *necessitate* illustrations, i.e.

low resolution halftones (e.g. newspaper quality)
high resolution halftones
colour

Breakdowns of the responses are given in tables 7, 8 and 9.

Two respondents did not answer the question.

Percentage of requests necessitating low resolution halftones	*no. of respondents*
0%	11
2%	1
5%	2
10%	4
20%	4
25%	1
30%	2
50%	2
60%	1
70%	2
75%	2
95%	1

Table 7

Five of the interviewees felt that low resolution halftones were often used to pad out the text. Their users were only interested in the text and could do without the halftones.

Two of the interviewees felt that low resolution halftones could enhance the text for the user. An instance was given by a university librarian where he felt that drama students could need this type of illustration.

Percentage of requests necessitating high resolution halftones	*no. of respondents*
0%	6
1%	2
2%	1
5%	3
8%	1
10%	5
20%	8
25%	2
40%	2
50%	2
85%	1

Table 8

Interviewees who had a requirement for high resolution halftones were asked what types of illustrations they had in mind. It appeared that most of these illustrations would be electron micrographs in the biology, microbiology and metallography fields. In these instances they would be very important. One interviewee said "one picture is worth a thousand words".

Percentage of requests necessitating colour	*no. of respondents*
0%	14
less than 5%	9
5%	4
10%	4
25%	1
30%	1

Table 9

Where interviewees expressed a need for colour it was emphasised that even in cases where the demand was low, the colour would be very important to the user. Examples of this need for colour were for illustrations used by drama students and for maps.

One interviewee felt that where colour occurred it was so important to their users that nothing but the original would suffice.

The questionnaire further asked if the respondents would be satisfied with a lower quality than the original, provided it was intelligible.

Thirty respondents said they *would always or sometimes be satisfied* with a lower quality than the original A few, however, added reservations which should be noted.

One interviewee with a definite requirement for high quality colour reproduction for maps said they would often be totally unusable without the colour.

Several of the interviewees stressed that even with a reduction in quality the document must be intelligible. It was, however, generally felt that it would be pointless offering such a service if the output was unintelligible.

One interviewee pleaded for the printout to be easy on the human eye and "not in microform please".

One respondent would accept lower quality for low resolution halftones but not for high resolution halftones or colour.

One interviewee felt that the printout would be acceptable as long as it was up to the standard of a reasonable photocopy.

Three of the interviewees commented that when a user was anxious to obtain material they would be "happy with whatever they could get".

Four respondents felt that they *would not be satisfied* with a lower quality than the original.

In two of these cases their need for good quality high resolution half-tones was very important.

One respondent did not answer this question.

5.2.4 Layout

The questionnaire asked if it was necessary to adhere to the layout of the original document:

always — often — sometimes — never.

Two respondents felt that it was *always* necessary to adhere to the layout of the original document.

Six respondents felt that it was *often* necessary to adhere to the layout of the original document. Twenty-three respondents felt that it was *sometimes* necessary to adhere to the layout of the original document.

Four respondents felt that it was *never* necessary to adhere to the layout of the original document.

Most of the interviewees who responded "sometimes" to the question did so because of a reluctance to say "never". Two interviewees expressed concern that tables could be distorted and lose their meaning and one suggested that if a particular layout was standard for a series of documents, any deviation from this layout would be unacceptable.

A second question asked "where text and illustrations appear together on one page in the original, is it necessary for the printer to:

switch between text and graphics

or

can it print text and illustrations on separate pages?"

Ten respondents thought that the printer *should switch between text and graphics.*

Two of the interviewees felt that where there were a number of illustrations with attendant text, it could become confusing and irritating if the illustrations were presented separately. One commented that this remark was based on experience of microfilming their own company reports. The placing of graphics at the end of the report is not favoured.

Twenty of the respondents thought that *text and illustrations could be printed on separate pages.*

An interviewee said that if this method kept the cost down then it would be acceptable.

Another interviewee expressed the belief that in the initial stages of an electronic delivery system the users would be quite happy to accept text and illustrations on separate pages. However, once the system was established expectations would rise and become more sophisticated. Indeed, this rise in expectation would cover all aspects of such a service.

Four of the respondents hesitated to present a firm answer to this question. When interviewed they felt that in some instances it would be acceptable to print text and illustrations separately, but that there could be occasions when the resultant printout would be confusing.

5.3 Delivery Environment

5.3.1 Urgency

The questionnaire asked how frequently documents were required within specified time spans. A breakdown of the respondents' answers is given in table 10.

	Always	*Often*	*Sometimes*	*Never*
immediately			22	9
within 4 hours		3	24	5
within 24 hours	1	10	18	3
within 2 days	5	20	8	1

Table 10. Frequency of need for documents

From the interviews carried out, and from an admittedly small sample, it appears that industrial, government and consultancy organisations demand the highest degree of urgency. Requests stem from such varied problems as: patent litigation; project proposals submitted for contracts; "the managing director wants!", a real need to know before a piece of work can continue; requests akin to the parliamentary question when "all the stops must be pulled out"; statistical and marketing information.

An attempt was made to find out from the interviewees what action was currently taken if material not in the library was demanded immediately or within 4 hours. One or two of the organisations had facsimile equipment but this was obviously of very limited use. A few

who were within easy reach of other cooperating libraries would put someone on a train or send a car to collect the information. This line of action was not undertaken lightly because of the time and cost involved.

For material required within twenty-four hours or two days, the first class post was relied upon.

Even where interviewees indicated *sometimes* they would need items within any time span up to two days a significant number of them felt that they would prefer to say *rarely* rather than sometimes.

Academic and professional organisations tended to have a lower degree of urgency for material.

One university librarian commented that even where a user expresses a need for rapid delivery the documents, once obtained, can languish in the library for some days before being collected!

Several of the interviewees felt that their clients' demands and expectations were conditioned by what they knew to be currently possible. There was a feeling that if, in the future, electronic delivery systems became available then the expectations of the users would rise.

5.3.2 Confidentiality

The questionnaire asked if there was ever any need for confidentiality.

Fifteen respondents said that *there were times when it would be necessary to maintain confidentiality*. Several of the interviewees thought the occasions would be very rare. Government organisations could sometimes be handling politically sensitive enquiries and industrial organisations, although practically always requiring published information, needs to maintain confidentiality sometimes. The possibility of closed user groups, to allow material such as reports available only to members of a specific organisation to be delivered, was mooted by one of the interviewees.

Twenty respondents said that *there was never any necessity to maintain confidentiality.*

5.3.3 Document Destination

The questionnaire asked if there was a perceived need for simultaneous delivery of the same document to different geographical locations.

Eighteen respondents *could not see a need for simultaneous delivery of the same document to different locations.*

Fifteen respondents *could see* a need for simultaneous delivery of the same document to different locations. In most cases this facility would not be used very frequently. However, one interviewee said that 50% of their work was for staff who were not on-site. A university librarian said that the concept tied in with recent discussions they had been having

regarding computer conferencing. An industrial librarian said that the company had working parties made up of staff from different operating divisions including overseas divisions and that simultaneous document delivery could be very useful. A government librarian also experienced this problem with staff working on the same projects but scattered around the U.K. and Europe.

Of the fifteen respondents who could see a need for simultaneous delivery of documents eight thought it *would not be absolutely necessary* for the documents to be in the same format. Seven of the respondents thought that it *was necessary or preferable* for the documents to be in the same format.

Two of the respondents did not answer this question.

5.3.4 Terminal and Printer

The questionnaire asked if a terminal which is unmanned during reception was required.

Twenty six respondents wanted a terminal which was *unmanned* during reception. The views of the interviewees who expressed this opinion was summed up by one who said "we don't want to have to sit with it!".

Three respondents did not answer this question and one interviewee had no feelings either way. It was felt that as the equipment would be firmly under the control of the library it would be immaterial whether it was manned or not.

The questionnaire asked if the proximity of the printer was of great importance.

Sixteen respondents thought that the proximity of the printer *was* of great importance to them. The interviewees who expressed this opinion felt that the equipment should be housed in the library. Many of them had experienced irritation by having to cross a large site to use, for example, the telex or facsimile equipment or by the delay in internal post systems.

Fifteen of the respondents said that proximity of the printer *was not* of great importance. However, ten of these interviewed said that it should be in the same building.

One of the interviewees added that this comment was based on casual use. Should an electronic delivery system be set up and its use became the rule rather than the exception then a dedicated piece of equipment would be required in the library.

Four respondents did not answer this question.

5.3.5 Output Media

The questionnaire asked which of the following output media would be acceptable:

plain paper
coated paper
film, same size
film, micrographic

All the respondents opted for *plain paper.*

Twelve respondents said that they would find*coated paper* acceptable.

Six respondents said that they would *tolerate coated paper.*

Two respondents said that they would find *same size film* acceptable.

Twenty respondents said that they would accept *microfilm.* However, the degree of acceptance varied. Unqualified acceptance came from thirteen respondents, but where interviews had been carried out the majority of people specified that they would want microfiche. On the whole roll film is not liked in library situations.

Six respondents said that they would grudgingly accept microfilm.

Four of the respondents totally rejected *film* of any kind.

5.4 General

Print quality, transmission speed and cost per page of document transmitted are three important features for the user of a document delivery service. To help assess the relative values of these factors the questionnaire asked:

(a) rate on a scale from 1 to 5 with 5 the most important, the importance of print quality and of transmission speed.
(b) indicate what would be regarded as an acceptable cost per 5,000 words transmitted.
(c) indicate whether cost considerations would substantially modify acceptability criteria for print quality.
(d) indicate whether cost considerations would substantially modify acceptability criteria for transmission speed.

5.4.1 Print and Transmission Quality

Table 11 gives a breakdown of the replies to part (a) of this question.

Scale	*1*	*2*	*3*	*4*	*5*
Print quality	4	5	6	14	6
Transmission speed	2	8	15	9	1

Table 11

Several of the interviewees who opted for a low print quality felt that as the items would be working documents only, or were items that were either obscure or needed in a hurry, then a low print quality would be accepted by their users. However, a comment was made that if an electronic document delivery system became commonplace, then the users would tend to expect a higher print quality.

When interviewees rated print quality at a higher level on the scale, it was because of their need for good quality halftones which were important to their users.

Interviewees generally found that this was a very difficult question to answer as far as transmission speed was concerned and except in one instance their responses were based on guesses which were not even backed up by experience of, say, facsimile transmission. One interviewee who had experience of fax opted for '4'. This decision was based on the fact that when using fax the 4 minute rather than the 6 minute transmission was opted for.

5.4.2 Cost

Eighteen of the respondents indicated that a charge in line, or slightly above, the current British Library Lending Division charges would be acceptable. Current charges are £1.75 per article up to 30 pages. Several of the interviewees indicated that they would be prepared to pay slightly more (between £2 and £2.50) for the added convenience.

Below this price range two respondents suggested around 50 pence, and two opted for £1.25.

Above the £1.75–£2.50 range the respondents suggested: £3.00, £3.50, £4.00, £4.00–£8.00, £5.00 (3 respondents).

Seven of the interviewees said that they could envisage times when they would be prepared to pay higher prices for documents which were either obscure or required very urgently. The higher prices were, in general, not specified and it was emphasised that it would be on very rare occasions. One interviewee did, however, suggest that a charge of £10 would be acceptable for these rarely needed items, but that for

general use a cost nearer BLLD charges would be needed. He summed up the feelings of all the interviewees by saying — "the lower the cost, the more use would be made of the system".

Six of the respondents did not answer this question.

5.4.3 Cost Considerations v. Print Quality Acceptability Criteria

Fifteen respondents indicated that cost considerations would affect *print quality* criteria.

Twenty respondents indicated that cost considerations would not affect *print quality* criteria.

Three of the interviewees felt that their demands for print quality were so low that costs would determine whether they even used the system. Two of the interviewees with high print quality ratings which were important to their users said that costs which were too high would only lead to rejection of the system.

5.4.4 Cost Considerations v. Transmission Speed Acceptability Criteria

Twenty-six respondents indicated that cost considerations *would affect transmission speed* criteria.

Nine respondents indicated that cost considerations *would not affect transmission speed* criteria.

5.4.5 Current Systems for Obtaining Documents

Finally the questionnaire asked the respondents what systems were currently used to obtain documents and what were the advantages and disadvantages of the systems used.

All but four of the respondents answered this question. In every case material was acquired on inter-library loan from whatever network of libraries the respondents had built up over the years. Generally speaking requests and deliveries were by post, although a number of the interviewees in the UK indicated that they were on the BLLD van delivery service which was, in most cases, considered to be efficient.

In some instances respondents indicated that they would request items via telex, telephone and two mentioned online ordering.

Apart from the post and BLLD van, other delivery systems mentioned were facsimile transmission, used in very exceptional circumstances by a few of the respondents, and personal messenger where the holding library was near enough to permit a visit either by the potential user or messenger.

Respondents generally felt that the advantage of the systems they used were that they were familiar, tried and trusted systems and that in the main they worked.

Other advantages mentioned were:

- costs accepted
- currently no alternative
- ability to locate most of the items required quickly
- single source (BLLD) for most of the requests
- can borrow the document (as opposed to photocopy) where print quality is important
- savings in purchasing costs
- straightforward clerical procedures
- BLLD van delivery saves postage charges
- coverage is exhaustive (particularly for older material)
- accurate
- jobs
- enables a routine to be established.

Delay in delivery (mainly postal) was the main disadvantage mentioned by almost all the respondents. A number of respondents felt that costs were high.

Other disadvantages mentioned were:

- problems of obscure (grey) literature
- incidences of failures
- BLLD not as efficient as in the past
- labour intensive
- cumbersome
- incompatibility of facsimile terminal

5.5. Conclusions

Although the sample used for the survey of user needs was small, the respondents were considered to be well informed on the topic of document delivery. The survey indicated that there were a number of features which it was either essential or desirable for the terminal to handle and some features which were required for specialist use only.

Table 12 on the following page indicates the features and their perceived importance.

Where it has been possible to work out percentages from the results:

Essential = 60% and over
Desirable = 40% and over
Specialist = below 40%

Where the results cannot be expressed as simple percentages a judgement has been made based on the distribution pattern of the replies and opinions expressed in the interviews.

Essential	*Desirable*	*Specialist use*
A4 size	Russian	larger than A4
European diacritics	italics	colour halftones
Greek (mainly for mathematics)	regular diagrams irregular diagrams	switch between text and graphics
scientific/ mathematical	high resolution halftones	unusual character sets
underlining/ vertical lining	adhere to original layout	quality equivalent to original
unmanned terminal	maintain confidentiality	delivery within 4 hours
plain paper printout	simultaneous delivery to different geographical locations	
cost equivalent to BLLD charges	delivery within 24 hours	
high print quality	high transmission speed (to keep transmission costs low)	

Table 12

APPENDIX B

AVAILABILITY OF TERMINALS SUITABLE FOR DOCUMENT DELIVERY

CONTENTS

1 Introduction

This document reports on the availability of terminals suitable for document delivery (DOCDEL) and capable of operating in coded character or facsimile mode, or both. It replaces and updates an earlier, interim, report reference 6520 of 30.07.82.

As such, the document fulfils the requirements and objectives of Section 3.2 of the work specified by DG XIII of the European Commission for the DOCTERM project. It is designed to be read in conjunction with the report on User Requirements, reference PS6520 of 18.06.82 and reproduced in Appendices A and 1 herein, which was prepared for Logica by the U.K. Paper and Board, Printing and Packaging Industries Research Association (PIRA), in fulfilment of section 3.1 of the DOCTERM work specification.

This report gives an overview of the state of the art in reprographic terminals potentially suitable for the Commission's DOCDEL project; it is based primarily on interviews with Research and Development personnel of major European manufacturers and senior regional representatives of other manufacturers with a strong European base.

The interviews with suppliers were structured according to an agreed Interview Questionnaire, presented for completeness in Appendix F. The data obtained from the interviews are comprehensively tabulated in Appendix E and constitute the prime base from which the conclusions of the survey are drawn. Additional information obtained from the suppliers is presented in Appendix G.

The body of the report provides an analysis of the basic survey data given in Appendix E. Section 2 provides a brief summary of the *current technological state* of potential DOCDEL products; Sections 3 and 4 review *technological trends* in print and paper-handling mechanisms. Section 5 outlines *new terminal applications* that can affect the technological trends. In sections 6 and 7 the *commercial attitudes* of the suppliers are noted and *recommendations* made concerning the next phase of the study and additional worthwhile areas of study/ specification.

The assistance and cooperation of suppliers' staff is gratefully acknowledged. The supply companies interviewed were:

Agfa-Gevaert	(B)
Canon-Europa	(NL)
CIT-Alcatel	(F)
Facit	(S/GB)
Hewlett-Packard UK	(GB)
Hitachi Europe	(GB)
IBM Europe	(F)
Kalle-Infotec	(D)
Muirheads	(GB)
Nixdorf	(D)
Oce	(NL)
Olivetti	(I)
Olympia	(D)
Philips-Mullard	(NL/GB)
Printronix Europe	(NL)
Rank Xerox	(GB)
Sanders UK	(GB)
Siemens	(D)
SEL/ITT	(D)
Thomson/CSF	(F)

2 State-of-the-art Overview

2.1 Technology Convergent — but not Integrated

Convergent technology in the laser and microchip field has been driving suppliers of facsimile and printer devices along similar development lines, towards machines able to print both coded characters and graphic images. However, an economically priced (i.e. for much less than ECU 20,000) *integrated product* able to do this while doubling as a facsimile transceiver (and ideally trebling as a convenience copier) appears to be still some way off.

Manufacturers are generally still pursuing narrow specialism on the applications front, and few plan to put even two, let alone all three, of these complementary office functions into one cheap box in the near future.

This specialism responds directly to market demand, which has so far tended to be for faster and cheaper printers *or* plotters *or* telefax machines rather than for any combination of the three. There exists, however, an awareness that specialist demand is beginning to move towards such integrated capability, and that there is a lively demand from the rapidly increasing personal computer user population for cheap reprographic devices able to print at least the elementary graphics they can achieve on their video displays, as well as alphanumerics.

2.2 Fax/Text Products and Plans

DOCTERM inquiry so far has revealed one electronic *product* (Muirhead) able to make a cheap, standard facsimile machine print coded characters.

Agfa-Gevaert and CIT-Alcatel were both planning at the end of 1982 to launch document delivery systems based on the concept of multiple, distributed input scanners working to a central laser beam printer with very wide character set and graphics capability. Both were thus essentially combining tele-facsimile with coded-character printing, and the ability to produce multiple copies of scanned documents, at a similar price in the 20,000-ECU range for the printer *plus* an as yet unfixed amount for scanners.

IBM has also recently (18 Nov, 1982) announced its endorsement of this concept. However, its new product, Scan Master I, is much more limited than those of Agfa-Gevaert or CIT-Alcatel. It needs a very heavy IBM environment to work and is not going to be easily made compatible with any other suppliers' (or even CCITT) standards. Also, whilst its ECU 12–16,000 price bracket looks attractive, that is only the beginning: providing a complete IBM environment, with full SNA support,

does not come cheaply. The most powerful effect of its announcement is therefore likely to be that of forcing down the prices of suppliers with a more flexible approach to machine compatibility.

There have been considerable advances on the coded character printer front, as regards the extent and range of available character sets. It seems reasonably safe to assume that, by the end of 1983, most major print device suppliers will be producing, in quantity, reasonably priced machines able to address all the European roman-character languages and probably cyrillics as well. This development appears largely driven by Teletex, which is having a healthy, though apparently not yet universal, effect on standardisation.

Many suppliers will also be able to print the whole range of characters in a wide range of point sizes and typefaces.

There is nevertheless an evident need (and considerable market opportunity) for an intelligent "black box" able to store multiple character fonts and graphic symbols, interpret these in both matrix and vector-plotting terms, provide large areas of buffer store for large documents and heavy graphics in transmission, and generally act as central print server to a wide variety of reprographic devices, including hybrid fax/printers.

On the printer front, a useful next step would appear to be the establishment of an agreed "graphics alphabet" of standardised symbols, shapes and graphic components, so that the substantial time, bandwidth and storage savings inherent in encoded transmission may eventually be achieved for reasonably complex graphics as well as characters.

2.3 Technology and DOCDEL

In the DOCDEL exercise, print devices cannot be considered in isolation; one needs particularly to know how graphic symbols and elements will be electronically captured and stored, and the forms and control information with which they will be most economically communicated.

Information derived from DOCTERM, COMPCOMP and EXCHAR, and from other relevant Commission-sponsored exercises such as the multilingual keyboard investigation, needs to be rapidly amalgamated.

It should then be conveyed forcefully to European suppliers — who are close to a powerful renaissance on the printer design and manufacturing scene — so that they can more directly appreciate and address European needs for integrated text and graphic processing systems.

3 Print Technology

3.1 Technological Development

Technological development of printing, copying and telefax equipment has been steadily converging over the past decade, centring on laser and/or microchip technology.

This is clearly seen in the offerings of a number of the suppliers consulted, some of whom have adapted their telefax technology to the code-driven printing function (e.g. CIT-Alcatel in France) while others have taken their existing copier technology and adapted it as the basis for new-technology printers (e.g. Olympia in West Germany and Agfa-Gevaert in Belgium).

Of the major suppliers consulted, only one (CIT-Alcatel) has so far spoken of firm plans for an integrated office terminal handling coded character and facsimile reception at a price in the general range expected for telefax transceivers and matrix printers. Even in this case, the product is at least two years from realisation.

There is, however, one interface product of established viability (Muirheads MS473 character generator and digital/analog adapter) which drives a CCITT Group I or II facsimile machine in coded character mode. Developing this device to meet Group III requirements and 200 lines per inch resolution is said to be feasible. Muirheads has also demonstrated the viability of a hybrid OCR/facsimile scanner which can transmit either coded characters or digitised pictures up a communications path, depending on whether or not the device 'recognises' shapes it scans.

3.2 Convergence

Convergence is also evident on five other fronts:

— *Resolution* of printers appears increasingly to be aiming for matching or modestly exceeding the 200 lines per inch standard set for Group III facsimile. While laser printers *can* achieve a resolution five or six times in excess of this the majority of suppliers claim, perhaps for technical reasons, that the perceptible difference in images printed on all but art-quality paper is so negligible that resolutions over 300 lpi are irrelevant in ordinary office printing terms.

One supplier (Agfa-Gevaert) has, however, decided to opt for 400 lpi on the grounds that (a) 300 lpi is still not quite enough for sharp serifs and (b) 16 x 16 pixels per square millimetre provides an easy route to excellent 16-greyshade halftones. Agfa believe at least two Japanese and one European supplier will follow their lead.

— A high percentage of suppliers are aiming for 10 European *character sets* plus 'American' (hash-mark, dollar and cent signs), and endeavouring to arrange that at least the 309 fairly generally agreed characters of the *Teletex standards* can be handled online.
— *Paper-handling* seems increasingly likely to be based on proven copier mechanisms.
— *Printer interfaces* are generally standardised on RS232 serial and/or Centronics parallel.
— *Raster-scan/Vector-plot* conversion is being recognised as desirable for some applications needing very flexible graphics intermixed with standard shapes. Both major suppliers of plotters (Calcomp and Tektronix) have recently announced 'black boxes' to carry out such conversion.

3.3 Facsimile

From the user study conducted in Phase I of the DOCTERM exercise, it was immediately evident that a high percentage of user needs *could* be met by any one of the wide range of commercial offerings of CCITT Group III facsimile transceivers, provided hard copy originals were available. They meet a generally acceptable image resolution standard (200 lpi), and can obviously handle a limitless range of character sets and image types.

Since this was known, considerable emphasis was placed, in the DOCTERM investigation, on code-driven printers capable of going at least some way towards graphic image handling.

Facsimile transmission presents a number of significant operational disadvantages compared with printers for document delivery in the way envisaged by the overall DOCDEL exercise:

— while some telefax equipments have been (and most could be) *adapted* to be driven in coded character mode, no supplier is currently offering a dual-mode fax/printer *product*
— this implies that, unless a converter of the Muirhead type or similar device were used, the fax terminal could not be driven directly by electronically stored data streams unless these were first input to store from a compatible fax scanner. In order to retrieve text from electronic storage at a central point and transmit it, therefore, that text would first have to be printed out, then scanned and transmitted by a facsimile machine. Such a process would involve significantly more effort and equipment than would be required to drive a remote printer directly from an electronic database

- low-cost facsimile devices need human attendance at both ends of the transmission line; automation of the feeding mechanism at both ends can be costly
- simultaneous transmission from a central point to multiple destinations can only be achieved with great difficulty and cost — CCITT standards for facsimile are designed for point-to-point transmission
- telecommunications connect time/cost for facsimile, even with substantial data compression ratios, is significantly greater than for coded character transmission
- similarly, full-scan facsimile information places *very* heavy demands on storage devices if it is to be switched en route. An A4 page scanned at 200 lines to the inch requires, without data compression, roughly four *megabits* (half a megabyte) of store, as compared with something like four *kilobytes* for the characters covering such a sheet in their coded form
- facsimile transmission is inherently more vulnerable to image degradation by interference on the transmission line.

3.4 Coded character

At the start of the DOCTERM study, it was decided to divide examination of code-driven printers into four broad categories:

- impact (with single-element and needle/pin-matrix sub-categories)
- thermal
- ink-jet
- laser

During the study, a fifth category — xerographic — had to be added (Olympia).

It was felt initially that single-element and thermal printers would be less rewarding to study, since the former were limited by the number of symbols which could be accommodated on the print element, the latter slow, needing specially treated paper, and difficult to use in office operation (slow to warm up, fire hazard). However, the study has clearly demonstrated that *all* print technologies are making considerable advances.

3.4.1 Impact Printers

Single-element printers are being expanded by

(a) introducing wheels of up to 192 characters

(b) (perhaps more promisingly) development of segment-printing and graphics-mode capability, chiefly to accommodate Teletex printing needs.

Needle/pin-matrix printers, with enhanced multiple-pass strike capability and dual needle-heads giving as many as 16 dots per strike, can now produce high quality character images and very flexible graphic images.

3.4.2 Thermal Devices

The use of low-speed thermal printers has proliferated in home computing because of low price and the fact that the devices will work 1-on-1 with the editing terminal used, lowering the need for speed.

The (Japanese) OKI thermal print head has become something of an industry standard both for thermal printers and facsimile devices using heat-sensitive paper, mainly due to its long operating life (10,000-plus hours) between maintenance, ease of replacement and low cost.

For professional/shared use, however, new multiple-head thermal printers are now available (e.g. RICOH) with rated speeds matching those of computer line printers (1000 lines per minute and above).

3.4.3 Ink-jet

The two major operational drawbacks to using ink-jet devices (nozzle-clogging by fast-drying ink and the converse problem of image stability with non-clogging ink) are largely overcome. Suppliers now claim that, with added heat treatment, images can be rendered stable within a second or two of printing and before they are accessible to human hands.

Speed is also being enhanced, overcoming another difficulty generic to non-impact printers — they cannot produce carbon copies. Multiple serial printing of top copies (preferable for quality) is an operational practicality with increased speed.

One (Japanese) manufacturer is experimenting with an ink-jet device in which ink bubbles are produced by the thousand, by flash heating of the ink, and then 'burst' in processor-determined patterns onto paper, achieving very high line printing speeds.

Ink-jets also look to have a promising future in full-colour printing.

3.4.4 Laser Beam

Laser printers appear to offer the greatest promise of combined flexibility and speed of printing, with the possibility of continuous upgrading of image resolution, always provided that printing is limited to black-and-white and half-tones.

From a manufacturing point of view, they also offer an attractively straightforward adaptation of existing photocopier products, replacing the optical-scan element of the machine with a laser mechanism, but conserving the electro-mechanical apparatus intact (and *ipso facto*

virtually eliminating the mechanical de-bugging which could heavily delay introduction of a wholly new product).

This will be an important consideration with regard to pricing, since laser units will not cost more than a few hundred units of account (ECU) to assemble in production-line numbers and the beginnings of a price war are already evident; Hitachi, for example, could halve the OEM cost of the laser beam printer quoted by Canon.

All current laser printer offerings are raster-scanning devices, requiring digitisation of dot matrices for characters and graphic elements, as opposed to the freer vector-painting approach employed in CRT typesetters and (although at some cost in control software development) theoretically open to laser system suppliers.

Most of them operate at or around 240–300 lines per inch.

The laser beam printer category is very broad, ranging from simple desk-top models (e.g. CIT-Alcatel) to the very large (e.g. Hewlett-Packard) self-contained printing system with its own computer, mass storage and editing display built in.

3.4.5 Xerographic

This type of printer 'writes' an electro-magnetic charge straight onto the reprographic drum of an electrostatic copier system; the magnetically traced outlines can achieve a reasonably high degree of resolution, but are felt unlikely to equal laser beams in this respect.

3.5 Character Set/Graphics Mode Control

All the matrix-based types of device listed above can theoretically print any character or graphic shape whose image can be scanned, digitised and stored as a dot matrix, with a resolution directly geared to the size of the smallest dot they can print.

The process of digitisation from a sample image to the production of a new character set can vary anywhere from forty-eight hours to three months. Typically, to add character fonts may be expected to take around six to eight weeks for those devices capable of font change or of holding multiple fonts online.

The vast majority of small or medium-capability printers store their character sets in read-only memory (PROM), with add-on characters in random-access memory (RAM) linked to the PROM. There are usually fairly tight limitations on the number of characters and type styles which can be held online (typically not more than four fonts of 128 characters, or equivalent). One of the new medium-priced machines (Agfa-Gevaert P400) will, however, have up to four megabytes of online font storage.

Other fonts must be brought in either by memory module replacement (e.g. Sanders), a software-triggered switch between an array of ROMS, downline loading of new instructions from a host computer, or, in the case of the Agfa-Gevaert machine, by loading from floppy disk.

The larger, self-contained printing systems (e.g. Xerox 9700, Hewlett-Packard, Siemens 500) are able to store a very wide range of character fonts on hard disk.

Size of characters typically ranges from an absolute minimum of four points (the lowest human-readable level) to forty-eight points or anything between, in half-point steps, and above forty-eight points quite often to a whole A4 page if that should be needed, using aggregated dot matrices.

Beyond simple images such as the conventional shapes of an IBM flow-chart template, or the notoriously difficult benzene ring, which can be stored as expanded single-character images, graphics are still very much of a problem.

Assembly of pictures from such stylised graphic elements appears crude, and without the transmission of very complex scanned information, coupled with significant addition of terminal intelligence to give full vector-plotting capability, images even of the complexity of the sample page used in the Phase I questionnaire will not convincingly be handled.

It may well be that, to achieve sophisticated mixed graphics and text printing for a wide variety of users, it will be necessary to look to the design of a multi-function 'black box' (possibly a 32-bit microcomputer) able to store extended ranges of character sets and interpret vector commands in full plotting mode. Such a box would, ideally, be able to control the image production of a very wide range of print devices. (See Section 7, Recommendations).

4 Paper-handling

4.1 Mechanisms

Paper-handling mechanisms for print devices range from hand loading of single sheets for the cheapest devices to expensive front-end feed and back-end guillotine and collation sub-systems, handling in one case a 10km roll of paper, for the most expensive.

Three types of loading mechanisms appear most appropriate for likely DOCDEL scenarios:

- automatic single-sheet hopper feeder, as typically used with daisy-wheel printers in word processing systems
- continuous fan-fold paper tractor
- copier cassettes.

4.2 Sizes

All printers can handle printing layout on A4 stationery, and all but the simplest do it in both portrait (vertical) and landscape (horizontal) mode.

A3 is less common, particularly in landscape mode, and A5 (although smaller than A4) is not widely addressed.

Mixing of physical paper sizes online is generally not easy, but can be achieved in some systems with:

- twin-hopper feeders, supplying two different paper sizes or types
- fan-fold stationery carrying mixed sets of peel-off sheets (but the sequence of sizes needs to be determined in advance if wastage is to be avoided)
- machine-selectable cassettes.

4.3 Special Paper

The great majority of printers do not need special paper. Exceptions include:

- one laser printer (CANON) which has specially coated paper to enhance image quality
- most ink-jet printers, which specify a high-absorption surface sometimes likened to blotting-paper.

5 Additional Applications

5.1 Convenience Copier

Only one supplier (Hitachi) currently plans to launch a print device which can also be used as a convenience copier. Two others (Agfa-Gevaert and CIT-Alcatel) have plans for scanner options to be added to their laser beam printers to provide the dual capability.

Manufacturers seem so far largely to have ignored the market appeal of a device combining two fairly expensive office reprographic functions in one box at a reduced price and offering enhanced operational efficacy.

5.2 Teletex

Many medium price (£1500–£2500) printer suppliers are working hard to achieve Teletex compatibility for their devices, providing a range of up to 309 or 314 agreed characters (depending on whom you talk with and in which country) and, quite often, additional graphic symbols.

They see the printers being integrated with editing VDU's into Teletex work-stations.

5.3 Videotex

Many manufacturers are aware of a user desire to be able to dump a screen-full of data from a Videotex system onto paper. A few are about to offer an interface to do this, the rest say it would be a relatively simple optional extra (in principle).

The fact that videotex has as its basic philosophy the use of video display rather than hard copy printout is generally felt not to have diminished end user desire (as perhaps opposed to hard need) for such an option.

5.4 Full-Colour Printing

Needle and ink-jet printers are moving into a new era of attractive full-colour printing at prices more reasonable than those hitherto experienced, and with technology less crude than the quadruple ball-point pens used by a couple of current (highly expensive) printer plotters.

Needle printers with sophisticated overstrike facilities, using four-colour (cyan, saffron, magenta, black) ribbons, are being put on the market by a number of suppliers (including Olivetti and Facit). It is anticipated that such devices will cost only about 20% more than their black and white forerunners.

Similarly, four- and eight-nozzle ink-jets have been developed to spray full colour mixes onto white paper.

These options are seen as particularly attractive in conjunction with colour graphics displays on personal computers.

6 Commercial Considerations

6.1 Supplier Attitudes

Despite fairly widespread scepticism, particularly among European manufacturers, about the institutions of the EEC as a market-place for their products, there is a general willingness to assist with pilot trials.

Small and medium scale suppliers appear ready in principle to make trial machinery available:

- on free trial for typically 2–3 months *or*
- at a zero-profit rental price for a term of up to about six months *or*
- on some similar favourable terms.

Large-system manufacturers appear ready to cooperate in a somewhat different way, by arranging for trials to be run at their own sites, or sites of friendly users of their equipment. Understandably, they are not prepared to ship upwards of ECU 200,000 worth of equipment to a trial site for three months, or even six. There is, however, some willingness to talk about rentals with a one-year bail-out option.

6.2 Price Levels

Prices for printers which may be suitable for trial in various operational scenarios range from around ECU 500 for some of the latest personal computer devices (with limited capability enhanceable by more expensive software) to around ECU 400,000 for a fully configured Xerox 9700.

In the middle ground, OEM prices from around ECU 3500 for a fairly flexible needle-printer to ECU 20,000 for a laser beam printer.

6.3 Reliability and Support

Under mainly Japanese influence, there is an increasing tendency to calculate preventive maintenance needs, reliability statistics and all-up running costs on a sheet-count basis. Reliability figures are climbing rapidly, with several suppliers of copier-based machines talking in terms of 40,000–50,000 sheets or more between routine maintenance calls.

Laser systems, usually based on proven copier chassis, appear to be proving significantly more trouble-free than impact or ink-jet equivalents, since the laser system itself has only one moving part (a mirror mechanism) at most.

Support is increasingly based on widely-spaced preventive maintenance with emergency call-out limited to those situations which cannot be resolved by increasingly sophisticated internal diagnostics giving clear-language instructions to end users.

7 Recommendations

7.1 Phase III Discussions with Suppliers

NOTE: This subsection is reproduced here for completeness. Its recommendations were carried out within the scope of Phase III of the DOCTERM study.

Analysis of the available technology and identified user needs leads to the conclusion that most, if not all, of the requirements can be met by current or forthcoming products in the price range up to ECU 20,000. Within this price class, it is believed that equipment based upon developments of facsimile products, or on the combination of laser and copier technology, have most to offer for black and white and half-tone applications, with simple colour requirements being met by needle-printer based devices. Accordingly, it is recommended that the following suppliers be contacted within the scope of Phase III of the DOCTERM Project:

Agfa-Gevaert
CIT-Alcatel
Muirheads
Olympia
Philips-Mullard.

It is proposed that each of these companies should be supplied with a copy of the DOCTERM Phase I and Interim reports (excluding Appendices) and that discussions should then be held to determine:

- how far their development plans can (or need) be modified in order to meet the user requirements identified by the DOCTERM study, and to fit in with timescale and other constraints imposed by the DOCDEL pilots
- their willingness to participate in DOCDEL pilots, either as main bidder, consortium member or subcontractor
- their preparedness to collaborate in the specification and conduct of technical trials, along the lines discussed in 7.2.1 below.

These recommendations relate, as noted, to the smaller systems, since it is believed unlikely that a full DOCDEL pilot could justify the sole utilisation of the more powerful, more expensive devices like those of Siemens, Rank-Xerox and IBM. However, as a means of obtaining useful additional knowledge about the capabilities of such large systems, it is recommended that the DOCDEL industry forum representatives of these three companies be asked to discuss arrangements for running in-house tests of complex text and graphics documentation on their systems.

7.2 Extension of DOCTERM Work

Work so far conducted on the DOCTERM study has highlighted the need for extension of the scope of work, or the commissioning of additional studies relating to:

- technical trials of the equipment, prior to conduct of the DOCDEL pilot
- the required functionality of a complete document delivery work station
- standards relating to document specification and encoding of graphics information
- specification of a generalised print-server.

Each of these areas is commented on briefly below.

7.2.1 Terminal Testing Scenario

In order to pave the way for testing of integrated pilot systems under the DOCDEL programme, initial testing of the suitability of the print systems envisaged for pilots should be specified and undertaken.

This testing should cover, with the collaboration of the suppliers mentioned above:

- code driven facsimile terminals
- several different types of coded character printer
- large stand-alone systems.

Ideally, the testing will be carried out in three different types of operational scenario:

- one user/one print device
- small department sharing one device
- large 'mailroom' using one device

NOTE: An outline test specification was produced under an extension to the DOCTERM contract. It forms Appendix D of this report.

7.2.2 Expansion to Work-Station

It is important to expand the concept of the DOCTERM receive terminal, as defined in the study's terms of reference, to embrace the complete work-station likely to be used in DOCDEL experiments, as soon as possible.

Additional work should be commissioned to establish functional specifications and a range of operational scenarios for the complete work-station.

7.2.3 Standardisation

Further work should be undertaken to establish the feasibility of expanding still further the character sets for STM publishing to be

defined in EXCHAR, to include a range of standard graphic segments which may be used to build up at least crudely regular graphic images.

Desirably, since simple determination of the set of characters and symbols required is insufficient to achieve clean delivery of a document emulating the original (same layout, font etc.) this work should be further extended in order to specify standard document format(s) for DOCDEL pilot exercises.

7.2.4 Print Server Functional Specification

Incorporating lessons learned from COMPCOMP and EXCHAR, a short study should be commissioned to produce a functional specification for a computer-based print server able to store a wide range of character sets and interpret these in driving terms to a range of print device types (see Section 3.5).

This specification, an outline of which is presented as Appendix C, should then be put out to tender for the building of a prototype of such a 'black box'.

7.3 The Intelligent Copier/Printer/Fax Machine

The Commission — through its connections with manufacturers, standards bodies and other influential groups — should seek to pressure suppliers to move towards products which integrate the intelligent printer, convenience copier and facsimile transceiver (or at least two of those) in a single unit.

APPENDIX C
PRINT HANDLING BLACK BOX

Outline Functional Description of an Intelligent Device Controller to Hybridise a Multiplicity of Facsimile and Coded-character Print Devices

CONTENTS

1 Background

This document expands the suggestion of a print device controlling 'black box', contained in Section 5.2.4 of the main report.

Its aim is to describe in outline the configuration and functions of a computer-controlled print device server which would make it possible:

- effectively to provide any print device capable of achieving a resolution of 100 lines per inch or more with the capability to print a very wide range of character sets and graphic outlines
- for users with a variety of print quality and output speed requirements to attach their selected device type to this server, and have the print device switch easily between facsimile and coded-character mode
- by fulfilling these first two aims, to reduce dramatically the cost to each end user of having a multi-font printer capable of reasonably flexible graphic output.

This paper should be read *in conjunction* with a working paper produced by PIRA and submitted to the DOCDEL Industry Forum, entitled:

> *A suggested Modular Approach to the Development of Software for a Document Delivery System*

Familarity with EXCHAR and COMPCOMP study documentation is also assumed.

2 Hardware

2.1 Controller

The basic hardware requirement envisaged is:

- large microprocessor(s) or minicomputer with between 500K and 4 megabytes of fast access memory
- 20–80MB hard disk storage
- floppy disk drive (for new font loading)
- not less than eight fully-buffered communication ports able to accept input at speeds from 50 bps to 19.2 Kbps
- not less than eight output ports able to work at a similarly flexible range of device speeds.

2.2 Printers

Print devices to be controlled will include:

- Group II and III (and eventually IV) facsimile transceivers
- medium-speed high-resolution needle-matrix printers
- electrographic printers
- thermal print-heads
- ink-jet printers
- laser beam printers
- *any mix of these.*

3 Resolution

The server should embody a raster-generator capable of driving devices with print resolution levels of 4, 8, 12 and 16 pixels/mm (approximately 100, 200, 300 and 400 lines per inch).

Resolution setting for a given transmission to a selected device should be either:

- — manually at receiving centre
- — by up-line signal initiated manually from the receiving print station
- — by control character sequence transmitted down-line from the sending system.

4 Character Fonts

The device should be able to store, for immediate online access, encoded dot matrices suitable for the resolution settings and machine types described above to provide at least:

- — four x 512-character apha fonts, with full accent/diacritical range, italics, sub and superscript and complete European character sets, to ISO 6937 or similar standard, with additions
- — full numeric fonts including fractions to thirty-secondths, sub and superscript
- — mathematical and chemical symbol sets derived from EXCHAR recommendations.

User-defined special fonts, logos or additional symbols should be loaded either down-line or from a local floppy-disk library.

All text should be capable of being printed at type sizes of 8, 10, 12, 14 and 18 points, as a minimum, with software-controlled infill (overstrike for needle printers) between dots at the larger point sizes.

5 Graphics

The device should drive any print mechanism capable of the appropriate resolution levels in Group II or Group III facsimile receive mode.

It should be able to store at least one A4 page equivalent of (uncompressed = ca 4mb) graphic data per input buffer.

6 Format Control

Complex issues of format definition need to be resolved outside the basic scope of this paper, involving as they do input and telecommunication considerations.

However, the server should at least support Teletex and ECMA Office Document Formats as these become progressively agreed and/or applied in Europe.

It should also have the capability to accept 'idiot tape' (seven-bit ASCII character streams with upper and lower case-shift and paragraph markers) and format this input arbitrarily to a very simple standard which will involve neither hyphenation nor justification of text, nor sophisticated pagination.

(In this context, it is worth noting that the DOCTERM investigation showed that the great majority of uses are not concerned about preserving the original typeface, pointsize or format of *text*).

7 Communications Interfaces and Diagnostics

The device should be able to meet, as the 'mini-host' to its guest printers, all the communications requirements laid down in Sections 4 and 6 of the print device test specification (Appendix D).

APPENDIX D

PRELIMINARY PRINT DEVICE TEST SPECIFICATION

CONTENTS

1 Introduction

The Commission of the European Communities plans to carry out preliminary testing of equipment for use in pilot trials of electronic document delivery services to be offered over the EURONET-Diane telecommunications network, in a project which has been code-named DOCDEL.

This document specifies tests to be carried out to demonstrate that print devices offered for DOCDEL trials(s) can:

- handle all tasks likely to be assigned to them
- integrate operationally with a variety of host computers, telecommunications devices and other sub-systems
- work reliably in a wide range of environments.

Its content relates very closely to the findings and recommendations of two DOCDEL study projects:

- EXCHAR, dealing with expanded character sets needed for scientific, technical and medical (STM) publishing
- DOCTERM, analysing the requirements for print devices capable of handling graphics and a very wide range of characters and symbols.

Suppliers intending to offer equipment for DOCDEL trial exercises should read the reports of both studies, and are strongly advised also to take into account the findings and recommendations of a third DOCDEL study, COMPCOMP, which looks at electronic typesetting of STM materials.

In this document, the word 'must' is used to denote elements of print device competence which it is *essential* to demonstrate, and the word 'should' where such demonstration is *highly desirable*.

2 Printout

This section seeks to explore the various levels of capability of print devices proposed for pilot trial as part of the DOCDEL programme.

At the time of preparation (November 1982) of this document, it was felt improbable that coded-character print devices (as opposed to facsimile transceivers) would be able to handle the totality of requirements expressed in sub-sections 2.1 to 2.6.

A high percentage of those requirements must, however be met at a reasonable price (to be defined by the Commission) in order to qualify for possible participation in DOCDEL trials and experimentation.

Needs expressed in sub-sections 2.7 and 2.8 are recognised as primarily pertaining to a relatively small group of specialist users who may be prepared to pay more for their needs to be fully met.

2.1 Roman Alphabet

The print device *must* be able to handle the complete range of Roman characters envisaged by the ISO/DIS 6937 recommendation.

2.2 Numerics & Punctuation

The device *must* also demonstrate its ability to print out all numerics, punctuation and other symbols contained in ISO/DIS 6937.

2.3 Greek Characters

The machine *must* be able to print at least those Greek symbols derived from ISO 5428 for use in mathematical publication (see fig. 6.11, EXCHAR second interim report).

2.4 Mathematical Graphics

The device *should* be able to handle a high proportion of the G2 and G3 character sets proposed in the EXCHAR study recommendations (see figs. 6.5 and 6.6, second interim report).

2.5 Chemistry Graphics

The device *should* be able to handle most of the graphic elements suggested in Fig. 6.12, EXCHAR second interim report.

2.6 Office Graphics

The machine *should* be able to handle simple 'office graphics', which are defined for the purpose of testing as those symbols and outlines represented in a flow-chart template of the IBM type, and selectable sub-elements of those symbols.

2.7 Complex Graphics

Machines *entered for this test category should* be able to print irregular black and white material of the complexity of the attached sample (as used with DOCTERM study questionnaires), *and* demonstrate half-tone representations of e.g., samples 18 and 19 given in Appendix 1.

2.8 Full Colour

Devices *able to handle full colour should* print samples of (a) complex graphic image(s) of the type, given as sample 20 of Appendix 1 and (b) the saffron, cyan, magenta and black separations involved in the build-up of that image.

2.9 Resolution

All devices *must* be able to print with an image resolution of at least 8 lines to the millimetre (approximately 200 lines per inch). Preference will be given to machines able to print at resolutions better than 250 lpi (10 lines/mm).

2.10 Image Durability

Resistance of the printed image to abrasion/moisture *must* be demonstrated by rubbing a rough, damp cloth over sample printed sheets held on a firm surface within five seconds of output.

3 Paper-handling

3.1 Output speed

The print device *must* demonstrate its ability to print and output an A4 sheet of (a) text (b) graphics in not more than 30 seconds.

3.2 Paper Size & Format

The machine *must* output paper in at least:

- A4 portrait (vertical) mode
- A4 landscape (horizontal) mode.

and *should* then demonstrate its capability with other sizes and/or formats.

3.3 Paper Types

The device *must* print samples on:

- plain, untreated sheets of bond paper of between 60 and 70 grammes/square metre in weight, *or*
- continuous edge-punched fan-fold computer stationery.

3.4 Other Media

The device *should* print samples of output on transparency film of the type used for overhead projection.

3.5 Feed Mechanisms

Print devices *must* demonstrate the ability to use, in unattended mode, *one* of the following:

- single or dual sheet hopper feed
- continuous stationery tractor
- cassette-type paper loading

4 Communications

4.1 Interfaces

The device *must* demonstrate RS 232 serial and Centronics parallel interfaces.

4.2 Remote Controls

The device *must* be tested in remote printing mode and demonstrate communication back to the sending device of control signal(s) covering at least the following checks:

- power on
- paper loaded
- top of form aligned
- ribbon ok (where applicable)
- toner/ink ok (where applicable)
- ready to receive transmission.

4.3 Transmission Integrity

The device *must* demonstrate the ability to detect line failure and/or parity errors caused by noise bursts or other interruption. It *must* be able to identify corrupt or incomplete incoming data blocks.

It *must* indicate failure of attempted transmission to staff at the receiving station and *should* automatically:

- request the sending station to re-transmit from the start of the page during which the failure/noise/corruption commenced, *or*
- keep requesting re-try of corrupt data blocks until successful block receipt occurs.

4.4 Computer Connection

The device *should* be demonstrated being driven in text and graphics mode by micro, mini or mainframe computers from at least two of the following suppliers:

Siemens	Honeywell	ICL
Philips	Univac	DEC
Data General	Hewlett-Packard	IBM
Burroughs	Xerox	NEC
Apple	Commodore	Wang

4.5 Transmission Speeds

The device *must* demonstrate the capacity to receive transmitted digital data at a rate of at least 300 bits per second.

It *should* also receive and produce sample output for quality comparison at 2400 bps and all other data rates of which it is capable.

5 Reliability

5.1 Power Failure

Power failure must be simulated by switching off mains power supply to the device, three times in half an hour, and then powering it up again within a maximum of ten minutes from shut-off. Sample printout must be taken after each re-start. There *must* be no perceptible deterioration of quality.

5.2 Power-sharing

The device must be run for at least six hours on a mains circuit shared by at least two other electrically powered devices, one of which must be a photocopier. Sample printout should be taken at intervals and must include two sets of samples taken while the copier was in use. Again, there *must* be no perceptible quality deterioration.

5.3 Environmental Soak Test

The device *must* be run for not less than twenty-four hours in an uncooled work space having a volume not greater than 75 cubic metres, and whose access door(s) will remain closed except for user staff access.

Temperatures in the room must be monitored and sample printout taken at least every three hours. There *must* be no quality deterioration.

5.4 Print Medium Replacement

Print media (ribbons, ink, toner as appropriate) *must* be changed after the first eight hours' testing and sample printout taken immediately before and after the change.

5.5 User Safety

All safety precautions will be fully demonstrated.

NB: A device safety certificate from a body whose standards are approved by the EEC Commission *must* be produced before *any* testing begins.

6 Diagnostics

6.1 Hardware

The following device hardware failure conditions *must* be simulated, detected and rectified with the aid of the supplier's standard diagnostic routines and procedures:

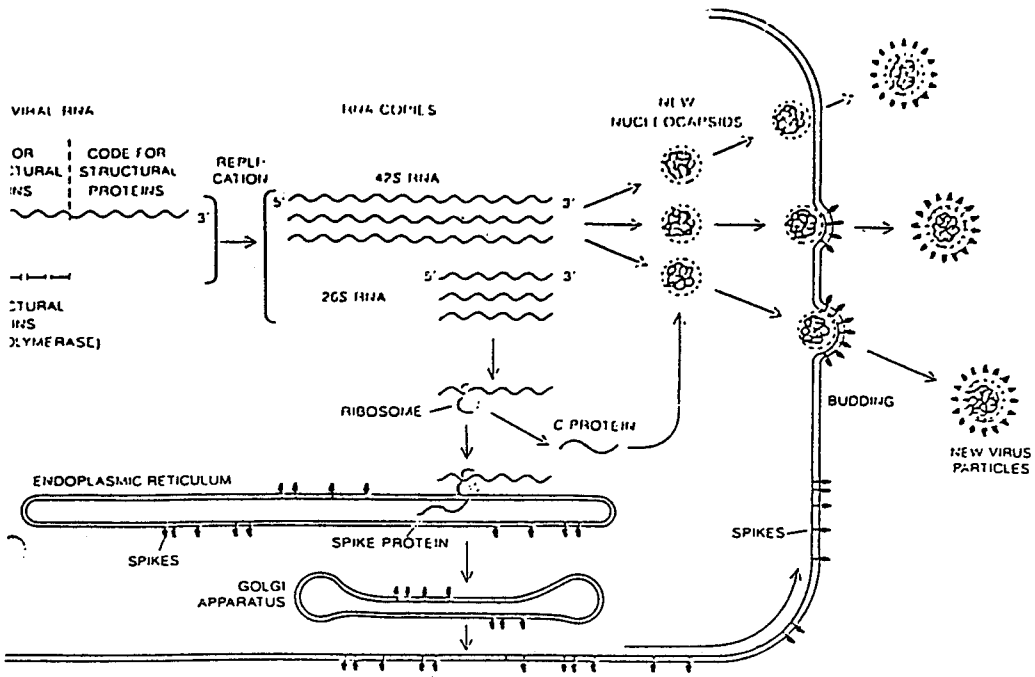
- paper jam/transport failure
- paper out
- print medium (ribbon, ink, toner) failure
- print element failure
- overheating
- cover/door not properly closed

6.2 Software

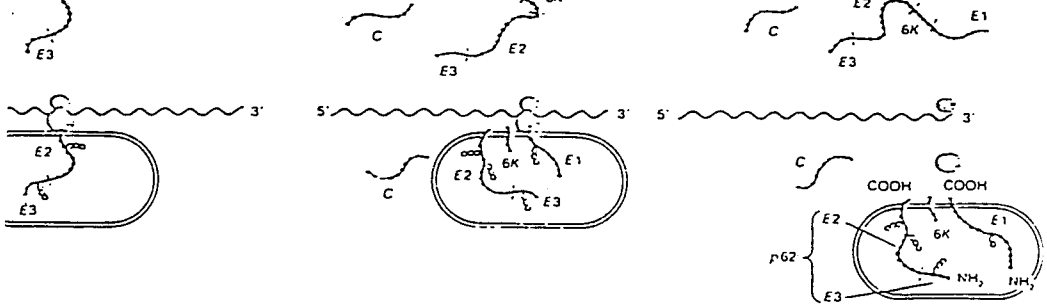
Diagnostic programs *must* be demonstrated in full, and finger-pointing exercises conducted to show how faults occasioned by hardware failure may be isolated from software-related problems and vice versa.

6.3 Communications

Device and line problems of the possible types identified in sub-sections 4.2 and 4.3 *must* be simulated, diagnosed and rectified using supplier's standard diagnostic routines, programs and procedures.



NA molecules. The 42S RNA is a copy of the complete viral-NA molecule; the 26S RNA is a shorter molecule that incorporates e genetic code for the four viral proteins. (S stands for Svedberg nit, a measure of the molecule's mass.) Within three to four hours ese are the most abundant RNA molecules in the cell. Now the 26S NA becomes attached to a ribosome and begins to act as messenger NA for the viral proteins. The four proteins are made continuous- in the order *C*, *E3*, *E2* and *E1*. As soon as the *C* protein is made it is ipped off by an enzyme. In the cytoplasm it joins a 42S RNA mole-ule to form a new nucleocapsid. The *E3* protein is made next. When the first few amino acids of the *E3* chain are assembled, the ribosome attaches itself to the endoplasmic reticulum, a network of interconnected membranes within the cell. The growing *E3* chain is threaded through the membrane of the endoplasmic reticulum; assembly continues with the chain extending into the interior of the reticulum. When the three spike-protein molecules have been made, they are combined to form the membrane spike. They are then transported to the organelle called the Golgi apparatus, where they are modified. The spike is inserted into the cell membrane, where it meets a new nucleocapsid. Finally the finished virus particle buds out of the cell.



of endoplasmic reticulum are added to the solution, however, the viral proteins are manufactured as they are in the cell. The *C* protein is made and cleaved from the chain. The first few amino acids of the *E3* chain constitute a "signal sequence" that binds the ribosome to the vesicle. Translation proceeds with the *E3* chain threaded through the membrane. The *E3* and *E2* molecules are made consecutively and remain connected in a protein called *p62*. Translation proceeds until a point near the end of the *p62* chain is reached. A stretch of hydrophobic amino acids there prevents the chain from passing through the membrane; the chain remains fixed to the membrane as translation continues. When translation of *p62* is complete, the *p62* chain is clipped off and the *E1* molecule begins to be made. The *E1* chain has its own signal sequence, *6K*, which is later clipped off. Assembly of the *E1* molecule proceeds until its passage through the membrane is stopped by a hydrophobic segment. As a result the *C* protein ends up outside the vesicle, in the region corresponding to the cytoplasm. Most of the *p62* and *E1* chains are inside the vesicle in the region corresponding to the interior of the endoplasmic reticulum. When the proteins are made in a cell, the *p62* chain is later cut to form the *E2* and *E3* chains; the three proteins are then assembled into the spike.

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Sample of an irregular Diagram

APPENDIX E
TERMINAL CHARACTERISTICS TABLES

Tabulated Results

This appendix presents the results of the supplier interviews in tabular, comparative, form. For each type of equipment considered, the tables provide summary technical and commercial information under the following headings:

General
Character Sets
Graphics
Image Quality
Paper Handling
Communications and Interfaces
Maintenance
Environment and Operations
Applications
Research and Development
Customisation
Pricing
Trial Participation
User Base
Interview Number.

In the table entries, the following general conventions are used:

Y	—	Yes, available
N, X	—	No, not available
F	—	Planned for future availability
O	—	Available as an option
NA	—	Data not available: not known
—	—	Not applicable.

Other codes, specific to the column of interest, are defined in the following amplification of column meanings.

General

This section covers general information about the device:

— *Device Type:* the type of device

PR	—	Printer
FX	—	Facsimile device.

— *Technology*: the main technology employed
  LR — Raster scan laser beam
  NM — Needle/Pin matrix
  DW — Daisy wheel
  IJ — Ink-Jet
  VD — Electron beam (CRT technology)
  XM — Xerographic/magnetic
  TH — Thermal.
— *No of Copies*: number of simultaneously printable copies.
— *Time to Print* A4 page: the time taken to print a typical A4 page, expressed in seconds.

Character sets

— Storage: the type of storage used for font memory (if applicable).
— No of European Character Sets: the number of national language character sets supported:
  Y or any — any character set can be supported
  F — any character set will be supported (future)
  all — all roman sets.
— Maximum number of Fonts Online: the number of different character fonts which can be simultaneously supported for online operation. Where character memory is extensible, the number for a typical configuration is given, with a + sign to indicate extensibility.
— Down-Line Loading: an indication of whether online character sets can be reloaded dynamically.
— Point Size Limits: the range of character sizes supported:
  ch/in — characters/inch
  pt — point (1/72 inch)
  scale, x — ability to scale size of characters in character memory (horizontally and vertically
  Y — variation possible, but limits not specified.
— Bold, Light, Italic: ability to support bold, light and/or italic variants of fonts.
— In Same Line: capability to switch between bold, light, italic and normal text within a line.

Graphics

- IBM Template: ability to produce regular diagrams using, for example, flow chart template symbols.
- Sample Page: ability to reproduce the example diagram page, circulated with the questionnaire.
- Graphics and Text: ability to support extended graphics/halftones, etc.
- In Same Page: ability to switch between graphics and text within a page.

Image Quality

- Resolution: resolution of the printer in lines per inch. Where one value is given, this applies both horizontally and vertically; two numbers are used to show horizontal and vertical resolution, respectively, where these differ. In some cases, the numbers are approximate only — e.g. 200 is often used when the facsimile Group III standard is in fact adhered to.
- Colour: ability to work in colour.
- Stability: an indication of stability of the image:
  - D — Sensitive to damp
  - S — Image quality affected by speed of operation
  - F — Sensitive to friction.

Paper Handling

- Plain/Special: indicates whether plain paper (e.g. standard copier quality) is used or whether special paper is required.
- Cut Sheet/Fan Feed/Roll: indicates form of paper supply. In some cases, several possibilities exist.
- Hopper: reflects the availability of a paper hopper.
- Size Limits: defines the paper sizes which can be handled by the device in measurement or standard size terms:
  - W — wide
  - (F) — possible in future (planned).
- Landscape: indicates whether the paper can be supported in landscape as well as portrait mode. In many cases, this is possible for A4, but not larger paper.

Communications/Interfaces

- Stand-Alone/Peripheral: indicates whether the device is intended for stand alone (offline) operation or as a peripheral on some other system.
- Speed: indicates the range of communications speeds supported, in bits per second.

— Buffer Size: specifies the size of the communications line buffer, either in bytes or number of typical A4 pages:

  Hard Disk — virtually unlimited storage

  — — no store in the printer. However, for some devices the printer is close coupled to another device (e.g. Teletex work station) and does not communicate directly with the external world.

— Unattended Operation: indicates whether the device can be left unattended.
— Control Data: indicates whether printer device control information is communicated to the transmitting device.
— Error Handling: indicates the availability of error detecting and correction protocols.
— Interfaces: provides an indication of which interfaces are supported.

Maintenance

— MTBF or Availability: gives the MTBF in hours or in terms of the number of pages printed or the percentage availability of the device.
— MTTR: indicates the expected mean time to repair in minutes.
— Troubleshooting Included: indicates whether the maintenance service includes on-call support services for problem analysis.
— Diagnostics: indicates whether the device has built in self-test and fault reporting capabilities.

Environment/Operations

— Normal Office: indicates whether the device can be operated in normal office conditions.
— Special Needs: defines special environmental needs or effects (special power supply, lighting conditions, noise levels).
— Interference: none of the equipments are stated to interfere with other office equipment operation.
— Safety Certification: indicates whether one or more safety certificates have been obtained.
— Trained Operator: indicates whether specially trained operators are needed. In some cases, where X is indicated, very limited training (30 mins–1 hour) is still needed.
— Training included: indicates whether operator training is included in the equipment price:

  OEM — inclusion or otherwise is up to the OEM concerned.

Applications

- Main Uses: indicates the main uses seen by the supplier:
  - Local — as local printing capability
  - WP — word processor printing
  - Remote — as remote printer.
- Other Foreseen: other users foreseen by the supplier.

R & D

- Budget: R & D budget, in ECU's, for this *and* related developments.
- Team Size: R & D team size, again for this and related developments.
- Location: location (countries) in which R & D, for this and related products, is conducted.

Customisation

Indication of the willingness to and experience of the supplier in customising this or similar products.

Pricing

- Purchase: estimated purchase price of the equipment, in ECU's.
- Discounts: indication of likely discount levels, where known:
  - neg — negotiable.
- Maintenance: cost of 1 year's maintenance, expressed in ECU's, or as a percentage of purchase price.
- Cost per 1000 Pages: estimated cost per 1000 typical A4 pages, expressed in ECU. Except where indicated, paper is excluded, but other costs, including depreciation and maintenance, are taken account of.

Trial Participation

Indicates the willingness of the supplier to participate in trials, and the financial basis he is likely to require.

User Base

- Number: number of existing users.
- Types: main types of user, either existing or anticipated.

Interview No

Reference to the supplier interview number. See appendix G for more details.

	Device Type	Technology	No of copies	Time to print A4 page (secs)	Storage	No of European Character sets	Maximum No of Founts On-Line	Down line Loading	Point Size Limits	Bold, Light Italic	In Same Line	IBM Template	Sample Page	Graphics & Tex	In Same Page	Resolution in lines per inch (H x V)	Colour	Stability
HEWLETT PACKARD 2685	PR	LR	-	1.3	DISC	Y	32	Y	22 ch/m - 1.38"/ch	Y	Y	Y	Y	Y	Y	over 100	X	D
CANON LBP 10	PR	LR	-	6	ROM	F	4	N	3 pt - A4 page	Y	X	F	F	X	X	240-480	X	X
PRINTRONIX P-Serial	PR	NM	6	3-6	PROM or E-PROM	Y	8 (x 64 ch)	N	1/10" to 20"	Y	Y	Y	Y	Y	Y	100	Y	S
PRINTRONIX MVP (September 1982)	PR	NM	6	3	RAM	F	4 +	Y	no limit	Y	Y	Y	Y	Y	Y	100	Y	S
ANON. 1983	PR	LR	-	1.3	DISC	all + Greek	12 (x 256)	Y	6-48 pt, no limit	Y	Y	Y	F	Y	Y	300	X	X
MULLARD-PHILIPS	PR	NM	5	23	E-PROM or RAM	10 + Greek	4 +	Y	up to whole page	Y	Y	Y	X	X	X	2-pass = 300	X	S
FACIT 4542	PR	NM	5	10-15	E-PROM	10 + Greek	512 chars	N	4 pt to 9.5 inch	F	F	Y	Y	Y	Y	144	O	X
FACIT SM10	PR	NM	5	10-15	E-PROM	10 + Greek	8 founts	N	4 pt to 9.5 inch	Y	Y	Y	Y	Y	Y	144	Y	X
CIT-ALCATEL 5520	PR	LR	-	3	ROM	F	3 x 128	N	8-pt + up	Y	Y	Y	Y	Y	Y	200	X	X
CIT-ALCATEL 5500	FX	LR	-	30	-	Y	-	-	no limit	Y	Y	Y	Y	Y	Y	200	X	X
SEL Teletex Printer	PR	DW	6	80	wheel	all roman	130 chars	N	only if wheel changed	bold only	X	F	X	X	X	120	X	X
SIEMENS ND3	PR	LR	-	0.33	256 mem. matrix	Y	5-6 x 256	Y	no limit	Y	Y	Y	X	F	X	144 x 180	X	S
OLIVETTI 5180 (1983)	PR	NM	5	30	RAM + ROM	Y	8	Y	Y, dot matrix	Y	X	Y	Y	Y	Y	120 x 264	F (83)	S
AGFA-GEVAERT P400	PR	LR	-	3	E-PROM or RAM (floppy)	Y	to ± 250	Y	any basic point size scale x 1, 1.3, 1.6, 2	Y	Y	Y	Y	Y	Y	391 x 406	X	X
SANDERS	PR	NM	4	10-15	ROM packs	all + Greek	18 to 32	N	7-12 pt, but no limit	Y	Y	Y	Y	Y	Y	960 x 288	X	S
RANK XEROX 9700	PR	LR	-	0.5	DISC	any	no limit	Y	4-24 pt + bigger	Y	Y	Y	Y	Y	Y	300	X	S
RANK XEROX Ethernet	PR	LR	-	5	DISC	any	no limit	Y	8-24 pt basic	Y	Y	Y	Y	Y	Y	300	X	S
HITACHI (1983)	PR	LR	-	2-3	ROM	F	not decided	N	virtually any	Y	Y	Y	Y	Y	X	300	X	X
NIXDORF 1	PR	LJ	-	12	ROM	F	128 chs +	N	Y	X	X	X	X	X	X	300	X	D
NIXDORF 2	PR	VD	-	3.5	ROM + RAM	F	5 x 96	Y	Y x 2	Y	Y	F	X	X	X	300	X	X
NIXDORF 3	PR	XM	-	8	ROM + RAM	F	5 x 96	Y	Y x 2	Y	Y	F	X	X	X	300	X	X
OLYMPIA 1	PR	LJ	-	25	ROM or E-PROM	F	1-3	N	S/W control	Y	Y	Y	X	Y	Y	200	X	X
OLYMPIA 2	PR	XM	-	5	ROM or E-PROM	F	3 x 120 + 3	N	S/W control	Y	Y	Y	F?	Y	Y	300	X	X
MUIRHEADS MUFAX Gp II	FX	TH	-	180	-	Y	-	-	no limit	Y	Y	Y	Y	Y	Y	100	X	X
IBM Scan Master 1	PR	LR	-	15-80	NA	Y	192 chars	N	12 pitch elite only	X	-	Y	Y	Y	N	203 x 98 or 203 x 196	X	X

	Plain/Special	Cut Sheet Fan Fold or Roll	Hopper	Size Limits	Landscape	Stand Alone/ Peripheral	Speed (bps)	Buffer Size	Unattended op	Control Data	Error Handling	Interfaces	MTBF or Availability	MTTR (mins)	Troubleshooting included	Diagnostics
HEWLETT PACKARD 2685	PL	FF	X	max W 12.7"	Y	SA	300-9600	hard disc	X	Y	X	2780 RS 232	90 % up	NA	Y	Y
CANON LBP 10	SP	CS	X	B4 max	Y	P	9600 max	3 x A4	Y	Y	X	RS 232 Centronix	24 K copies	45	-	Y
PRINTRONIX P-Serial	PL	FF/R	X	max W 16"	Y	P	300-19.2 k	2-4 Kb	Y	Y	Y	wide range	3000 hrs	30	-	Y
PRINTRONIX MVP (September 1982)	PL	FF/R	X	max W 16"	Y	P	300-19.2	2-4 Kb	Y	Y	Y	wide range	NA	NA	-	Y
ANON. 1983	PL	CS	X	8.5" x 14" max	Y	P	1200-19.2 k +	5 Mb	Y	Y	Y	RS 232, X-25, X-21	NA	NA	-	Y
MULLARD-PHILIPS	PL	CS/FF	O	A4	X	P	300 to 19.2 k	512 Bytes	Y	Y	Y	RS 232 Centronix	NA	60	-	Y
				US quarto	Y											
FACIT 4542	PL	FF	X	to 15.5" square	Y	P	110 to 19.2 k	8 Kb	Y	Y	X	RS 232, V-24 IEEEP	1800-2100 hrs	30	-	Y
FACIT SM10	PL	CS	O	to 15.5" square	Y	P	110 to 19.2 k	8 Kb	Y	Y	X	RS 232, V-24 IEEEP	NA	NA	-	Y
CIT-ALCATEL 5520	PL	CS	NA	A4	F	P	9600	64 Kb	Y	Y	X	RS 232 Centronix	NA	NA	-	Y
CIT-ALCATEL 5500	PL	CS	NA	A4	X	P	CCITT std.	-	X	Y	X	Fax group III	NA	NA	-	Y
SEL Teletex Printer	PL	FF	O	A4	Y	P	2400	-	Y	Y	X	Teletex std.	NA	NA	-	X
				A3, to 13.2" w	X											
SIEMENS ND3	PL	R	NA	max A3	Y	SA	85 k	64 Kb	X	X	X	IBM, ICL, Univac	10 K hrs	25	Y	Y
OLIVETTI 5180 (1983)	PL	any	O	A4	Y	P	150-19.2 k	1-4 Kb	Y	Y	X	RS 232 Centronix	NA	NA	Y	Y
				max A3	X											
AGFA-GEVAERT P400	PL	CS	Y	A4, quarto, folio	Y	P	to 19.2 k	to 4 Mb	Y	F	F	under dev.	NA	NA	-	Y
SANDERS	PL	any	O	A4	Y	P	110-9600	2 Kb min	Y	Y	Y	all	2.5 K hrs	30	Y	Y
				to A3	X											
RANK XEROX 9700	PL	CS	NA	A4	Y	SA	9600	12 Kb x A4	Y	Y	Y	wide range	125 K x A4	240 max	Y	Y
RANK XEROX Ethernet	PL	CS	NA	A4	Y	P	10 m	29 Mb	Y	Y	Y	RX only	NA	NA	Y	Y
HITACHI (1983)	PL	CS	NA	A4	Y	P	various	not decided	Y	Y	X	RS 232 Centronix	NA	NA	Y	Y
				to A3	X											
NIXDORF 1	SP	FF/CS	X	A4	Y	P	10 m	-	Y	Y	X	Centronix	2 K hrs	NA	-	Y
				to A3	X											
NIXDORF 2	PL	CS	X	A4	Y	P	100 k	2 x A4	Y	Y	X	Centronix	50 K x A4	NA	-	Y
NIXDORF 3	PL	CS	X	A4	X	P	100 k	0	Y	Y	X	Centronix	NA	NA	-	Y
OLYMPIA 1	PL	CS	X	to 380 mm w	Y	P	NA	1 x A4	Y	Y	X	various	NA	NA	-	Y
OLYMPIA 2	PL	CS	X	A 4/5	Y	P	19.2 k	1 x A4	Y	Y	X	RS 232 Centronix	NA	NA	-	Y
				A3 (F)	X											
MUIRHEADS MUFAX Gp II	SP	R	NA	A4	Y	P	50 to 9600 *	5 Kb	Y	Y	F	via FAXPORT	10 K hrs	30	-	Y
IBM Scan Master 1	SP	R	NA	up to US legal	Y	SA	2400-9600	1page image	Y	Y	Y	SNA vers. 2	NA	NA	-	Y

* = printer mode

	Normal Office	Special Needs	Interference	Safety Cert	Trained Op.	Training included	Main Uses	Others (foreseen)	Budget	Team Size	Location	
HEWLETT PACKARD 2685	X	power	X	Y	Y	X	Local, labels, a major applic.	Teletex + Videotex	NA	45-50	USA	lot
CANON LBP 10	Y	light	X	Y	X	Y	WP, mixed	Facsimile + Videotex	NA	30 +	JAP	rare
PRINTRONIX P-Serial	Y	noise	X	Y	Y	OEM	plotting, scientific	Plotter + OCR Output	NA	100 +	USA	fair amount
PRINTRONIX MVP (September 1982)	Y	X	X	Y	Y	OEM	remote + local working	Teletex	NA	100 +	USA	special founts
ANON. 1983	Y	X	X	F	X	Y	wide mix	Teletex + Copier	15-20 M	20-30 +	NL	a lot
MULLARD-PHILIPS	Y	X	X	Y	X	Y	remote and local	Videotex	> 3 M	5 +	D	several versions
FACIT 4542	Y	X	X	Y	X	Y	mostly local	Videotex	NA	20-30	S	occasional
FACIT SM10	Y	X	X	Y	X	Y	mixed	Videotex	NA	20-30	S	NA
CIT-ALCATEL 5520	Y	X	X	Y	X	Y	mixed	Teletex + Copier	NA	25-30	F	only if many
CIT-ALCATEL 5500	Y	X	X	Y	X	Y	fax	-	NA	NA	F	no
SEL Teletex Printer	Y	X	X	Y	Y	Y	remote	WP printer	NA	100	worldwide	no
SIEMENS ND3	Y	power	X	Y	Y	Y	local; typesetter replacement	none	NA	150	D	fount variants
OLIVETTI 5180 (1983)	Y	X	X	Y	X	Y	all	colour planned	NA	250	USA + I	some
AGFA-GEVAERT P400	Y	X	X	Y	X	Y	office printer/fax/copier	Teletex, Videotex,	NA	NA	B + D	open to neg.
SANDERS	Y	X	X	Y	X	Y	local, draft, + label printing Teletex	Teletex, Videotex	NA	12 +	USA + UK	some
RANK XEROX 9700	X	power	X	Y	Y	Y	offset - litho replacement	NA	> 20 M	100 +	USA + UK	fount building
RANK XEROX Ethernet	Y	X	X	Y	X	Y	all	Videotex	> 20 M	100 +	USA + UK	no
HITACHI (1983)	Y	X	X	Y	X	Y	25 % mainframe, 25 % mini, 25 % WP	Copier	NA	20 +	JAP	large orders
NIXDORF 1	Y	X	X	Y	X	Y	not known but local	Videotex	NA	40 +	D	neg.
NIXDORF 2	Y	X	X	Y	X	Y	local	Videotex	NA	40 +	D	neg.
NIXDORF 3	Y	X	X	Y	X	Y	local	Videotex	NA	40 +	D	neg.
OLYMPIA 1	Y	X	X	Y	X	Y	local	Teletex	40 M	40-50	D	not much
OLYMPIA 2	Y	X	X	F	X	Y	network	Teletex + Videotex	40 M	40-50	D	not much
MUIRHEADS MUFAX Gp II	Y	X	X	Y	X	Y	network	code-driven printer	NA	150	UK, USA, CAN.	fair amount
IBM Scan Master 1	Y	X	X	Y	N	Y	printer, copier, fax (but not CCITT comp)	-	NA	> 100	JAP, USA, D	no

	Purchase (ECU)	Discounts	Maintenance (ECU or % of price p.a.)	Cost per 1000 A4 pages (ECU)		Number	Types	Interview No
HEWLETT PACKARD 2685	200 k	neg.	20 k	varies with output	short rental	350	in-house printers	1
CANON LBP 10	20-25 k end user	neg.	-	40 (excl. paper)	not usual practice	3,000	big business engineering	2
PRINTRONIX P-Serial	6-9 k FOB Cal.	neg.	5 %	NA	short rental	35,000	all	3
PRINTRONIX MVP (September 1982)	4 k FOB Cal.	neg.	5 %	NA	short rental	new	NA	3
ANON. 1983	est. 45 k	to 18 %	-	60	negotiable	new	NA	4
MULLARD-PHILIPS	1-off = 3.5 k 1000-off = 2 k	neg.	500 or 18 %	NA	lend free for a few weeks	new	NA	5
FACIT 4542	4.5 k end user + 15 % colour	20-25 %	600	NA	free loan for evaluation	11,000	all	6
FACIT SM10	4.5 k end user	20-25 %	600	NA	free loan for evaluation	new	NA	6
CIT-ALCATEL 5520	17 k (not yet fixed)	flexible	10 % or less	NA	cost-only evaluation	new	NA	7
CIT-ALCATEL 5500	variable	flexible	NA	NA	cost-only evaluation	NA	all	7
SEL Teletex Printer	est. 8.5 k (complete work station)	neg.	-	NA	short rental	new	all	8
SIEMENS ND3	320 k fully configured	neg. 10-20 units	12 k	160 (incl. paper)	run experiments on own system	750	big printing ops.	9
OLIVETTI 5180 (1983)	2.2 k OEM	neg.	< 10 %	NA	OEM sample price	NA	all	10
AGFA-GEVAERT P400	est. 20 k	neg.	< 10 %	est. 50-130 (incl) dep. on volume	for discussion	new	NA	11
SANDERS	5.2 k end user	> 7.5 % (neg.)	650	40	rental or buyback	2,000	scientific	12
RANK XEROX 9700	390 k fully configured	neg.	65 k	20	might arrange on RX own kit	1,400	big printers	13
RANK XEROX Ethernet	36 k (+ Ethernet)	neg.	3.3 k	variable	not keen	new	all	13
HITACHI (1983)	7.5 k FOB Osaka 8.5 k incl. copier	neg.	10 %	NA	negotiable	new	all	14
NIXDORF 1	5 k	neg.	varies	NA	negotiable	100	prototypes	15
NIXDORF 2	20 k	neg.	sheet related	NA	negotiable	new	NA	15
NIXDORF 3	8.5 k	neg.	sheet related	NA	negotiable	new	NA	15
OLYMPIA 1	est. < 2.5 k	neg.	3-5 %	NA	at-cost rental	new	NA	16
OLYMPIA 2	est. < 8.5 k	neg.	3-5 %	NA	would run in-house for EEC	new	NA	16
MUIRHEADS MUFAX Gp II	4.5 k	neg.	10 %	40	trial, short rent	> 1,000	all	18
IBM Scan Master 1	12-16 k	0-15%,neg OEM to 35%	9-11 %	NA	negotiable	new	all	20

APPENDIX F
SUPPLIER INTERVIEW QUESTIONNAIRE

1 Introduction

1.1. Questionnaire Objectives

The Commission of the European Communities is carrying out a series of studies into requirements for electronic document delivery services which would utilise the facilities offered by the Euronet DIANE telecommunications network.

A central part of those studies lies in establishing user requirements for, and manufacturers' ability to supply, terminals capable of receiving both coded characters and graphics. These topics are being addressed in a study designated DOCTERM.

This questionnaire is aimed at establishing the availability, current and for the immediate future, of suitable terminal devices. It will be used as the basis for pre-selecting a short-list of suppliers with whom the Commission of the EEC will discuss the possibility of (a) providing such terminals for pilot trials (b) adapting them to meet more fully user requirements as outlined by investigations in another section of the study of which this questionnaire forms a part (DOCTERM).

The questionnaire is intended to be used as the basis for a relatively informal discussion with suppliers of their current offerings and those which are in the late stage of development. It is meant to be used by the interviewer to structure these discussions so that responses from between fifteen and twenty suppliers may later be correlated in directly comparable, probably tabular, form.

It is *not* proposed to ask suppliers themselves to complete the questionnaire, although in some cases it will be given to them, either (a) in advance, to facilitate provision of necessary detail or (b) where additional detail is needed but not immediately available during discussion.

1.2. Confidentiality of Response

It is appreciated that manufacturers will not readily divulge more than standard sales support information about their products if there is a probability that such information will find its way rapidly into the hands of their competitors.

It is, therefore, proposed to state at the start of discussions that three levels of confidentiality will be strictly observed by the interviewer(s):

1. contents of the resultant working document will be freely available within the EEC Commission and its Directorates-General i.e. effectively all such information will be in the public domain.
2. information given at Level 2 will be restricted to the DOCTERM working party, a maximum of 12 people.
3. maximum security, with the interviewer personally signing a commercial-in-confidence release, and the identity of suppliers giving information being withheld.

Suppliers will be asked to identify *very* clearly which of their statements are off the record, and which of the two levels of restricted access they wish observed. Any information not clearly identified as being restricted will be treated as publicly available.

1.3 Structure of the Questionnaire

The main body of the questionnaire (Parts 2 and 3 following this Introduction) has been divided between technical inquiry and commercial considerations relating to the device or devices offered by a manufacturer.

Interviewees will appreciate that, due to the different technologies and techniques used in printer and facsimile systems design and operation, some questions will be irrelevant for one type of system.

Sections 2.1 to 2.3 may appear excessively detailed for facsimile suppliers, since it is assumed that their products will be able to receive anything transmitted to them by a compatible facsimile device.

Facsimile equipment suppliers will therefore be asked to concentrate on sub-sections 2.1.1 and 2.2.8, to ignore 2.3 and then reply to the whole of the rest of section 2, and all section 3.

Printer manufacturers will not be asked to answer 2.6.1.

2. Technical Inquiries

2.1. Print Technology

2.2.1. In broad terms, would you describe your device(s) as a:
- — printer
- — typesetting device
- — facsimile receiver
- — mixture of two of the above
- — all three of the above.

2.1.2. Is the print element: (printer only)
- — impact
  - — single-element (e.g. daisy wheel)
  - — needle-matrix
  - — chain
  - — multi-element (line printer)
  - — other (please describe)
- — thermal
- — ink-jet
- — laser-based
  - — raster-scan
  - — vector-painting
- — other (please describe).

2.1.3. (Impact devices only) How many legible carbon copies can be made on bond paper weighing 85 grammes to the square metre?

2.2. Character Sets

2.2.1. Can the device print more than the 96 characters found on a daisy wheel, *without* changing the print element?

2.2.2. Can the point size of characters be varied for any typefont? If so, between what minimal/maximal limits?

2.2.3. How easy is it for the machine to switch between:
- — bold
- — medium
- — light
- — italic

versions of any given typeface?

2.2.4. Can point size and/or typeface be varied within a line of text?

2.2.5. (Intelligent devices) How are character sets stored and changed?

2.2.6. List the European ethnic-language character sets, mathematical, scientific and technical conventional symbols the machine can handle.

2.2.7. How many:

— characters/symbols
— typefonts

can be available online at one time?

2.2.8. How long (approximately) would the device take (working at its preferred/designed line speed) to output a page of text containing (say) 40 lines of 10 words each = ca. 2400 actual characters plus character spaces?

2.2.9. Is proportional spacing possible, allowing the spacing/letter size within one line of text to be adjusted to exactly align left and right margins?

2.3. Graphics

2.3.1. Can the machine handle simple graphic symbols e.g. flow-chart conventions from an IBM template?

2.3.2. Could it handle an image of the complexity of the drawing attached as Figure A.

2.3.3. Can it switch modes from graphics to text and vice versa:

— between pages
— within a page.

2.3.4. How many shades of grey can the device handle in black-and-white mode?

2.3.5. How long (approximately) would the device take to print out (at optimal rated speed):

— the sample page (Figure A)
— a half-tone half-plate newspaper photograph.

2.4. Image Quality

2.4.1. Is the resolution of the printed image:

— less than 100 lines per inch
— better than 200 lpi
— over 500 lpi

2.4.2. Can the device handle full colour output? how many shades?

2.4.3. Is the print image vulnerable to moisture and/or physical friction? If so, for how long after output?

2.4.4. Is print quality affected by speed of transmission?

2.5. Paper

2.5.1. Does the device use paper which is:
- — plain, untreated and commonly available
- — chemically treated
- — otherwise specially prepared (please specify).

2.5.2. Does the device use:
- — cut sheet feed
- — continuous roll
- — roll-feed with guillotine
- — continuous fan-hold.

2.5.3. If cut sheets are used, is a hopper sheet-feeder provided as:
- — standard equipment
- — additional option.

2.5.4 What standard paper sizes can be handled:
- — A5
- — A4
- — A3
- — other (please specify).

2.5.5. Can these sizes be handled in both portrait (vertical) and landscape (horizontal) mode, or portrait mode only?

2.5.6. Can different sizes be interleaved online?

2.5.7. What provision is made to ensure:
- — proper top-of-page alignment if cut sheets are hopper-fed?
- — accurate 'throw' of paper if continuous fan-fold paper is used?

2.6. Communications

2.6.1. (Facsimile devices only) Is transmission analogue or digital in nature? Is analogue/digital conversion (and vice versa) used/available?

2.6.2. (All devices) Can the device be driven online, direct from a text editing or computer-graphics system, or is it essentially intended as an offline printing sub-system (e.g. with own disk/tape drives, control terminal(s) etc . . .).

2.6.3. What range of data speeds will it work at?

2.6.4 What size of line buffer is provided (rough equivalent 'pages' for (a) text (b) graphics)?

2.6.5. Can the device be used in unattended mode? If so, within what limits?

2.6.6. Does it communicate control information back to the sending system: e.g. ready/*not* ready, paper in/out, etc . . .

2.6.7. Does it have any capability to detect and eliminate/compensate for data corruption due to line interference?

2.6.8. Describe the range of systems to which it has been interfaced. How standard is the interface?

2.7. Reliability/Availability

2.7.1. What statistics are available on:
- — mean time between failure of the device
- — mean time to repair

2.7.2. Over how many thousand hours of operational running time (approximately) have these figures been calculated?

2.8. Environmental Requirements

2.8.1. Does the device work in a normal office environment?

2.8.2. Does it need any special provision for:
- — noise suppression
- — cooling
- — dust filtering
- — chemical odour removal
- — stabilised power supply
- — earthing
- — fire protection
- — artificial/natural light control
- — anti-static surrounds.

2.8.3. In operation, is it likely to interfere with computer or other equipment:
- — in the same office
- — on the same power supply?

2.9. Operating Staff

2.9.1. Is the equipment fully certificated as presenting no health hazard to operating staff?

2.9.2. Is any special training required for user staff? Is so, how long will it last?

2.9.3. How far can user staff go in diagnosing/remedying device faults? What level of documentation is provided to assist with this?

2.10. Additional Facilities

What additional use(s) may be envisaged for the device e.g. convenience copier, incorporation into a Teletex work station, display printout from videotex?

Please describe options, actual and planned.

3. Commercial Considerations

3.1. Research & Development

3.1.1. Please indicate the approximate size of the R & D budget for this and related devices:
- — over the past three years
- — for the next three years

3.1.2. How many staff are currently assigned to development of this device and related equipment/new devices?

3.1.3. Where are these development staff geographically located?

3.1.4. What percentage of R & D work in this area has so far been devoted to special-purpose/customised devices?

3.2. Equipment Prices

What are the prices for:
- — the basic device
- — interfaces required to make it work with a given system
- — optional extras.

3.3. Support

3.3.1. Hardware — what is the annual cost of hardware support based on a four-hour *maximum* response time to fault calls?

3.3.2. What are the likely annual software support costs to the user of:
- — trouble-shooting
- — development?

3.4. Other Running Costs

3.4.1. What is your estimated cost per page of printout?

3.4.2. Quote the approximate cost per ream (500 pages) of:
- — plain paper of a suitable weight for use with the device
- — continuous stationery: roll, or fan-feed
- — specially treated papers.

3.4.3. Detail other relevant consumable prices.

3.5. Pricing Policy

3.5.1. What is your discount structure for bulk acquisition of devices:
- — by purchase
- — on rental.

3.5.2. Do you provide trial systems:

— on short-term rental
— with purchase/buyback option
— otherwise (please specify).

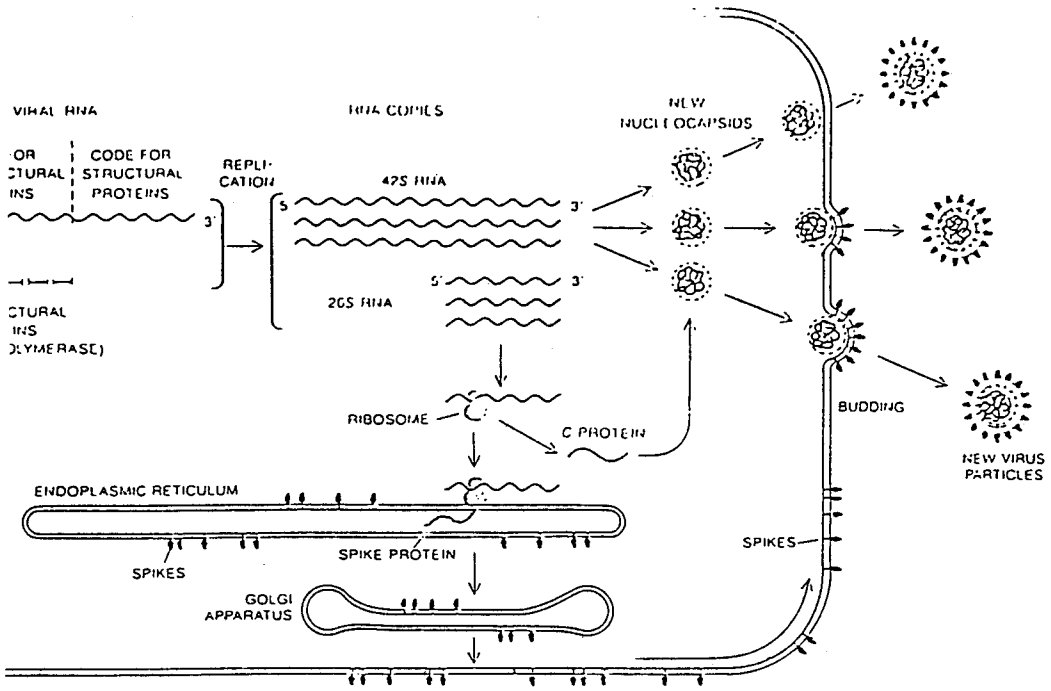
3.5.3. Is user training provided free with the device? What about training new generations of user staff?

3.6. User Base

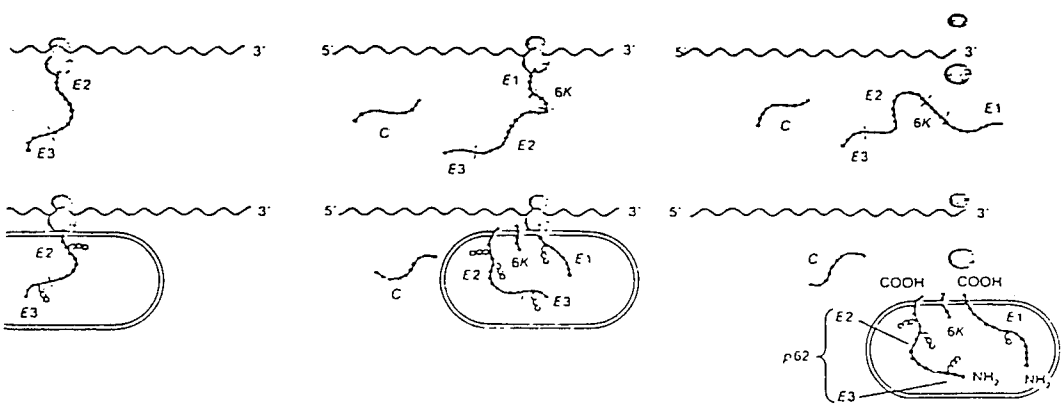
3.6.1. How many devices are installed with how many users in roughly what administrative or commercial sectors?

3.6.2. Outline the broad spread of applications of the device by:

— work type
— local working
— remote working.



NA molecules. The 42S RNA is a copy of the complete viral-NA molecule; the 26S RNA is a shorter molecule that incorporates e genetic code for the four viral proteins. (S stands for Svedberg nit, a measure of the molecule's mass.) Within three to four hours ese are the most abundant RNA molecules in the cell. Now the 26S NA becomes attached to a ribosome and begins to act as messenger NA for the viral proteins. The four proteins are made continuous- in the order *C*, *E3*, *E2* and *E1*. As soon as the *C* protein is made it is lipped off by an enzyme. In the cytoplasm it joins a 42S RNA mole-ule to form a new nucleocapsid. The *E3* protein is made next. When the first few amino acids of the *E3* chain are assembled, the ribosome attaches itself to the endoplasmic reticulum, a network of interconnected membranes within the cell. The growing *E3* chain is threaded through the membrane of the endoplasmic reticulum; assembly continues with the chain extending into the interior of the reticulum. When the three spike-protein molecules have been made, they are combined to form the membrane spike. They are then transported to the organelle called the Golgi apparatus, where they are modified. The spike is inserted into the cell membrane, where it meets a new nucleocapsid. Finally the finished virus particle buds out of the cell.



of endoplasmic reticulum are added to the solution, however, the viral proteins are manufactured as they are in the cell. The *C* protein is made and cleaved from the chain. The first few amino acids of the *E3* chain constitute a "signal sequence" that binds the ribosome to the vesicle. Translation proceeds with the *E3* chain threaded through the membrane. The *E3* and *E2* molecules are made consecutively and remain connected in a protein called *p62*. Translation proceeds until a point near the end of the *p62* chain is reached. A stretch of hydrophobic amino acids there prevents the chain from passing through the membrane; the chain remains fixed to the membrane as translation continues. When translation of *p62* is complete, the *p62* chain is clipped off and the *E1* molecule begins to be made. The *E1* chain has its own signal sequence, *6K*, which is later clipped off. Assembly of the *E1* molecule proceeds until its passage through the membrane is stopped by a hydrophobic segment. As a result the *C* protein ends up outside the vesicle, in the region corresponding to the cytoplasm. Most of the *p62* and *E1* chains are inside the vesicle in the region corresponding to the interior of the endoplasmic reticulum. When the proteins are made in a cell, the *p62* chain is later cut to form the *E2* and *E3* chains; the three proteins are then assembled into the spike.

APPENDIX G
SUPPLIER VISIT NOTES

Supplier Visit Notes

This appendix lists:

— representatives of print device suppliers contacted during Phase II of the DOCTERM study from April to mid-August 1982

— telephone numbers and addresses at which those representatives are contactable

— general points made during the discussions which are felt of sufficient interest to warrant setting down in addition to the detailed information summarised in Appendix B.

1 Hewlett-Packard 10.05.82

Fourier House	Jeff Kirby
London Colney	Area Sales Manager
Nr. Watford	
England	Tel. GB (44) 0737-68655

The HP 2685 is a very powerful, stand-alone printing system incorporating its own HP 3000 mini-computer and hard disk backing store.

It is not intended as a remotely driven printing device, but it is worth noting that the British Post Office have ordered six of these machines and two HP 3000's with a view to running a nationwide mailshot bureau operation starting in 1983. Vicarious experience may thus be gained by the Commission.

Cheaper machines using the same HP laser technology will be available within two years; the 2685 is the top end of a planned range of devices.

IBM may sell the 2685 on an OEM basis (it is currently being tried in IBM's White Plains NY laboratories) and Honeywell will offer the device.

2 Canon Europa 11.05.82

Van Leijenberghlaan 221	Hirotaka Takahashi
P.O. Box 7907	(Printer Product Manager)
1008 AC Amsterdam	Masaharu Tsujii
The Netherlands	Tel. NL (31) 020-448950

Within one year CANON will have a smaller and cheaper version of the LBP-10 laser beam printer described in the interview; how much cheaper is a commercial decision yet to be made. It will be called the *Compactman* and use dry toner.

CANON is also making a range of bigger printers, for offline use as photo-typesetter replacements, setting at up to 8000 (eight thousand) lines per minute. These are currently sold and supported only in Japan.

Messrs. Takahashi and Tsujii also outlined the characteristics of a new ink-jet printer currently in the final laboratory testing stage which 'explodes' 2000 ink bubbles at a time onto paper by flash heating ink, achieving printing speeds in the range of medium to high-speed computer printers.

3 Printronix Europe 11.05.82

Nijmegen
The Netherlands

Chris Bastiaanse
Technical Manager
Tel. NL (31) 08360-25404
or 080-558110

Printronic needle-matrix printers are factored worldwide by Philips.

Printronix intend to stay with needle-printers, while their friends and business allies QMS, who have done considerable development work with them, move into the laser printing field; QMS will have a printer selling at around $US 20,000 and outputting at 28 pages a minute later this year.

Printronix see themselves in a different price segment in the overall market from QMS, at the high-flexibility end of the needle-printer market.

4 Anonymous Supplier 12.05.82

European owned and based.

This supplier has an established position in the office copier market, and will next year launch a laser beam printer based on its heavy-selling top-of-the-range photocopier. Considerable investment in this and related office equipment development is being made by the company's national government.

The machine will be highly sophisticated and in the general price/performance range of such machines as the Xerox 5700 and IBM 6670.

5 Philips/Mullard 17.05.82

Mullard Ltd
Mullard House
Torrington Place
London WC1E

Norman Dugard
J.E. Meanwell

Tel. GB (44) 01-580 6633

Philips factor a number of other manufacturers' printers, including Printronix and EPSON (currently one of the most popular cheap, personal computer print mechanisms).

The machine discussed with Mullard, Philips' UK subsidiary, is, however, their own needle-printer.

6 FACIT UK 19.05.82

Rochester — Brian Barker
Kent
England

Facit UK is a UK subsidiary of the Swedish Facit company, owned by ELECTROLUX.

Facit call their matrix device a 'stored-force' printer since the print element impellor mechanism is held back electromagnetically and released rather than being pushed forwards; it is claimed this gives much longer life. In all other respects, it is a needle-matrix printer and is classified as such in this report.

7 CIT-Alcatel 26.05.82

Departement Transmission — Philippe Mondo
Division TME — Chef de Produit
Centre de la Verriere — Imprimantes
78320 Le Mesnil St Denis — Division Télécopie &
France — Messagerie de l'Ecrit
Tel. F (33) 3-062-4128)

CIT-Alcatel's Group III facsimile transceiver can be driven in coded-character mode by a WP machine, and will be shown in this guise at SICOB in Paris in September (82).

The 5520 laser printer is based upon electro-static rather than thermal technology and uses plain paper. It is derived directly from the 5500 fax machine.

The company is taking an integrated systems approach to document transmission, and intends eventually (around 1985) to offer a hybrid telefax/coded-character print device with an optional digital scanner.

The French PTT is planning to run a wide-ranging document delivery pilot scheme using CIT kit from the Autumn of 1982; again vicarious experience may be gained by the Commission.

8 Standard Elektriek Lorenz 8.06.82

Neuwirtstadt — Ing. Horst Wiedmann
Stuttgart — Ing. Rolf Nagel
F.D.R. — Tel. D (39) 711-821-5933

The daisy-wheel printer described is a reconfigured QUME machine specifically intended for incorporation into SEL's new Teletex terminal product; ITT owns both QUME and SEL.

9 Siemens 9.06.82

Bereich Kommunikations-technik
Vertrieb Peripheriesysteme
Otto Hahn Ring 6
Postfach 830951
D-8000 München-Perlach

Ing. Manfred Garbe

Tel: D (39) 089-636-2159

The full Siemens ND3 System 2500 configuration was shown, with input paper feed mechanism with a 10-kilometre roll of paper and output guillotine/collator (made by Boewe) under central computer control.

The ND2, a smaller, non-impact printer of similar technology will be announced in Autumn 1982.

10 Olivetti 10.06.82

Ivrea
Italy

Piero Peretti
OEM Marketing Director
Tel. I (39) 125-525

Olivetti manufacture a wide range of impact, thermal (made in France) and ink-jet printers and printer mechanisms; a selection of the most probably suitable was made from this range.

11 Agfa-Gevaert 12.05.82 and 12.06.82

Belgium

M. de Wolf
Agfa Board Management
responsible for Office Systems

L. de Schamphelaere
General Manager
Elektronische Beeld Systemen

Agfa is moving from high-grade photocopying to the laser printer field, using copier paper-handling mechanisms and techniques. An experimental scanner which could turn the machine described into a convenience copier is under trial.

12 Sanders 25.06.82

Real Time Systems
Farnborough
Hampshire
England

Richard Kendall
UK Sales Manager

Tel GB (44) 0252-546213

During the interview (at High Wycombe, Buckinghamshire) Mr Kendall explained that he would shortly be leaving RTS, which factors Sanders printers and develops specialised control software for them in the UK, to join Sanders Europe. He therefore spoke for Sanders rather than RTS. He mentioned that 68% of Sanders' total work was in Europe.

Sanders provision for changing fonts is simple and unusual; read-only memories (ROM's) are encased in plug-in plastic modules tough enough to support the weight of a 100-kg person and simply plugged in or pulled out from the printer case as required.

13 Rank Xerox 25.06.82

Bridge House	Dennis Roach
Uxbridge	Senior Acct Manager
Middlesex UB8 1HS	Network Systems
England	Tel. GB (44) 0895-51133

An account representative for the RX9700 laser printing system was also present for part of the discussion, which centred on the Ethernet-specific 300 lines/inch printer recently launched by Xerox. Both machines are covered in the tabular detail of Appendix B.

It was hinted that the Ethernet machine *might* become available as a separate device in perhaps two years' time. It is a very flexible printer. Its high data reception rate implies that some form of wideband local area network connexion is virtually inevitable; its considerable graphic capability is directly dependent on the very flexible input, editing and display software of the RX Star Work station.

14 Hitachi UK 13.06.82

Hitachi House	Ted Marshall
Station Road	Divisional Manager
Hayes	Computer Products
Middlesex UB3 4DR	
England	Tel. GB (44) 01-848-8787

The Hitachi device will also act as a normal copier.

Major expansion of this company's European computer product activity may be expected in Autumn 1982.

Hitachi also manufacture a range of needle-matrix printers.

15 Nixdorf Computer 14.06.82

Fürstenallee 7	Ing. Helmut Rohlfs
4790 Paderborn	Technical Product/Software
F.D.R.	Marketing
	Tel. D (49) 5251-3001

Nixdorf have three non-impact printer products under development and are debating which of these (at most two) to productise. One is an ink-jet printer, using a Siemens print-head, the second was a joint development with U-Bix (Mitsubishi of Japan) using crt technology for

a stand-alone printing system and the third an LED-based machine using a ceramic transfer medium instead of the more normal glass/selenium/gallium arsenide (NB which has been causing worries about possible health dangers to personnel needing to touch the transfer medium). There were technical problems with the ceramic system (shown at the Hannover Fair, but as a R and D project rather than a product) and this system should *not* be seen as a product.

16 Olympia

Olympia Werke	Dipl-Ing. Eilt-Heyo Rittberg
Olympiastrasse	Leiter der Grundlagen
D-2940 Wilhelmshaven	Entwicklung
F.D.R.	Tel. D (49) 4421-78-33-11

Olympia's new offerings are an ink-jet machine and a xerographic-magnetic printer.

Herr Rittberg travels frequently to Brussels to contribute to a (DG IX) working group on office automation. The company is currently constrained in spending by the crisis affecting its parent, AEG Telefunken.

17 Kalle-Infotec 4.08.82

Gower St	Tony Waring
London W1	(UK Facsimile Product Manager)

Kalle is experimenting with linking facsimile machines to mainframe computers over a switched network. Mr Waring did not, however, yet feel able to say they would have anything close to the outlined DOCTERM requirement for some time. He suggested a development strategy briefing later this year from Dr Van Landschoots (head of facsimile R and D) or Richard Parabo at Hoechst (parent company) HQ in Wiesbaden (D) Tel. (49) 6121-22051.

18 Muirheads 4.08.82

Elmers End	Dr. William Sutherland
Beckenham	(Technical director)
Kent	R.L. Hollingsworth
England	Tel. GB (44) 01-650-4888

Muirheads have had for some time a character generator (the MS 473 FAXPORT) for accepting code-character input and outputting it on *any* CCITT Group I or II facsimile *receiver*. The current version comes as a small stand-alone blue box, but the new version now being manufactured is in a standard 19-inch rack module for incorporation into a mainframe computer cabinet. Muirheads say it would be straightforward to adapt this machine to drive Group III machines, and this is

included in medium-range development planning. It will also work with a store-and-forward facsimile switch which they developed with British Telecom. They will be happy to explore further the possibility of cooperating with the Commission in this area.

The company also developed, but has currently frozen, a hybrid OCR/facsimile scanning device. This interprets 'known' character sets in a variety of point sizes and converts them to eight-bit code for transmission; they are re-converted into character symbols at the other end of the line. Shapes not 'known' to the scanner are transmitted as though they were graphic images, with a high white-redundancy data compression ratio.

19 THOMSON/CSF 4.11.82

Dept. Activités de Télécopie	François Barbier Responsable Marketing et Ventes Internationales
66, rue du Fossé Blanc 92231 Gennevilliers France	Tel. F (33) 1-799-9877

They have two new telefax machines, Group II digital (Group III compatible) and Group III (modèles 2000 et 3000).

The 3000 can print videotex screen images and, in principle, any other VDT image dumped from screen buffer, but it takes around two minutes. It has been demonstrated with Télétel, but is not yet a product and no price for the facility has yet been fixed.

Thomson have sold 30,000 units (20,000 Group II and 10,000 Group III) to 3M in the United States, to be factored as 3M products. Series Production of the 2000 only started in September ('82) and the 3000 starts in the first quarter of 1983.

20 IBM Europe, Paris 29.11.82

Text & Office Systems Segment Tour Générale Cédex 22	Jean Evrard Marketing Manager
92088 PARIS La Défense France	Tel. F (33) 1-776-4132 x 40311

IBM announced on November 18, 1982, ScanMaster I, a fully SNA-compatible image scanner/copier/printer intended to work eventually with all their office systems. It is *not* CCITT Group III compatible, and it would be expensive to make it so; the resolution, although the same as Group III, is claimed to seem much finer.

ScanMaster I will cost between ECU 12,000 and ECU 16,000, depending on country. It was not derived from 6670 copier/printer technology and indeed was largely developed in Japan rather than by the Colorado team which produced the 6670. A machine may be seen at La Hulpe, near Brussels, by contacting Tony Mary, OASC Manager at (2) 657-9080.

APPENDIX 1
SAMPLES OF DOCUMENT FEATURES

The energy used in lumber operations is very variable and the published literature gives a range of energies from 3.33 MJ/kg to 12.59 MJ/kg for the production of raw wood from standing timber [54–56]. An average value of 8 MJ/kg has been chosen as reasonable and this is assumed to be all oil fuels. There is typically a 5% loss of wood during manufacture. Hence 18.81 kg of softwood must be supplied for the production of a single pallet.

The softwood most widely used in pallet making is Portugese pine imported by sea an average distance of 1000 miles. Hence the energy required to transport 18.81 kg of pine can be derived from Table 3.4. Within the U.K. the wood is transported by road. Assuming an average round trip delivery distance of 150 miles on fully loaded 20 tonne vehicles, the energy associated with this transport may be calculated from Table 3.1.

The hardwood used in pallet making is usually home grown. Again assuming that the provision of this wood requires an energy of 8 MJ/kg and that there is again a 5% loss during manufacture, the energy required to supply the wood can be readily calculated. Assuming an average round trip delivery distance of 50 miles for delivery using fully loaded 20 tonne lorries, the delivery energy may be obtained from Table 3.1.

The fuel content (feedstock energy) of the wood depends upon the moisture content and ranges from 19.75 MJ/kg for dry wood to less than 16 MJ/kg as the moisture content increases [38]. With a 12% moisture content, the fuel value is 17.2 MJ/kg and this is the value used here. Making a 5% allowance for losses during manufacture, the feedstock energy can be readily calculated from the mass of wood used,

A variety of steel products are used in pallet construction. The energy required to produce these products may be calculated using the data for steel production given in Chapter 8. For the delivery of steel products, a round trip delivery distance of 200 miles with full loads on 20 tonne lorries is assumed so that Table 3.1 can be used directly.

Published data [11] have been used for sawing and making up and the total energy associated with the production of one pallet is therefore the sum of all the above contributions as shown in Table 5.1.

Most companies regard pallets as returnable so the energy attributable to products carried on them depends upon the number of trips made by pallets

Sample 2 *Text in Columns*

worst being a rating of 2, meaning 'average'). Almost 30 years later students give the same sketch an almost identical rating as a unique description of themselves."

Hyman gives a 13-point recipe for becoming a cold reader. Among his tips are these: "Use the technique of 'fishing' [getting the subject to tell you about himself or herself, then rephrasing it and feeding it back]; always give the impression that you know more than you are saying; don't be afraid to flatter your subject every chance you get." This deliciously cynical recipe for becoming a character reader is presented in considerable detail, presumably not to convert readers of the article into charlatans and tricksters but to show them how such manipulations are achieved.

Hyman asks: "Why does it work so well? It does not help to say that people are gullible or suggestible. Nor can we dismiss it by implying that some individuals are just not sufficiently discriminating or lack sufficient intelligence to see through it. Indeed, one can argue that it requires a certain degree of intelligence on the part of a client for the reading to work well.... We have to bring our knowledge and expectations to bear in order to comprehend anything in our world. In most ordinary situations this use of context and memory enables us to correctly interpret statements and supply the necessary inferences to do this. But this powerful mechanism can go astray in situations where there is no actual message being conveyed. Instead of picking up random noise we still manthe most to promote gullibility and irrational beliefs. Each award consists of "a tastefully bent stainless-steel spoon with a very transparent, very flimsy base." Award winners were notified, Randi explained, by telepathy, and they were "free to announce their winning in advance, by precognition, if they so desired." Awards were made in four categories: Academic ("to the scientist who says the dumbest thing about parapsychology"), Funding ("to the funding organization that awards the most money for the dumbest things in parapsychology"), Performance ("to the psychic who, with the least talent, takes in the most people"), and Media ("to the news organization that supports the most outrageous claims of the paranormalists").

The nature of coincidences is a recurrent theme in discussions of the paranormal. I vividly remember a passage in a lovely book by Warren Weaver titled *Lady Luck: The Theory of Probability,* in which he points out that in many situations the most likely outcome may well be a very unlikely event (as it is when you deal hands in bridge, where whatever hand you get is bound to be extraordinarily rare no matter what it is). A similar point is made in the following excerpt from a recent book by David Marks and Richard Kammann titled *The Psychology of the Psychic* (from which various excerpts were reprinted in one issue of *The Skeptical Inquirer*):

"First, we notice and remember matches, especially *oddmatches,* whenever they occur. (Because a psychic anecdote first requires a match, and, secwill be had for almost everyone as aging is brought under control." No. 2 (85 psychics) was "There will be a major breakthrough in cancer, which will almost totally wipe out the disease." No. 3 (also 85) was "There will be an astonishing spiritual rebirth and a return to the old values." So it went. No. 6 (81 psychics) was "Contact will be made with aliens from space, who will give us incredible knowledge."

There is something pathetic, even desperate, about these predictions. One can see only too clearly the similarity of the publications that feature these predictions to inane television shows such as "Fantasy Island" and "Star Trek." The common denominator is escape from reality. The point is well made in an article by William Sims Bainbridge in the Fall 1979 issue of *The Skeptical Inquirer.* Perhaps we all have a desire to dilute reality with fantasy, to make reality seem simpler and also more aligned with what we wish it were. Yet at the same time perhaps all of us have the potential capacity and even the desire to sift sense from nonsense, if only we are introduced to the distinction in a sufficiently compelling manner.

But how can this be done? In the "News and Comment" section of the Spring 1980 issue of *The Skeptical Inquirer* there was an item about a lively traveling antipseudoscience lecture act by "Captain Ray of Light," actually Douglas F. Stalker, associate professor of philosophy at the University of Delaware. The article quotes Stalker on his "comical debunking" show (directed at astrology, biorhythms, numerology

traditional role of the bookseller.

Historically, an interesting document as a picture of a conservative industry grappling uneasily with change. But also encouraging in revealing that figures and organisations within the book industry are working on change from within,lessening the risk that major changes will be forced upon the industry one day from without.

Information Technology, by the Cabinet Office. Advisory Council for Applied Research and Development. HMSO, 1980, £3.30, 56pp.

The Advisory Council for Applied Research and Development (ACARD) was established in 1976 to advise (British) ministers and publish reports as necessary on aspects of applied R&D. One of these aspects is information technology and in view of the development and competition from outside the UK, ACARD decided that a working group should identify likely directions of development and the constraints to development and application in Britain. The report uses the UNESCO definition of information technology (IT) and therefore covers important sectors of the electronic components industry (with emphasis on microelectronics), electronic equipment (computers, terminals, displays), the whole communications industry (including the broadcasting authorities and British Telecom/ Post Office) as well as users and suppliers of information (e.g. banks, transport services etc. Libraries/information centres are conspicuous by their absence).

The report notes the five stages of information handling — input, processing, storage, transmission, and output — and briefly looks at some of the technologies being introduced in these stages such as OCR and voice recognition techniques, bubble and optical storage, fibre optical and satellite transmission systems. As a result of developments in information technology there will be a marked increase in the quantity of rapidly accessible data and in the ability to manipulate it. One chapter deals in some detail with applications in various sectors of the economy such as public administration, manufacturing industry, service industries such as retailing, banking, transport, printing and publishing, health, legal and education (libraries not mentioned) and the home. A summary of the main feature of official policy regarding IT developments in Britain's principal competitors (France, West Germany, Japan and the USA) is given and contrasted with the lack of awareness and generally negative attitude in Britain. The report in fact recommends that the Government should make it clear that effective exploitation of IT is essential to the future industrial and commercial success of Britain.

The report notes that the development, production and application of IT are all constrained by a substantial shortage of skilled people with the ability and training to design systems and write programs, and recommendations are made to the effect that there should be better education and training in IT-related subjects. Other constraints or aspects which need examining are the laws relating to data protection and copyright. The Council also examined the role of communications in IT and considered — in fact recommended — that the Post Office/British Telecom should not have an exclusive right to supply terminal equipment and IT services, nor should it be the approving authority for such equipment and services provided by others. As to the role of government, it was felt that one Minister and Department should be responsible for co-ordination of government policies and actions on IT rather than the hotch-potch of ministries at present.

It is quite clear that the concept of 'information' referred to in the report is much, much broader than the traditional use of information in the library/information centre sense. In fact the word 'library' appears to be mentioned once only in the entire work. This would seem to indicate that if library and information centres do not want to be left out altogether they should embrace quickly and wholeheartedly these new technologies and

Sample 4 *Footnotes*

of three years' operation of the EMS and finding that technical progress could be made within the present institutional framework,[2] Parliament was holding a broad debate on the need to press on with the EMS.

The House also considered the fifth medium-term economic policy programme, the situation of small and medium-sized businesses, wine problems, energy problems, certain aspects of regional development and the French measures for 'reconquering' the home market. On the last item, Mr Narjes reminded the House that the Commission was following events very closely with regard to both official communications from France and complaints lodged from economic sources against direct and indirect barriers to free movement. This question would also be discussed with the French Prime Minister, Mr Mauroy, when he visited the Commission in March.

Several debates revealed concern in the House over the deterioration in political and trade relations between the Community and the United States (steel, agriculture) and over the ties of dependence created between the Community and the Soviet Union (supplies of natural gas, sales of farm products).

Finally, Parliament adopted a report on its role in the negotiation and ratification of international agreements between the Community and non-member countries and expressed its intention of taking a greater part

future was tied up with the discussion on the follow-up to the May mandate. The Council needed to act on the Commission's mandate proposals to revive European integration, improve the common agricultural policy without jeopardizing its principles and resolve the budgetary difficulties of the United Kingdom. If the European Council at the end of March failed to do that, warned Mr Thorn, the Community would be confronted with 'an identity crisis' in which the Commission would have to face up to all its responsibilities.

Mr Thorn felt that the 20 years of the common agricultural policy had produced positive results. There was nevertheless a need

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[1] This report was prepared from *Le point de la session* published by Parliament's Secretariat. The complete texts of the resolutions adopted by Parliament are reproduced in OJ C 66, 15.3.1982, and the report of the proceedings is contained in OJ Annex 280. The political groups of members are indicated in brackets by the following abbreviations: *Soc* = Socialists; *EPP* = European People's Party — Christian Democratic Group; *ED* = European Democratic Group; *Com* = Communists and Allies; *Lib* = Liberals and Democrats; *EPD* = European Progressive Democrats; *Ind* = Group for the Technical Coordination and Defence of Independent Groups and Members; NA = Non-affiliated. The countries of origin are indicated as follows: B = Belgium, DK = Denmark, D = Federal Republic of Germany, GR = Greece, F = France, IRL = Ireland, I = Italy, L = Luxembourg, NL = Netherlands, UK = United Kingdom.

[2] Point 2.1.2.

[3] Point 2.4.4.

How an Animal Virus Gets into and out of Its Host Cell

Experiments with the Semliki Forest virus show in considerable detail how the cell is caused to manufacture new virus particles, including an outer membrane that is a piece of the cell's own

by Kai Simons, Henrik Garoff and Ari Helenius

For an animal or a plant the cell is the fundamental unit of structure and function. For a virus the cell is merely a means of making new virus particles. A virus particle consists of one or more strands of nucleic acid (DNA or RNA) enclosed in a protein shell called a capsid. In many viruses the capsid itself is enclosed in a membrane with protein molecules embedded in it, much like the outer membrane of an animal cell. The nucleic acid within the particle constitutes the genetic information needed for the virus to replicate itself. The virus particle, however, lacks the apparatus to transform this information into its own finished structure. That apparatus is supplied by the host cell. The large molecules such as proteins and nucleic acids.) Only then does a reaction unique to the virus occur: the outer viral membrane fuses with that of the lysosome, releasing the capsid and its content of RNA into the cytoplasm of the cell and allowing them to escape the degradative enzymes of the lysosome. Then the process of replication of the virus particle can begin.

The duplication of the viral RNA and the manufacture of the capsid proteins and membrane proteins are accomplished almost entirely by the normal metabolic processes of the cell. The new RNA and capsid proteins are joined in the cytoplasm to form a new virus core: a nucleocapsid. The proteins destined

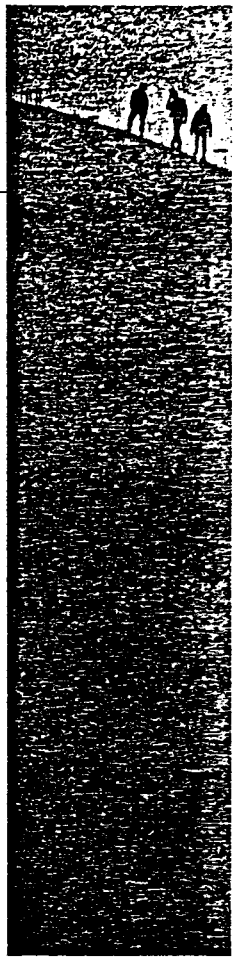
the three types of viruses are somewhat different. The Semliki Forest virus is an animal virus that infects a wide range of vertebrates and invertebrates. It is closely related to the viruses that cause yellow fever and dengue. Semliki Forest virus can cause encephalitis in mice but is not generally pathogenic for man.

The Semliki Forest virus is one of a class of viruses known as togaviruses. Togaviruses are small and spherical. They are also relatively simple in structure. The name of the group stems from the fact that its members all have a membrane—a "toga"—around the capsid. This is in contrast to those viruses in which the outer surface of the virus particle is formed by the capsid. At the cen-

Sample 6 *Display Types*

CHEMICALS

Dow Plans to Keep Growing in Europe



The European chemical industry is troubled with excess capacity and shrunken profits, but one company remains undismayed.

by ROBERT BALL

In the European chemical industry these days, happiness is breaking even. The past two years have been the worst since the recovery from the ruin of World War II. Among the companies losing money are not only chronic problem cases like Montedison and Rhône-Poulenc, but also the Dutch Akzo Group and the chemical divisions of Shell and British Petroleum. Most of the rest, including Imperial Chemical Industries and the leading West German companies, have reported sharply reduced earnings.

Bulk chemicals, plastics, and synthetic fibers have all been money losers, with industry losses on plastics alone reportedly running at $200 million a month. Overcapacity weighs heavily on prices. Western Europe has enough capacity to turn out 18 million metric tons a year of ethylene—the basic petrochemical building block—in a market currently absorbing only about 13 million tons. Moreover, Eastern Europe, frantic for hard currency, is pushing its products West at almost any price, while just over the horizon loom the new Mideast petrochemical plants that will get their feedstock virtually for nothing.

A pattern of retreat

Add lofty labor costs to this picture and it's no wonder American chemical companies have been cutting back in Europe. Monsanto and Union Carbide have sold off substantial European operations and Tenneco is seeking a buyer for a British subsidiary. Gulf Oil searched unsuccessfully for someone to buy its European chemical plants, and will now simply close them down.

One U.S. chemical com
remains undismayed, e
about the prospects in
Chemical of Midland, Mi
years the European branc
huge and fully integrated
ny itself. Its sales of $3.3
accounted for 28% of the p
total worldwide sales. (Se
In a normal year Dow C
also contributes a hefty
corporate profits.

Last year was not norm
Europe did manage the ir
making a profit on plasti
come, $135 million, was l
previous year's, and the
tributed to corporate pro
much more than a quarte
ure. Yet Dow continues to

Color Vision in Fishes

The visual environments of fishes are blue, green or near infrared. The retinal pigments acquired by diverse fish species in adapting to these environments are a valuable clue to the evolution of the eye

by Joseph S. Levine and Edward F. MacNichol, Jr.

The photosensitive cells of the retina are the outer extension of an animal's visual system. The cells catch the photons of visible light and in effect count them, thereby triggering a complex series of chemical and neural events that can result in visual sensation. In many animals the data-collecting function of the cells has developed to take advantage of discriminations possible on the basis of color as well as brightness, because in many environments color vision is an efficient means of gaining accurate information essential to survival. In deepwater environments, however, the number of photons that bathe an organism is much reduced and the color of the ambient light is confined to a narrow spectral band. The construction would be relatively straightforward. One might assume, for example, that fishes known through fossil evidence to have undergone little recent evolutionary change would retain relatively primitive visual systems. Accordingly one might also assume that species evolving in relatively recent times would incorporate visual systems more advanced than the ones found in the older species. Both assumptions, however, take no account of the possibility that eyes may have evolved independently of other organs, because eyes themselves may confer selective advantages for such vital activities as finding food, avoiding predators and selecting a mate. The selective advantages of one visual system over another, in a particular environmental circumstance is the possession of such a complex system an encumbrance rather than an advantage? Although relatively little is known about the constraints on vision that are specifically related to feeding, fleeing or mating behavior, much has been learned about the lighting conditions that prevail underwater.

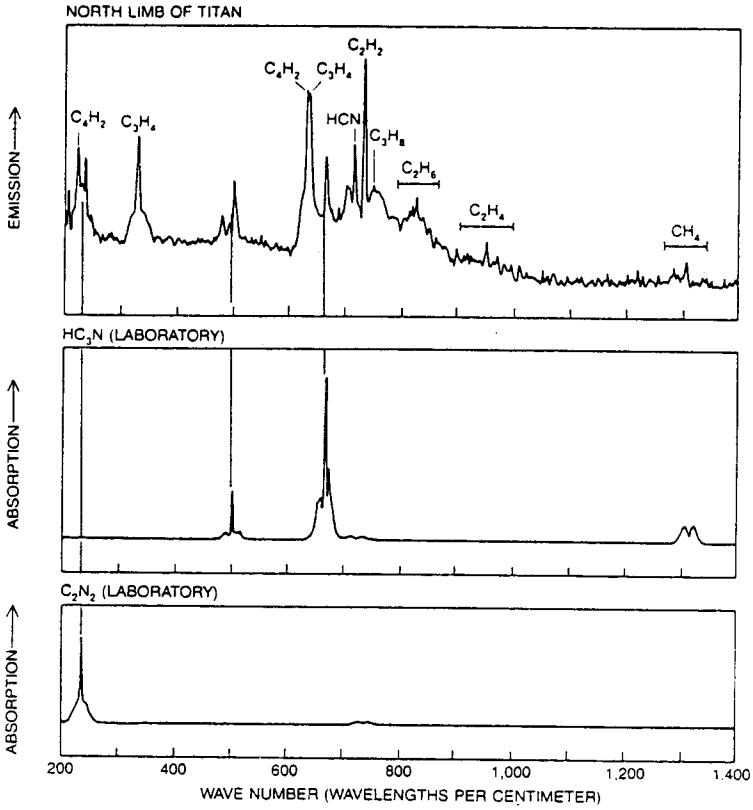
The solar radiation reaching the surface of the water is made up of photons of every visible wavelength, together with photons of the infrared and ultraviolet regions of the electromagnetic spectrum. The energies of visible-light photons correspond to colors or wavelengths, from violet with a wavelength of 400 nanometers to deep red with a wavelength of 700 nanometers. When

Titan failed to develop an atmosphere like that of Mars or Venus, an atmosphere rich in carbon dioxide? The reason is that oxygen is unavailable: it is trapped in water ice inside the solid moon. The unique combination of Titan's size and Titan's temperature has allowed the atmosphere of Titan to evolve and yet remain a reducing one.

It is generally accepted that Titan formed in a proto-Saturnian nebula, an isolated part of the cloud of dust and gas that became the solar system. Then too it seems reasonably certain that Titan formed with Saturn, Saturn's rings and Saturn's other moons some 4.5 billion years ago. The density of Titan measured today (1.9 grams per cubic centimeter) indicates that it consists of approximately 52 percent rock and 48 percent ices. The proportions represent a slight enrichment in rock compared with the composition of the solar system overall. The ice, however, would have been crucial for the subsequent evolution of Titan's atmosphere, because the ice would have trapped gases from the proto-Saturnian nebula to a far greater extent than the rock would have.

Twenty years ago Stanley L. Miller of the University of California at San Diego predicted that the icy moons of Saturn should include methane hydrate ($CH_4 \cdot 7H_2O$), that is, methane trapped in water ice. The known presence of methane in Titan's atmosphere supported his idea. The newly discovered presence of several additional gases suggests that they too were trapped as hydrates. In order to predict with assurance which substances really were trapped, one must know the values of temperature and pressure for which a given substance and its hydrate are in equilibrium. (At equilibrium the rate at which molecules or atoms of a substance escape from the hydrate equals the rate at which they are trapped, so that the quantity of the hydrate does not diminish and the hydrate is stable.) It is thought that the proto-Saturnian nebula's temperature did not fall much below 60 degrees K. At that temperature the equilibrium pressure for nitrogen molecules or argon atoms and their respective hydrates is less than 10^{-7} bar.

A pressure of 10^{-7} bar is lower than the pressure that nitrogen or argon is likely to have contributed to the proto-Saturnian nebula; therefore these gases



SPECTRA MADE BY VOYAGER 1 in the infrared part of the electromagnetic spectrum allow the identification of several gases on Titan other than methane. In this case the identification of cyanoacetylene (HC_3N) and cyanogen (C_2N_2) is demonstrated by a comparison of absorption spectra made in the laboratory with an emission spectrum of Titan made by the spacecraft. The comparison is valid because the molecules of a given gas absorb and emit radiation at the same set of characteristic wavelengths. Spectral features of several other gases identified by similar comparisons are labeled in the spectrum of Titan. For all three spectra the horizontal scale represents wave number, or waves per centimeter. A wave number of 200 corresponds to a wavelength of 500,000 angstroms; a wave number of 1,400 corresponds to a wavelength of about 71,000 angstroms. The spectroscopy was done by a group led by Rudolf Hanel of the Goddard Space Flight Center of the National Aeronautics and Space Administration.

most abundant isotope of neon is 20, or four more than the upper limit set by Jeans's theory for escape from Titan at its present mass.) The absence of neon tends to confirm that Titan's atmosphere formed after the body itself accreted and that the atmosphere formed from gases trapped as hydrates.

How did the gases escape from the hydrates and get to the surface of Titan? In the first place the release of gravi-

Plainly there are ways in which gases once trapped in Titan's ices could escape and form an atmosphere. One sees evidence of such escape on other Saturnian moons. The cracks on Dione rimmed by material brighter than the surrounding terrain are the most conspicuous example. Dione was simply too small to retain an atmosphere. Other Saturnian moons show signs of fresh surfaces. The material that resurfaced

CHAPTER IV

PERSONAL PRONOUNS—THE VERB *vara*—NUMERALS

97. The personal pronouns used as objects and after prepositions are as follows :

	Singular	Plural
1st Person :	***mig*** [mɛj[1]] ' me '	***oss*** ' us '
2nd Person :	***dig*** [dɛj[1]], ***e(de)r*** ' thee you '	***e(de) r*** ' you '
3rd Person :	***honom*** ['hɔˈnɔm] ' him '	
	henne ['hɛˈnnə] ' her '	***dem*** ' them '
	den ' it '	
	det ' it '	

Further remarks on the Personal Pronouns

98. The object forms ***den*** and ***det*** above are used in the same way as the subject forms (see Chapter III). When a neuter noun denotes a person, the object form ***honom*** is used, in accordance with the natural gender. In the case of nouns like the neuter *barn* ' child ', *honom* or *henne* would be used if the sex were known ; otherwise *det*.

In the second person the shortened form ***er*** is the normal ; the full form ***eder*** is only used in formal style.

99. The Verb *vara* to be.

The present tense of this verb is as follows :

jag är ' I am '	***den är*** ' it is '
du är ' you are '	***det är*** ' it is '
ni är ' you are '	***vi är(o)*** ' we are '
han är ' he is '	***ni är(o)*** ' you are '
hon är ' she is '	***de är(o)*** ' they are '

Note.—In the spoken language the verb is ***är*** throughout ; in the written language (high style) the plural is ***äro***. But the shortened form is very usual in everyday prose and modern literature generally.

Imperative : ***var*** ' be '

[1] Only pronounced [mi:g] [di:g] in ceremonial or church style.

Caliper, mm	0.508	0.610	0.782	0.864
(In.)	(0.020)	(0.024)	(0.030)	(0.034)
Weight, g/m²	316	371	452	508
Density, kg/m³	622	608	583	588
Taber stiffness, g-cm				
MD	300	484	695	850
CD	143	221	331	410
GM[a]	207	320	480	590
MD/CD	2.10	2.10	2.10	2.07
Ply thickness, 10^{-4} in.				
Top liner	3	3	3	3
TMP filler #1	T_1	9	12	14
TMP filler #2	T_2	9	12	14
Back liner	3	3	3	3
Predicted structural rigidity				
Laminated plate model				
$N_{xx}h/W_{xx}$, kN/m				
MD	0.029	0.048	0.085	0.123
CD	0.026	0.042	0.076	0.113
GM[a]	0.028	0.045	0.081	0.118
MD/CD	1.17	1.14	1.16	1.11
Laminated beam model				
EI, mN-m				
MD	26.1	42.8	77.3	109.0
CD	9.5	15.4	28.3	39.6
GM[a]	15.7	25.6	46.9	65.7
MD/CD	2.75	2.76	2.75	2.76
Converted Taber stiffness, g-cm				
MD	238	390	713	998
CD	87	142	259	363
GM[a]	144	235	430	602
MD/CD	2.75	2.76	2.75	2.76

[a]The GM values are the geometric means of the values of MD and CD. For example, Taber stiffness, T_{GM}, is $(T_{MD} \times T_{CD})^{1/2}$.

where N_{xx}, N_{yy}, N_{xy}, are stress resultants and

$$F(x, y) = \sum_{p=1}^{P} \sum_{q=1}^{Q} B_{pq}\left(1 - \cos \frac{2p\pi x}{a}\right)\left(1 - \cos \frac{2q\pi y}{b}\right) \quad (2)$$

The transverse deflection of the plate is described by the function

$$W(x, y) = \sum_{m=1}^{M} \sum_{n=1}^{N} W_{mn} \sin \frac{m\pi x}{a} \sin \frac{n\pi y}{b} \quad (3)$$

In the mathematical modeling, the laminated plate theory is used, the nonlinear Von Karman kinematic relations are applied, and the behavior of the materials is assumed to be linearly elastic. The detailed governing equa-

$\overline{N}_{xy}$

An incremental method of loading is used. The loads are divided into many increments as

$$\begin{aligned} q &= q^1 + \Sigma \Delta q \\ \overline{N}_{xx} &= \overline{N}^1_{xx} + \Sigma \Delta \overline{N}_{xx} \\ \overline{N}_{xy} &= \overline{N}^1_{xy} + \Sigma \Delta \overline{N}_{xy} \end{aligned} \quad (5)$$

For a very small initially applied load, the nonlinear terms D can be neglected and the linearized version of Eq. 4 yields a very accurate solution: B^1_{pq} and W^1_{mn}. For a small increment of the applied load, one can find the changes in response, ΔB_{pq} and ΔW_{mn}, by replacing B_{pq} and W_{mn} with $B^1_{pq} + \Delta B_{pq}$ and $W^1_{mn} + \Delta W_{mn}$, respectively, and then retaining only the terms linear in ΔB_{pq} and ΔW_{mn}. Thus, the new values for B_{pq} and W_{mn} are obtained by

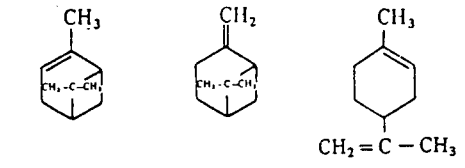
$$\begin{aligned} B^2_{pq} &= B^1_{pq} + \Delta B^1_{pq} \\ W^2_{mn} &= W^1_{mn} + \Delta W^1_{mn} \end{aligned} \quad (6)$$

This step is repeated to the desired level of applied load. Furthermore, since the equations linearized in ΔW_{mn} and ΔB_{pq} are nonhomogeneous, even for zero change in the applied load, one can iteratively solve them at the same level of applied load in order to improve the solution.

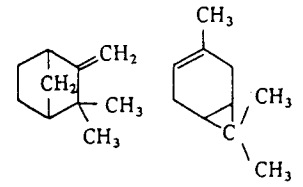
A computer program has been written in FORTRAN IV and numerical results obtained on the Georgia Tech computer (CDC-CYBER 70, Model 74-28).

Laminated beam

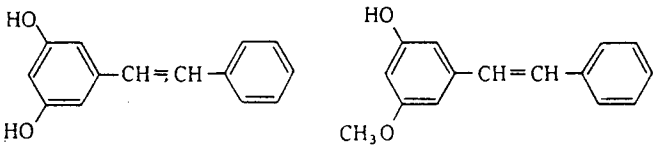
The standard Taber test for board stiffness can be modeled as a cantilevered beam. The bending modulus of elasticity of a laminated beam is equal to the average of the moduli of elasticity parallel to the span of the various plies. E_i, weighted according to their moment of inertia about the neutral plane, I that is,



Alpha Pinene Beta Pinene Dipentene



Camphene 3 - Carene



Pinosylvin (I) Pinosylvin monomethylether (II)

Figure 4-115. Some turpentine constituents.

stored. Maximum turpentine yields can only be obtained if the wood fed to the digester is in a relatively fresh condition. The magnitude of this yield loss is dependent on the conditions during storage. Chip storage results in a greater loss in turpentine than roundwood storage. A typical relationship between loss in turpentine yield and chip storage time is shown in Figure 4-116.[728] Losses are

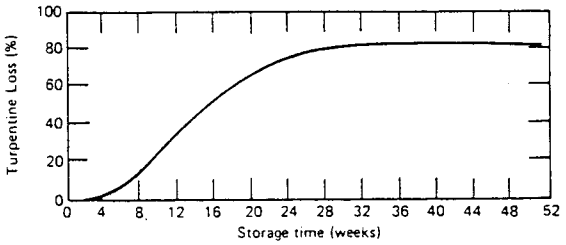
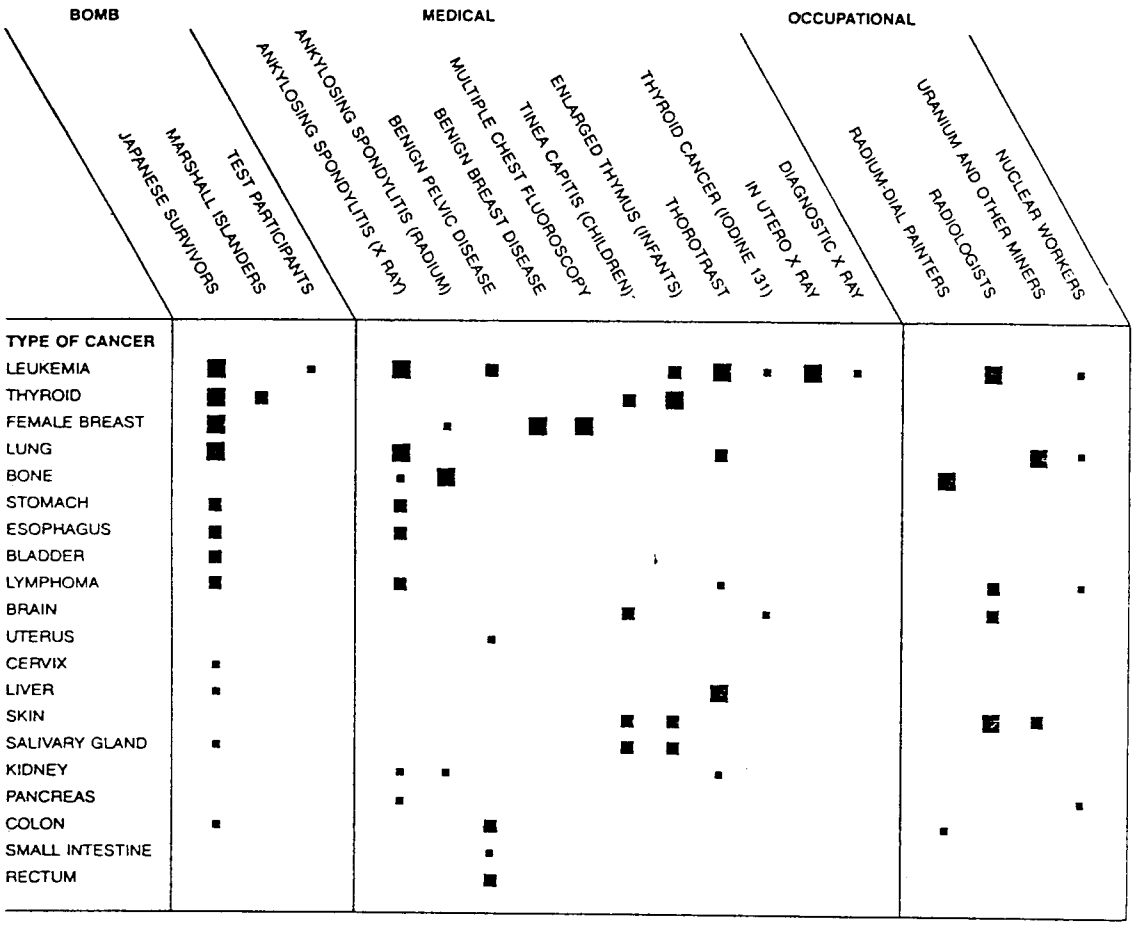


Figure 4-116. Loss in turpentine yield with chip-storage time.

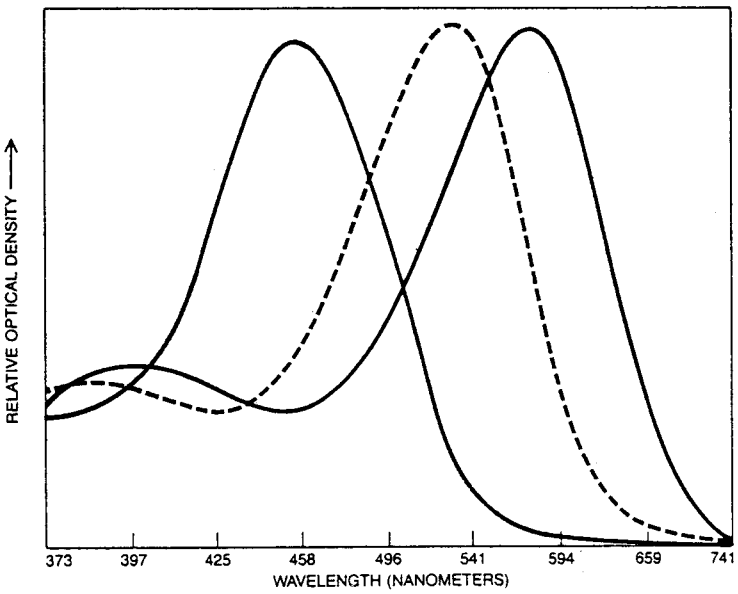
their tracks and penetrate deeply into tissue. Charged particles are characterized by a higher linear energy transfer and shallower penetration. The capacity radiation with low linear energy transfer is likely to consist of fairly simple lesions such as single-strand breaks in the two-strand double helix of DNA. Severeffects of radiation. The abnormalities include changes in the number and structure of chromosomes. They result from the breakage and rearrangement



INCIDENCE OF CANCER associated with radiation is charted for people exposed to radiation in three different circumstances: the atomic bombings of Japan, radiation therapy and occupational exposure. A strong association of a certain type of cancer with a certain type of exposure is indicated by the large squares, a meaningful association by the squares of medium size and a suggestive but unconfirmed association by the small squares. The three groups are the ones in which the exposure to radiation is fairly well documented.

with wavelengths between 500 and 510 nanometers, even though the local space light is yellow-green at wavelengths between 525 and 550 nanometers. Rod pigments in freshwater fishes from both deep and medium-depth habitats appear to be limited to a maximum absorption probability at wavelengths no longer than 540 nanometers, even though reddish orange light with a wavelength of 600 nanometers dominates the space light in their environment.

In 1966 J. N. Lythgoe of the University of Sussex suggested that the apparently mismatched pigments were set off from the color of the space light in order to maximize visual contrast. Lythgoe pointed out that when a pigment is matched to the space light, there is a relatively high contrast between a dark object, which deposits relatively few photons on the visual pigment, and the space light, which deposits many photons. A bright object, however, will deposit many photons on the pigment no matter what its color, and so it will not be strongly distinguished from the background space light. On the other hand, if the light illuminating the object is spectrally broad and the pigment is not matched to the space light, the situation will be reversed. A dark object and the space light will both appear dark, so that they will be relatively indistinguishable. A bright object will look bright, how-



ABSORBANCE SPECTRA show, for each wavelength of light, the relative optical density of a visual pigment; they can be related mathematically to the probability that a photon of that wavelength will be absorbed by a visual pigment. Three absorbance spectra, one spectrum for each pigment of the cichlid fish (*Cichlasoma longimanus*), are graphed. The colors at the top of each curve indicate the appearance to the human visual system of the wavelengths of light to which each pigment is maximally sensitive, at 455, 532 and 579 nanometers respectively. For convenience in analysis the machine employed by the authors plots the absorbance of the pigments as a function of frequency. Hence when the same curves are employed to represent absorbance as a function of wavelength, the wavelength increments vary along the horizontal axis.

Sample 16 *Special Symbols*

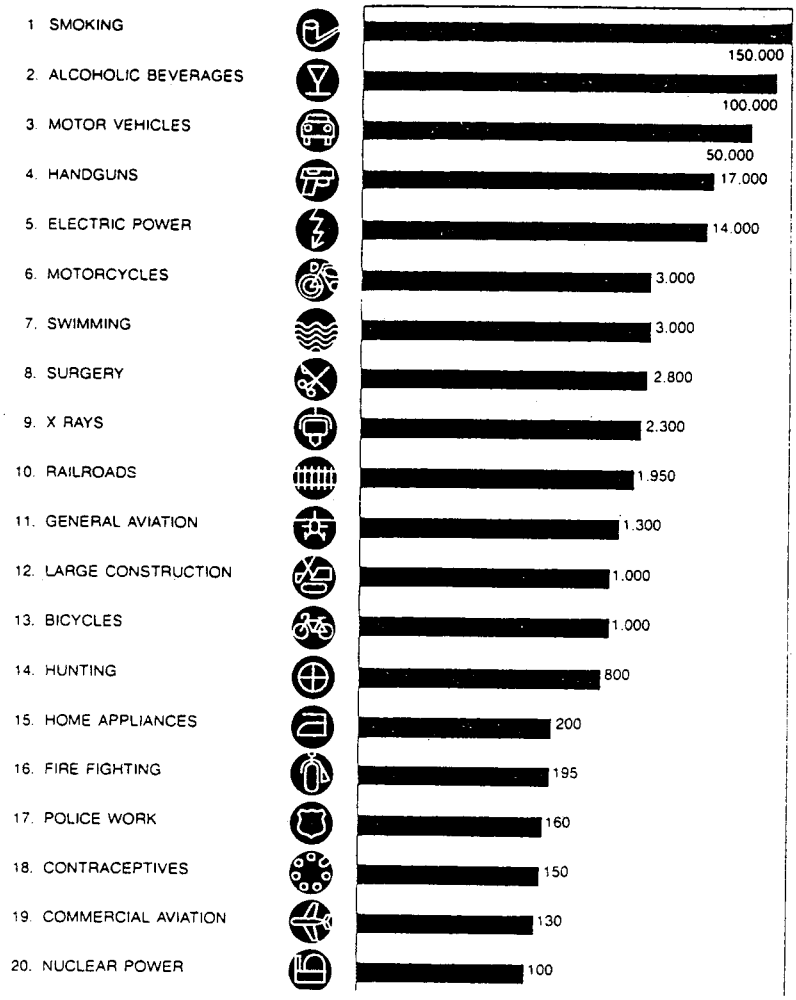


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TABLE 1 Output, costs and employment, 1976–1978
All United Kingdom establishments classified to mining, manufacturing, construction, gas, electricity and water (a

Standard Industrial Classification Orders or minimum list heading (b)	Industry	Year	Sales of goods produced, receipts for work done and services rendered	Merchanted goods	Increase during year in work in progress and goods on hand for sale	Gross output	Cost of purchases (c)
			£ million	£ million	£ million	£ million	£ million
ORDER XVIII	**Paper, printing and publishing (continued)**						
484 (2)	Miscellaneous manufactures of paper and board	1976	355.8	10.6	4.0	370.5	207.4
		1977	451.8	16.9	4.4	473.2	269.9
		1978	490.5	18.8	0.8	510.1	269.1
485, 486	Printing, publishing of newspapers and periodicals	1976	1,620.1	29.9	3.9	1,654.0	482.3
		1977	1,886.0	34.0	2.2	1,922.2	544.1
		1978	2,244.1	42.0	2.6	2,288.6	577.7
489	General printing and publishing	1976	1,864.1	89.8	26.3	1,980.2	671.1
		1977	2,224.3	103.0	57.4	2,384.7	814.0
		1978	2,738.4	151.2	57.3	2,946.8	1,015.8
ORDER XIX	**Other manufacturing industries**	1976	3,583.7	321.8	75.3	3,980.9	2,007.6
		1977	4,186.4	424.0	97.7	4,708.0	2,420.0
		1978	4,740.5	531.3	58.7	5,330.8	2,689.2
491	Rubber	1976	1,350.4	163.1	26.7	1,540.3	781.7
		1977	1,529.2	215.4	49.3	1,793.9	949.0
		1978	1,700.3	243.9	15.9	1,960.1	1,022.5
492	Linoleum, plastics floor-covering, leathercloth, etc.	1976	223.1	4.9	6.6	234.6	136.9
		1977	250.3	7.6	2.3	260.2	152.7
		1978	270.5	8.4	−1.6	277.4	148.2
493	Brushes and brooms	1976	67.0	7.5	1.5	75.9	36.5
		1977	79.9	8.5	1.3	89.7	44.7
		1978	90.4	9.7	0.8	100.9	46.5
494 (1)(2)	Toys, games and children's carriages	1976	264.8	24.1	8.5	297.4	121.6
		1977	292.7	23.9	7.6	324.2	136.2
		1978	308.6	24.4	6.5	339.6	146.0
494 (3)	Sports equipment	1976	90.0	15.6	3.4	109.0	48.6
		1977	110.2	23.6	5.5	139.2	65.6
		1978	127.1	31.5	5.9	164.5	81.2

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