2 Online public access catalogues

The phrase Online Public Access Catalogue (OPAC) is used in this report to mean an online catalogue which is the main or only catalogue for the users of a library. This excludes from the discussion those computerised circulation control and cataloguing systems which *can* be used for catalogue search but are normally so used only by library staff; some libraries have made terminals to such systems available to those general users who care to learn how to use them — these systems are not counted as OPACs unless they are the chief means of catalogue access.

This chapter is not meant to be a comprehensive introduction to the subject. The topics which have been covered are those which have some bearing on this research and on the design of Okapi, the project's prototype OPAC.

2.1 Sources of information on OPACs

The team learnt about OPACs by looking at them, by reading and by talking to OPAC users, designers and researchers.

2.1.1 Existing OPACs

There are still few OPACs in this country and a majority of these are Geac circulation control systems, some of which have certain enhancements, often done locally with assistance from Geac — the University of Hull system allows Boolean searching, the University of Sussex has an approach to rotation of title keys. The team observed the use, and talked to staff and users, of the Geac catalogues at the Polytechnic of the South Bank and the London Borough of Bexley. In July 1984 two of the team spent a day with the University of Cambridge's interesting and unconventional OPAC [1], which was developed by library automation staff there on a very low budget. During a visit to the United States in 1983 Mel Collier looked at the Pikes Peak District Library system and the University of California's MELVYL (see below).

2.1.2 *Written sources*

General

There are two articles by Alan Seal in [2] which form a clear and very concise introduction to the subject, but the single essential written source is Charles Hildreth's excellent monograph [3]. The coverage of Hildreth's book is much wider than the title suggests, and after four years, which is a long time given the pace at which technology is moving, it is still almost all pertinent. There is a "guide for managers" by Matthews [4], which includes brief descriptions of nearly forty systems; it is useful for reference in spite of containing many typographical errors. Fayen's book [5] also contains some useful material, but the subject is, perhaps, treated from the librarian's point of view rather than from that of users. Markey's book [6] on subject access is extremely valuable, although it does call for some prior knowledge of OPACs and OPAC research. This book is mentioned below in connection with the use and evaluation of OPACs.

Specific OPACS

The fullest readily available source of information on a specific system is the excellent series of articles on MELVYL published in *Information Technology and Libraries* [7,8]. These describe the design, development and use of this elaborate and ambitious OPAC in considerable detail and without glossing over the difficulties encountered or the shortcomings of the resulting system. In some ways, the most ambitious and advanced existing OPAC is the National Library of Medicine's CITE, developed by Doszkocs and others. Published material on CITE [9,10,11] is not as informative as it might be, but is nevertheless essential reading for designers of future systems. (CITE is briefly described below in Section 2.4.4.)

Catalogue Research

Since most users have no other model to apply, it is reasonable to assume that many of them approach OPACs with something of the preconceptions which they have about conventional catalogues. Hence studies of the use of conventional catalogues are highly relevant. Of particular importance are the group of papers by Tagliacozzo, Kochen and others [12,13,14] and the work of Krikelas [15]. There is a list of catalogue use studies and a discussion of their methods in Chapter 2 of Markey [6].

On the evaluation and use of OPACs there was an extensive research project which was carried out for the Council for Library Resources (CLR) in the United States, and which resulted in a a number of publications from the various participating bodies, including a three volume "Final report" from the Online Computer Library Center (OCLC) [16,17,18]. This was the outcome of a large amount of planning and work, but the concern in the report with statistical generalisations can be misleading if quoted after only a cursory reading. Much valuable material underlies the report and this is available for further analysis and research. It includes transaction log tapes and interview and questionnaire data.

Karen Markey, the author of volume II of the final report of the CLR study [17], expands this material, to considerable effect, in her book on subject access [6]. Although we did not see Markey's book until our design ideas had already hardened, it should be required reading for future designers.

Other Material

As well as the above sources, there are two or three hundred relevant journal articles and occasional papers, many of which one or more of the Okapi team has read. These are to be found in the librarianship literature, in sources concerned with information science and computing, and in the fields of human-machine interaction and human factors or ergonomics. A bibliography of some two hundred items has been compiled, broadly classified under nine facets. This may be published as a separate annotated bibliography.

2.2 OPACs as IR systems

2.2.1 Coverage and source

One of the differences between OPACs and conventional IR systems is that online catalogues often access references to bibliographic material in many subject areas, if not the whole of knowledge (as well as fictional material). "Traditional" online or in-house reference retrieval systems usually cover one or a few narrower fields in which terms are less context-dependent, so that it is feasible to build a thesaurus.

Another important aspect of OPAC files is that their content is usually limited to what is in MARC records: few libraries have been prepared to key in catalogue records since a large proportion of these are available from cooperatives in MARC format. These records do not have abstracts, assigned (controlled) indexing is often poor or too broad — Library of Congress Subject Headings for example — but there is some classification scheme, most commonly Dewey or Library of Congress.

2.2.2 Users and usability

The major requirement of an OPAC is that, unlike a conventional online reference retrieval system, it must be usable by people with widely varied backgrounds, without an intermediary: library users cannot be expected to know much about computers, catalogues or IR techniques, nor is it reasonable to expect them to learn them. The only suitable way in which users can be assisted is while they are actually using the OPAC, that is by the system itself (help messages, suggestive prompts, error messages), and by instructional material in the form of leaflets or brief instruction sheets on display near the terminals.

Because OPACs must be readily, efficiently and, if possible, pleasantly usable by at least as broad a section of the community as that which uses conventional catalogues, and preferably by all those who use libraries for any purpose, it can be said that they must combine features of IR systems, cash dispensing machines and computer games (Section 7.3). The user interface design is absolutely crucial.

To summarise, an OPAC can be characterised as being an IR system (a) for users from widely varied backgrounds, (b) which needs no intermediary, (c) whose records are not restricted to a single (or a few) subject areas, and (d) its records are usually MARC or MARC-derived, enriched only by controlled subject descriptors (subject headings and classification numbers) which are often too specific or too general.

2.3 From conventional catalogues to OPACs

Participants at a conference in 1980 were asked to give a definition of an online catalogue. Some of these were lists of desirable features rather than definitions, but two of them are quite succinct (quoted by Fayen in [5]):

> "[An online catalog provides] online access to the complete bibliographic record of all the Library's holdings with minimal access points being the same as those in a card catalog." (National Library of Medicine.)
>
> "A true 'On-line Public Catalog' should provide sophisticated access for unsophisticated patrons. It should remove from the patron the burden of any interpretation of library procedures and practices". (Pennsylvania State University.)

It is clear that OPACs have certain inherent advantages over conventional catalogues. The principal advantage is that they can easily be made to provide a much greater range of access points. Another advantage, which until recently obtained mainly in the more primitive OPACs derived from circulation systems, is the inclusion of availability information and users' ability to make reservations. Most writers would assume that all OPACs in lending libraries must provide this function [2].

It is less immediately clear, but must be appreciated, that OPACs also have a number of serious disadvantages. Perhaps the most important of these is that ease of use tends to vary inversely with the sophistication of the functions provided. This has resulted on the one hand in OPACs which are easy to use but ineffective, and on the other in OPACs offering enhanced access and sophisticated facilities which are not taken advantage of by most of their users. This has been cogently but perhaps over-pessimistically expressed by Lipow: " 'user-friendly' to me is synonymous with limited service" [19]. It is generally true that even the simplest OPAC gives the user a feeling of being more highly involved than do most conventional catalogues. The almost unavoidable use of a keyboard for user input is also an important source of user frustration and of searches which fail because of spelling and keying mistakes.

2.4 Types of OPAC currently in use

There are probably now (early 1985) between fifty and a hundred distinct OPAC systems in use. Most of these are in the USA, with a handful in the UK and the rest of Europe. Some are commercially available, increasingly now as part of integrated library systems. Many were developed as in-house systems by academic, national and public libraries.

It may be helpful to regard OPACs as falling into three categories, of which the first is, in the main, historically the oldest. These are roughly

equivalent to Hildreth's "three generations" of OPAC which he defined in a recent paper [20], but it should be realised that it is not always possible to place a given OPAC firmly in a specific generation.

The first and second generations are most readily distinguishable by the types of access key provided.

2.4.1 First generation OPACs

OPACs of the first generation will be referred to in this report as *phrase indexed* or *pre-coordinate* OPACs. Their access points are usually similar to those of a hard copy catalogue: author, title (as a *phrase*), class mark or call number, sometimes subject heading(s) — as a phrase. There may also be "derived" or "acronym" keys which the user has to know how to construct. It is a characteristic of this category that to find a title, or a subject heading, a user must enter either a phrase (at least the beginning of it), or else a derived key.

Of OPACs in this category, some are derived from circulation control systems, some from cataloguing systems and some were designed as OPACs. A pioneering example is the LCS (Library Control System) OPAC from Ohio University, which has been operational as an OPAC at least since 1978, and since 1970 for circulation control [4]. Other examples include the Pikes Peak Library District system [4] and the many Geac circulation control systems which are being used as OPACs in this country.

One of the features of this type of OPAC is that a search usually results in the display of *something*: an author mistyped as SMTH might result in a display of a number of brief records including

> SMOUT T C. A history of the Scottish people.
> SMULLYAN R M. What is the name of this book?

as the two "nearest" author entries to SMTH, and it is normally possible to browse backwards and forwards in alphabetical sequence. The user might find SMITH by browsing backwards through this author sequence, without even noticing that s/he has mistyped it. This can be a useful feature. The process of searching is not very dissimilar from searching a conventional catalogue, with the disadvantage that entries

have to be *keyed* as well as recognised, rather than just recognised as they are when a search is done by scanning cards or microform.[1]

2.4.2 Second generation OPACs

These are referred to as *keyword* or *post-coordinate* OPACs. Their access points are similar to those provided by the traditional online reference retrieval systems such as Lockheed DIALOG: *words* from the free and controlled text of the bibliographic records.

These OPACs differ from the reference retrieval systems in the nature of their records and in the mode of user interaction. The OPAC records, being usually MARC or MARC-derived, do not have abstracts, nor do they have controlled indexing except, sometimes, for subject headings; thus access points are *words* from title-like fields, author and other *names*, and words from subject headings when these are present. As regards user interaction, it was obvious to most OPAC designers[2] that, since online reference retrieval systems need trained intermediaries to mediate between the user and the system, users would not be able or prepared to tackle the task of learning a fairly complicated command language. The approach taken in keyword OPACs has often been to try to provide a much simpler (and more limited) approach to user interaction.

Several second generation OPACs have two levels of user interaction — a simple one for "naive users", and an advanced one which may be the full command language of a typical Boolean IR system. At the simple level, normally only the Boolean AND is available: in a title or subject search, the user can enter a phrase, and the system will assume an AND between the individual words.

In many cases, OPACs of this type have their own software, but several make at least partial use of existing IR system sofware. Examples are the University of California's MELVYL (own software for access with file management by ADABAS) [7,8] and the Dartmouth College system (modified BRS software) [22].

(1) A VDU screen is doubtless quicker to scan than a deck of cards, but the amount of information which can be carried on a screen is far lower, and often less readable, than that in a microfiche frame. Hence it is easy to understand the appeal which these types of OPAC had in the United States, where few libraries introduced microform catalogues, but rather went straight from card catalogue to OPAC. The reasons for their appeal to UK librarians are less obvious.

(2) A few libraries have assumed that users may be able and willing to learn a command language — see for example the OPACs at the Library of Congress referred to by Arret in her paper on learning to use OPACs [21].

The appeal of keyword systems is largely because they provide a much larger number of access points than do pre-coordinate systems, together with the well-developed state of Boolean IR system design. Obviously searches of an OPAC which processes title or subject phrases by implicitly ANDing the constituent words are not affected by misapprehensions about word order; on the other hand post-coordinate searching of large files results in a high proportion of "false drops".

In contrast to the first generation systems, a search of a keyword system retrieves a *set* of records, and sets may be empty, or unmanageably large. Although it could be said that users can "browse" through the records in a retrieved set, this is very different from the way items are located by browsing in a phrase-indexed OPAC (and one cannot browse an empty set).

Some of the more recent OPACs, particularly those now being offered as part of an integrated library system, although basically keyword, post-coordinate systems, do also allow phrase indexing and searching [23,24]. It will appear later (Section 2.5) that it is fairly obvious that both types of access are necessary in an OPAC.

2.4.3 The third generation

Reverting to the Pennsylvania State University OPAC definition quoted at the beginning of Section 2.3, this would be satisfied by a third generation system, but it is doubtful whether any such OPAC yet exists. According to Hildreth [20, p41], they would feature both phrase and keyword access, their bibliographic records would be enriched by the inclusion of additional controlled and uncontrolled access points, they would accept search expressions in "ordinary language", provide context dependent automatic help and guidance and a degree of error-correction — in short, they would combine some of the functions of a reference librarian with those of a catalogue.

Several OPACs have certain third generation features, most notably the National Library of Medicine's CITE system [9,10,11], and to some extent also the Beth Israel Hospital system, Paperchase [25], and this project's Okapi. In addition, as mentioned above, there are now some second generation OPACs which offer both phrase and keyword access.

All the third generation features listed by Hildreth could be implemented to some degree, using techniques which are currently available in IR and

in the design of interactive computer systems. This is not to say that we know even approximately how to implement them satisfactorily — merely that the techniques *are* available, and what is needed is a major research effort to learn how to apply them. Some of the more important aspects of research and development are discussed in more detail in Section 9.4.

2.4.4 *The National Library of Medicine (NLM) CITE OPAC*

Since CITE will be referred to quite frequently in this report, a very brief description may not be out of place here. CITE is the catalogue for a fairly large collection (at least 500,000 items) of medical monographs. It uses a subject searching technique which has been little tried elsewhere except in experimental IR systems.[1]

The user enters a search statement in "natural language", rather as it might be presented to an online search intermediary — for example "Kidney disease in infants and newborns". CITE then performs a search using the words from the search statement together with morphologically similar terms and related subject headings (MeSH headings). (The combinatorial search technique used in Okapi is substantially the same as that of CITE, and is described in Section 6.5.) This will result in the display of a number of catalogue records, some of which may be relevant. The user is then required to indicate which records are relevant and which terms from them are important, the search is reprocessed, and these steps are repeated until the user decides to stop.

Some of the techniques used in CITE cannot be applied to general catalogues or their users. The ways of obtaining related terms and subject descriptors are subject-specific and dependent on the existence of a set of well-defined subject headings. The users of the NLM are medical professionals and students, and cannot be regarded as being similar to users of general academic or public libraries: users need a rather high degree of motivation, as well as subject knowledge, to obtain satisfactory

(1) CITE was also one of the subjects of perhaps the only comparative evaluation of two OPACs under operational conditions in the same library [26]. It was tested against the more conventional ILS OPAC (since enhanced, and adopted by OCLC for its LS/2000 "local system"), and found to be more effective and generally preferred by users of the medical library.

results. Nevertheless, it would certainly be possible to implement systems of this type with other moderately specialised collections, and the success of CITE does suggest some of the lines along which OPAC research and development should proceed.

2.5 Types of catalogue search

It has been widely accepted that user searches of library catalogues fall mainly into two categories, *specific item* and *subject* searches. It is better to use the expression *specific item* rather than the more frequent *known item* because quite a high proportion of searchers are looking for a specific item but have only an imprecise specification for it (in extreme cases a specific item searcher may have neither the author nor the title, but only the knowledge that such an item exists and s/he would recognise it on sight).

Several other types of search have been identified, including *bibliographic* searches (checking references) and *author* searches (checking holdings of works by a specific author) [27].

The proportion of subject searches decreases with the academic level of the user, and is high in public libraries. The overall proportion of subject searches shown by various studies of conventional catalogues ranges between 62% and 10%, while the figures from OPAC use studies lie between 65% and 34% (the lowest figure was obtained in a study of a catalogue which offers subject access only by pre-coordinated LCSH) [6, p76].

Certainly the proportion of subject searches is higher in OPACs than it is in conventional catalogues.

Studies such as that of Tagliacozzo and Kochen [12] on the use of card catalogues indicated that most searches were of the author/title catalogue but that a substantial proportion of these were "hidden" subject searches. In some cases the reverse happens: subject catalogue searches are attempts to locate imprecisely known specific items.

Most conventional catalogues encourage and perhaps even give rise to this specific item/subject dichotomy because there is an author/title

sequence and a subject or classified sequence (except in some dictionary catalogues).

2.5.1 *Specific item searching*

Most searchers arrive with an author and/or title rather accurately specified. Although they may be misspelt, the most significant parts (last name of an author, first few words of title) are usually substantially correct [13], with titles more likely to be correct than authors. In a conventional catalogue this means that most specific item searches can be satisfied by browsing an author/title sequence in the region of the entry point. Similar browsing can be done with the pre-coordinate, phrase-indexed type of OPAC, but not with a purely keyword system. Hence, keyword approaches do not seem particularly well suited for specific item searching: a majority of searches succeed, if they are going to succeed at all, on a phrase search. However, a keyword system can work fairly satisfactorily with titles; it does of course succeed when there are word transpositions, but spelling mistakes in title citations are far more frequent than mistakes in word order.

2.5.2 *Subject searching*

It is generally felt (for example by Markey [6]) that it is in the area of subject access to library materials that OPACs can show their real advantages.

Here there is a divergence between US and UK catalogue practice. Most US libraries do not make use of classification for subject access, relying rather on LCSH or other subject terminology consisting of pre-coordinated headings and subheadings. One of the major difficulties in subject access has been users' inability to find or guess the exact subject heading, or at least its beginning. Hence there has been much emphasis on the potential of keyword-type OPACs for giving access to the component words of subject headings, thus making them available as terms to be used in post-coordinate Boolean-type searching.

In the UK, on the other hand, subject access to conventional catalogues has usually been via a classified sequence accessed by means of a printed index relating subjects to classification numbers. Although this is a two-stage process it may be more effective than many libraries' use of LCSH, because related subjects are more likely to be adjacent in a classification schedule than they are to be alphabetically adjacent in a subject heading

list. Many MARC records in the UK do not contain subject headings, so in many OPACs the user would have to consult the printed subject index and then search by class number, just as in a conventional catalogue. The Geac system at the Polytechnic of the South Bank has a subject index online [28], thus avoiding the necessity of searching the printed subject index.

Many MARC fields other than subject headings and classification numbers can contain subject-rich information, most notably titles and subtitles, but also series titles, corporate names, and some of the notes fields (when these are used). In Appendix F of [6], Markey gives a list, which is comprehensive apart from the omission of cross-reference fields, of subject-rich fields and subfields of MARC records.

The most obvious and simplest approach for subject searching is to use post-coordination of keywords. This is often implemented by allowing access by any word or words from title fields and subject headings, if present, and assuming Boolean ANDs between words. Certainly an online search intermediary would often obtain better recall and precision, but this simple method may be at least as effective as forcing the user to try to find the correct subject heading(s) or class number(s).

That a purely post-coordinate approach is not ideal for subject searching was demonstrated by examining the results of a search for items on library science in a keyword system. With the Okapi prototype searching the PCL catalogue this gave a precision of about 30% on 216 items retrieved.

2.6 User interaction with OPACs

This material is covered in Sections 7.2, 7.3 and 7.4. It is introduced here because of the prime importance of user interaction in OPAC design.

2.6.1 User attitudes and behaviour

Surveys show that most users of most OPACs seem to like them. The CLR survey also found a generally favourable attitude among non-users. The first experience of the catalogue is important in determining a user's attitude. It is felt that users' expectations will increase and that attitudes may, and should, become more critical as people have more exposure to different OPACs [18].

Features which need an appreciable effort to learn or use tend to be little used. Where different levels of user interaction, "expert" and "novice", have been provided, most searchers choose the easier level, despite the fact that this may deny them access to the more powerful facilities of the catalogue [29].

Usage of a feature is highly dependent on its ease of access. The University of Sussex wanted its combined author/title derived key search to be used, because it is effective and does not need much processing power; merely moving it to the top of their menu increased its usage dramatically [30]. This suggests (what is borne out by studies of other types of interactive systems) that users tend to take the first option which appears at all satisfactory, and it follows that only a small number of courses of action should be offered at one time.

There is also a tendency for users to assume that they "know" an interactive system after they have had a few successful experiences with it; thereafter their level of expertise does not increase, so that they may be unable to carry out tasks which are within the capability of the system but which did not form part of their initial experience. Most OPACs offer online help facilities, but it has been found that online help screens which have to be explicitly requested by the user are little used [6]. This is the motivation behind Hildreth's "third generation" requirement that OPACs should offer automatic help and guidance wherever possible. However, this must be done gracefully and unobtrusively.

2.6.2 OPAC input from users

Almost all systems require users to type not only commands or choices (menu selections) but also their search statements. Surveys show the number and distribution of "errors" made by users of systems which expect specific commands, but they do not show the extent and effect of spelling mistakes and miskeyings in search terms. It is to be expected that, particularly with keyword systems, misspellings will be a common cause of search failure. A further very important factor, which has scarcely been mentioned in the literature, is that most people type very slowly and make many corrections. It would seem likely that for most users who arrive with reasonably accurately specified known item requirements, microform catalogues would be quicker than OPACs (although an OPAC may be quicker than a large card catalogue).

Whether OPAC searches tend to be slower than searches on conventional catalogues, or whether it is because people find them more fun or more effective and so search more, it seems that the number of VDUs required is greater than the number of microform readers needed to service the same population.

The only alternative to keyboard input in OPACs has been the use of touch-sensitive screens. It seems that they might have a place when made available as an alternative to a keyboard. They are evidently not suitable for the input of keywords to a post-coordinate system.

2.6.3 OPAC output

Since output is usually to a conventional VDU with 24 lines of 80 character spaces, it is not possible to provide a browsing display of anything other than brief one or two line records. Most OPACs provide at least two levels of display for the public: brief and less brief. Either type of record may include circulation information. Many OPACs also provide a "full" record, but these are mainly for use by staff. A series of experiments by the Centre for Catalogue Research showed convincingly that almost all catalogue searches can be satisfied by records which are very concise compared to the entries in traditional card or microform catalogues [31].

The typographical quality of VDU displays is extremely poor in comparison with printed text. It is difficult to produce output which can be read fast, comfortably and accurately.

OPAC surveys have shown that many users would like printed output on request, and this is provided by a few systems, which have printers attached to some of the terminals.

2.7 OPAC design

2.7.1 OPAC components

To a large extent there is only a loose connection between the search *functions* of an OPAC and the *modes* by which these functions are accessed: one can build two IR systems which look very different on the same functional substructure. This is well exemplified by the "elementary" and "advanced" versions of MELVYL or the Dartmouth College system; other examples are the many experiments on giving untrained

users access to dial-up online reference retrieval systems. In addition, there is of course the question of the content, structure, storage and maintenance of the bibliographic and other files accessed by the OPAC.

Thus, an OPAC can be regarded as having three components: its data structures, its functional aspects, and the modes of user interaction.

In planning the design of an OPAC each of the components influences both the others. As in any other elaborate design process, constraints, either chosen, or else imposed by financial, hardware or other considerations, can simplify matters by removing many of the degrees of freedom. There is some truth in the statement that first generation OPACs were mainly constrained by file structures and second generation by functional considerations. To make a third generation OPAC it will be necessary to start with the user interaction component.

2.7.2 The design of Okapi

The initial constraints on the design of Okapi were those imposed by hardware and the necessity of using as source file the tapes used to produce the Polytechnic's COM catalogue. However, having read Hildreth [3], and having some experience of the use of interactive computer systems by untrained users, the team was aware of the prime importance of the interaction component.

The comparative slowness of disc access in the project's first LAN (the Nestar Cluster/One — Section 3.4) meant that the functional component had to be designed so that searches entailed an absolute minimum of disc access, and it was by no means obvious that any but the simplest Boolean combinations (ANDs on small sets) would be feasible. An index structure and search procedure which would only need a single disc access for most searches was evolved. The alternative to keyword post-coordination is to provide a degree of pre-coordination by means of an index, at least of phrases from title-like fields, containing entries which are informative and readable enough to be usable as search *results*. (The display of index entries is discussed in Section 5.3.)

The acquisition of the faster PLAN 4000 network allowed the disc access constraint to be relaxed. This historical accident may have been partly responsible for the fact that Okapi emerged as a system combining pre- and post- coordination, and that so much attention was paid to indexing. The more advanced hardware also allowed the incorporation of the

computationally quite demanding combinatorial search, and made feasible the automatic search sequencing ("search trees"). Both of these features are described in Chapter 6.

There is an account of the Okapi indexing in Chapter 5, and the functional aspects of design are discussed in Chapter 6. On user interaction Chapter 7 deals in some detail with the topics mentioned in Section 2.6 and gives a fairly full account of the rationale behind the design of the user interface.

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