The Library Abstract eSCAPE Demonstrator
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ISBN 1-86220-079-3
Lancaster University, 1999
This report is available from http://escape.lancs.ac.uk/.
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This deliverable describes the second year work of the eSCAPE project concerned with the development of a thematic abstract electronic landscape demonstrator. The development of the thematic landscape presented in this deliverable has been undertaken as a means of consolidating and integrating the initial explorations of the work of the first year of the project. Two main objectives drove the work of the thematic demonstrator reported:

- The bringing together of the work on social scientific studies, the different artistic explorations and the development of new environments.
- The involvement of real world users in the development of the electronic landscape in order to meet the demands of a particular community.

The thematic space development reported in this deliverable represents a shift from the earlier conceptual and technical explorations of the project. In the first year of the project the research work focused on the development and demonstration of new interface techniques and approaches. The driving force was in the adventurous development of new and potentially radical interface approaches. This thrust has continued in the second year of the project but has been complemented with a turn toward real world user communities and the development of systems to meet the needs of real applications.

The project has been able to resolve the tension inherent between the development of new adventurous interfaces and the construction of real world applications by maintaining a separation between the construction of thematic space and the development of new artistic installations. Essentially, the process has been to develop radical interfaces in artistic setting (see deliverable D5.1) undertake ethnographic studies of these (deliverable D4.0) and to migrate the pertinent portions of this work to the evolving thematic demonstrator.

The core of the thematic demonstrator reported here is a abstract electronic landscape where the structure of the space and the layout of bodies in the space is dependent on the content of the data. This work build directly on the work of the first year in the development of the web planetarium and the construction of a range of extensions to populated information terrains. This notion of populated information terrains as a means of structuring an electronic landscape is further developed within this deliverable by extending the concepts and functions of the Q-PIT work of the first year of the project. The extensions of the Q-PIT facilities...
is augmented by the inclusion of features and lessons from the artistic explorations of new forms of interactive environment.

This development of the thematic landscape presented here is driven from a series of studies of real world information users. In particular we focus on a series of studies of users of a library on line public access catalogue (OPAC) and an understanding of how they use the OPAC to meet their needs. This focus allows us to complement the artistic and technical research drivers with a consideration of the need of a real world community of users. Essentially, the application domain provides us with a means of grounding our exploration in a real world application and offers the opportunity to assess the utility of the developed techniques in practice.

The structure of the deliverable

The deliverable presented offers a broad account of how the project has exposed the explorations of interface techniques to real world users and undertaken the development of a new electronic landscape in the context of an emerging understanding of the needs of a community of users.

Chapter One presents a brief overview of an ethnographic study of users collaborative search the libraries on-line catalogue in order to find material within the library collection. The study stresses the need to consider the actions and activities of others in the development of search strategies and the understanding of the information space that is being searched.

Chapter Two considers a potential design for an abstract electronic landscape to meet the needs of the users of the catalogue developed during a series of design workshops. This outline design emerged from discussion between the ethnographer undertaken the studies, the developers of the electronic landscapes and the artists involved in the construction of the more radical interfaces.

Chapter Three considers the more radical and artistic explorations who have provided inspiration and how the lessons from the development of these interfaces have been migrated to the thematic electronic landscape. This migration has taken the form of lessons of use from studies of the electronic landscapes, the migration of key concepts and the migration of a display from an artistic piece to work in the context of the thematic electronic landscape.

Chapter Four considers the various extensions to the original Q-PIT landscape reported last year and considers how the structuring of the landscape is driven from the semantic content of the electronic landscape. The extensions of the electronic landscape to meet the needs of clustering are presented and the grouping and formation of data clouds described.

Chapter Five presents a description of the developed electronic landscape and the coupling between the content dominated landscape and the associated activity based landscape. In the content dominated landscape the information in the catalogue is used to structure the space and objects corresponding to the
information entities in the space are position within it. In the activity dominated
landscape an aggregated display is used to show the effects of prolonged activity
and to highlight the inter-relationships between entities to emerge from the use of
the catalogue.

Chapter Six considers how users may make use of the electronic landscape in
order to search the library catalogue. The different interfaces offered by the
electronic landscape is presented and the way in which a user may use the
landscape to manage their searching activities considered.

Chapter Seven presents the initial results from an on-going situated evaluation
of the developing electronic landscape. The assessment has taken the form of a
series of studies of real world library users. Initial results indicate that the
potential of the electronic landscape is favourably received and users like using
the developed system. However, a number of shortcomings persist and this
chapter considers the nature of these shortcomings.

Chapter Eight considers the future of the thematic demonstrator and the work to
be done in the further development of this electronic demonstrator. This work
takes both a reactive and a proactive approach. The reactive approach is to further
refine the developed electronic landscape in response to the study results reported
to date. The proactive approach is to capitalise with the familiarity of the user
community to allow the direct exploration of more adventurous interface
techniques and interaction devices.
Chapter One:
Understanding Searching as a Socially Organised Achievement in the Library

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This chapter draws upon an ethnomethodologically informed ethnographic study of university library users. The study investigated the everyday use of the on-line public access catalogue (OPAC) for information searching and retrieval to understand how library searches 'get done'. Our interest is in explicating the social organisation of searching as made observable by 'users' in the 'lived' or embodied production of library searches and the accomplishment of information retrieval in this real world setting. The overall aim of the study is to identify, and thereby make available for reflection in design, the social practices whereby users identify, locate and retrieve materials that satisfy their information requirements.

Introduction

This chapter is concerned with understanding the practices of an existing real world community that accesses information – university library users. The aim is to understand how a real world community use a corpus of information accessible through on-line information facilities. We then use this understanding to provide some sensitivities to design in order to guide the development of a demonstrator of the abstract information landscape. In the case of the demonstrator, design is directed towards the development of virtual spaces having little or no tangible resemblance to physical spaces. We are therefore concerned with how users understand landscapes where the content of the information is used to drive the structure of the information rather than exploiting more familiar metaphors and facsimiles such as the cityscape explored in deliverable D4.2.

One of the central concerns in the development of the abstract electronic landscape is how users organise and make sense of on-line information and the social organisation of activities in understanding this information. In the case of the library this focuses on the means by which users search for, locate and then use the information in the library. Previously the majority of work in the construction of electronic landscapes has focused on the exploration of concepts. We wish to consider how to develop purposeful landscapes that put the concepts developed in the first year of the project to work. In order to do so we seek to develop application oriented abstract electronic landscapes meet the needs of real
world communities of users. The design issue involved in this endeavour centre around the question as to ‘just what’ might constitute an abstract space? It was in order to formulate a rather more concrete sense of the constitution of this abstract space that search behaviour in a real world library became a topic of inquiry in the eSCAPE project.

Search Activities

Lancaster University library is a central facility that meets the demands of a large community of citizens with a particular focus on the needs of academic students. The users of the library access and exploit a large collection of material that ranges from the traditional books and journals to audio and video material and computer programs. In addition to acting as a repository for this information one of the central roles of the library is to support users in searching for information within the library.

Search activities in the library were considered to be of particular relevance to the design of the demonstrator due to the abstract character of the information ‘within’ this particular kind of space. Information in the context of library search activities is largely embodied in books, journals, documents, files, on CD-ROMs, microfiche, and other visual, audio, and text-based media. Studies of how such media are organised as a collection so as to afford the finding and retrieving of particular information provides valuable insights into the constitution of an abstract electronic landscape. In other words, studies of ‘just how’ library users produce and accomplish search activities in dealing with a collection of various media contributes towards informing the design of abstract electronic landscapes.

Search activities in the library are a widely researched area. Under the auspices of Library Information Science (LIS), search activities have largely been studied under, or in response to, the notion of ‘question-negotiation’ (Taylor, 1968). At the heart of matters lies a concern with the articulation of information requirements within the constraints of the library catalogue’s organisation. The ‘problem’, to put it another way, is that in order to accomplish a search (whether successfully or not) library users must articulate their requirements in a manner which ‘fits’ the library catalogue. User and system each have a different relationship to the catalogue design plan. The plan directly determines the system’s behaviour: the user, however, is required to first find the plan as the product of a set of procedural instructions. Negotiating and reflexively navigating the catalogue – the structured entity which ‘houses’ and provides access to information – is the central concern in disciplinary studies of search activities in libraries.

Following the widespread replacement of card-based indexes for electronic Online Public Access Catalogues (OPACs), search activities, construed as question articulation and catalogue navigation activities, have been visualised in a number of ways. So, for example, searching has been characterised as consisting of conversions of ‘anomalous states of knowledge’ (Belkin, 1980); ‘matching’
operations (Lancaster, 1984); ‘berrypicking’ techniques (Bates, 1989); distinct ‘sense-making’ processes (Kuhlthau, 1993); and ‘orienteering’ skills (O’Day & Jeffries, 1993).

Just as search activities have been characterised, and explained, in a variety ways within the LIS field, so too have they been studied in a similarly varied fashion. On-site interviews (Tagliacozzo & Kochen, 1970), observations of traffic patterns (Lipetz, 1972), protocol analysis (Markey, 1984), information flow analysis (Mayes, 1988), and a growing trend of late, ethnographically-informed studies of user behaviour (Mellon, 1990; Bradley, 1993; Sandstrom & Sandstrom, 1995), are methods commonly employed towards understanding search activities.

Our study adopted an ethnomethodologically informed ethnographic approach (Twidale et al. 1997) towards the study of search activities. However, rather than pursue the prevalent explanations of searching current in LIS, these concerns were set aside in favour of an ‘unconstructive’ programme of inquiry (Crabtree et al., 1997; Crabtree et al., to appear). LIS explanations of the organisation of search activities were set aside in that they were seen to be a product of the analysts’ methods. Our interests lie not in the analysts’ methods but in members’ or library users’ methods (or practices) for accomplishing search activities – the two are not the same (Garfinkel & Sacks, 1970; Lynch, 1993).

Pursuing this ‘unconstructive’ programme of inquiry, the following studies of search activities in the library focus on the observable work in and through which library users conduct search activities. Particular attention is paid to OPAC-in-use and the embodied practices in and through which library users ‘go about’ locating and retrieving (potential) information of relevance. Although largely ‘unnoticed’ in LIS studies to date - largely due to a concern to explain what members do, in contrast to explicating what members do - there is nothing mystical about the organisation of search activities documented here. The embodied practices in and through which OPAC is organised and comes to be used, and those through which particular items come to be located and retrieved, occur everyday in the library. They require no specialist expertise for their observation, and are available to any competent member of society who has a passing familiarity with library inquiries (Sacks, 1984).

Catalogue Navigation

The production of searches and accomplishment of information retrieval may be usefully categorised as electronic and physical catalogue navigation (navigation for brevity’s sake). Ethnographic findings suggest that members engage in navigation in one of two basic ways:

- In the first instance, members know exactly what they want and the practical navigational task is thus:
• establishing the presence within the catalogue of known-and-sought-after items
• establishing the availability of those items
• establishing the materials whereabouts
• retrieving required items or materials.\(^1\)

• In the second instance, members do not know exactly what they want or need but rather, have a general idea of their requirements - an idea which in-itself may and often is quite specifiable - and the practical navigational task is thus:
  • establishing the existence of some unknown-but-possibly-suitable items that might satisfy the specifiable information requirement
  • establishing the materials whereabouts
  • retrieving required items or materials.

In either case the *prima facie* point and purpose of systems navigation is to identify, locate and retrieve search items that *satisfy* information requirements. The research and design question to be addressed then is: what work does systems navigation - construed as identifying, locating and retrieving search items - consist of so as to provide for the satisfaction of information requirements? That is, ‘just how’, in the course of the embodied or ‘lived’ work of identifying, locating and retrieving search items, do members satisfy information requirements? Understanding how members achieve this provides us with a first step in ensuring the electronic landscapes we seek to develop meet the needs of its potential users. If we are to answer this practical research question, we need to know:

• How members ‘go about’ establishing the *presence* of known-and-sought-after search items?
• How members ‘go about’ establishing the *existence* of unknown-but-possibly-suitable items?
• How members ‘go about’ establishing the *whereabouts* of known and unknown search items?
• How members ‘go about’ establishing whether or not located items - known or unknown - will *satisfy* their *information requirements* and thus or thereby retrieve items of personal relevance?

If we are to develop an adequate appreciation of searching’s real-world, real-time organisation in order to develop an electronic landscape to support it, we

\(^1\) Knowing exactly what is required is not, as we shall see, without its problems for inasmuch as members know what they want, they have to actively satisfy that known-want; the question is: how do they do that; what does actively satisfying a known-want consist of as a practised activity?
need to know how all of the above is done in detail. That is, we need to uncover the real-time, real-world details of the production and accomplishment of the everyday activities of identifying, locating and retrieving materials in the library.

**OPAC Functions**

One of the central elements used in undertaking searches in the library is the Online Public Access Catalogue (OPAC) system. Members often (but by no means exclusively) undertake searches for known and unknown items in and through the use of the OPAC. Members also ‘go about’ establishing the presence of known-and-sought-after items on the basis of their organisational knowledge or their ‘familiarity’ with the catalogue. In such cases members go directly to specific sections of the physical catalogue. Alternatively, they may use CD-ROMS, microfiche, or other resources (see Twidale et al., 1997 for details).

Members often (but by no means exclusively) use the OPAC system to locate and access information. The library’s on-line catalogue offers its users some nine search options (see Figure 1):

<table>
<thead>
<tr>
<th>SEARCH OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Title</td>
</tr>
<tr>
<td>2 Author</td>
</tr>
<tr>
<td>3 Author-Title</td>
</tr>
<tr>
<td>4 Keyword</td>
</tr>
<tr>
<td>5 Subject Index</td>
</tr>
<tr>
<td>6 Serials / Journals</td>
</tr>
<tr>
<td>7 Classmark (Shelving Sequence)</td>
</tr>
<tr>
<td>8 ISBN</td>
</tr>
<tr>
<td>9 Short Loan</td>
</tr>
</tbody>
</table>

**Figure 1.** The search options offered by OPAC

OPAC terminals consist of a VDU and keyboard. These are set up in public places within the library alongside other resources and catalogues used to locate and access information in the library.

The search options display is a users starting point in navigating the physical catalogue (it may be noted that the above is not a full representation of the OPAC search menu display; other information options are also displayed - help and library information for example - the above represents all available search options however). Members select a search option by pressing the digit on the keyboard that corresponds to the digit displayed next to the required option (3 for Author-Title search for example). Pressing corresponding search option digits produces new visual displays:
These specific option displays prompt, and thereby instruct, members to input brief details (author-title details in this case). The display furnishes members with simple ‘format examples’ and ‘hints’ that instruct members as to how to use the displayed option. The display also provides information concerning the catalogue’s organisation and thereby furnishes users with further relevant navigational information. Users input ‘author-title’, ‘keyword’, ‘serial / journal’, ‘ISBN’, etc., via the keyboard, which then produces a new visual display:
Figure 3. The list of returns from author search displayed as a retrieval list in the OPAC systems

Items are displayed on these ‘retrieval lists’ in alphabetical order - by author’s surname then forename initial(s) - and the list places members at the ‘beginning’ of the relevant section: the ‘beginning’ not being, for example, the Smith section but rather, the Smith, J section. Item ‘titles’ are displayed correspondingly. Each item is numbered from 1-14 and 1-14 only. Members move ‘down’ (or ‘up’) the list by pressing the ‘B’ (or ‘F’) key on the keyboard as provided for by the instructions displayed at the bottom of the list. Moving either up or down the list produces a new, continuously ordered retrieval list in which items are again numbered from 1-14. Members select an item by pressing the ‘S’ key and then the digits corresponding to the item’s displayed number. ‘Selecting’ an item produces a further display:
**Figure 4.** The details of a specific item selected from retrieval list in the OPAC systems

This display represents the ‘baseline’ in OPAC searches: notably it provides members with the item’s classmark - which in terms of the catalogue’s physical organisation provides for the item’s ‘placing’. For members (both staff and users alike) an item’s classmark serves as a navigational ‘sign-post’, being employed as a locational device. Furthermore, an item’s classmark provides bibliographic details, ‘telling’ members how many copies are present and available.\(^1\)

It may also be noted that different search options produce different displays. ‘Subject index’ and ‘classmark’ retrieval lists are ordered by classmark; ‘ISBN’ requires that a precise item number be input and goes directly to the specified item; ‘keyword’ retrieval lists are randomly ordered; ‘title’, ‘author’, ‘author-title’ and ‘serials / titles’ retrieval lists are alphabetically ordered; all ‘listed’ items are numbered from 1-14 and all ‘baseline’ displays are the same regardless of search option-in-use.

\(^1\) Although not shown here ‘baseline’ displays also provide members with further cataloguing details such as the number of ‘holdings’ for serials / journals (years and volume numbers) and also points, or refers, members to library personnel (by ‘ask enquiries’ next to classmark) in obtaining access to restricted or alternatively ‘managed’ materials.
OPAC Embodied: Establishing the Presence of Known-and-Sought-After Items

Having outlined the basics of OPAC operation, the purpose of this chapter is to explicate OPAC’s real-time, real-world employment. A number of studies are reported below, beginning in this section with an account detailing ‘just how’ members ‘go about’ actively establishing the presence and availability of known-and-sought-after items. This is followed by an account of OPAC use in the search for unknown-but-possibly-suitable items. Next we study ‘just how’ library users establish the location of sought after items ‘within’ the physical catalogue, and ‘just how’ members determine the suitability of located items. These latter two studies serve to elucidate the socially organised relationship between electronic artefact and the physical space such artefacts are ‘surrounded’ by – a relationship which is by no means inconsequential to the accomplishment of searching.

In this first example then, we furnish an account of the lived work involved in actively establishing the presence and availability of known-and-sought-after items. The talk below takes place between a library user looking for known items and the ethnographer:

**Fieldnote extract #1.**

1) Ian: three friggin quid it cost me that
2) Sam: what’s this
3) Ian: its an audit commission report
4) Sam: oh right .. that’s what you’re using for y’
5) Ian: yeah . its got references in it
6) Ian: so that’s not in anyway
Ian reviews the audit’s bibliography - providing known-and-sought-after items - initiates an ‘author-title’ search - Farrington, D / Understanding and Preven - OPAC displays a retrieval list, Ian browses the list, the item is not displayed; Ian scrolls back up the alphabetically ordered list, the new display doesn’t contain the item either.
7) Ian: it only came out last year
8) Sam: right
9) Ian: I wonder if Smithy might have it ... one way of cutting down on er . photocopying bills if you can borrow it off your supervisor isn’t it
Ian reviews the audit, returns to the OPAC menu and initiates a ‘serial / journal’ search - Psychological Bulletin - the item is No. 2 on the retrieval list, Ian selects the item and retrieves the item’s specific bibliographic details which he reviews and then writes down the item’s classmark correspondingly in the audit’s bibliography
10) Ian: right
Reviews audit, initiates ‘author’ search - OECD - OPAC displays two OECD items listed No. 2 and No. 3

11) Ian: suppose it’ll be there
12) Sam: (inaudible)

Ian selects item No. 2 - OPAC displays ‘352 main entries’ in alphabetical order, Ian scrolls forward through the list; the item is not displayed where it ‘should’ be (i.e. its alphabetical place). Ian checks the audit reference which furnishes further particulars regarding the OECD item (full title, publisher etc.) and checks one display past where the item should be listed, he then writes N/A next to the audit reference and selects another item

13) Ian: author

Ian initiates an ‘author’ search - Utting, D - the item is No. 3 on the retrieval list

14) Ian: that’s the one
15) Sam: yup

Ian selects and reviews the item’s specific catalogue details
16) Ian: one copy . long loan
17) Ian: I’ll have to order that
18) Sam: you’re going to order it yeah .

19) Ian: yeah . there’s only one copy so I better had

Ian writes the item’s ISBN number next to the audit reference, reviews the audit and initiates a ‘serial / journal’ search - Criminal Behaviour and Mental Heal - the item is not displayed; Ian scrolls back, forward and forward again, writes N/A next to the audit reference, reviews the audit and initiates a ‘title’ search - Oxford Book of Criminology

20) Ian: this one will be in surely
21) Sam: you’d have thought so wouldn’t y’. something like that

OPAC does not display the item; Ian scrolls back, forwards, forwards, writes N/A next to the reference audit and initiates an ‘author-title’ search - Brodie, I / Exclusion From School - OPAC displays 6 items, the required item is not displayed

22) Sam: not a lot of luck
23) Ian: no . I didn’t think there would be a lot to be honest

Ian selects another item from the audit bibliography and initiates an ‘author-title’ search - Gillborn, D / Racism and Exclusions

24) Ian: nope

Ian scrolls back then forwards, writes N/A next to the audit reference and initiates another ‘author-title’ search - Rutter, M / Fifteen Thousand Hours

25) Ian: now if this bugger’s not in here I’ll eat my hat even though I haven’t got one
Ian sighs
26) Sam: you’re joking . it might be further up

Ian scrolls back one display

27) Ian: I don’t believe that ain’t in . its got to be in
28) Sam: that’s what . standard . classic text or something

29) Ian: yeah

Ian writes N/A next to the audit reference and initiates a ‘serial / journal’ search - Journal of the American Academy of and selects No. 6 on the retrieval list

30) Sam: that it

31) Ian: no that’s not the one

32) Sam: that the one . no

33) Ian: no

34) Sam: what’s it called Ian

35) Ian: its the journal of the american academy of child and adolescent psychology

Ian writes N/A next to audit reference and initiates an ‘author’ search - Health Advisory Service - the item is not displayed, Ian scrolls forward and forward again then initiates a ‘title’ search - Together We Stand

36) Sam: is that the same

37) Ian: yeah (title of the Health Advisory Service item)

OPAC doesn’t display the item, Ian scrolls forwards, forwards and forwards again, writes N/A next audit reference and initiates an ‘author-title’ search - Learmonth, J / More Willingly to School - item not displayed, Ian scrolls back then forwards, writes N/A next to audit reference and initiates an ‘author-title’ search - Lewis / Truancy, the Partnership App - the item is not displayed

38) Ian: have a look at that

39) Sam: what’s that

40) Ian: another one of his

Ian is referring to an item displayed on the retrieval list, he selects the item Student Teacher Interaction - and reviews its specific catalogue details

41) Ian: no

42) Ian: did I try that . y’ know when I did that rutter one . did I try that on the . er . ti . on the title

43) Sam: tell you in a minute (checks his notes)

44) Ian: cause I can’t believe that’s not in

45) Sam: fifteen thousand hours . author-title you did

46) Ian: right . try that on title then

Ian initiates a ‘title’ search - Fifteen Thousand Hours: Secondary - the item is displayed No. 1 on the retrieval list

47) Sam: got it

Ian selects the item and reviews its specific catalogue details

48) Ian: twelve copies . fucking hell

Ian writes the item’s classmark next to the audit reference

49) Ian: right
50) Sam: that it
51) Ian: try and go and find the other two bits eh
52) Sam: yeah
53) Ian: didn’t get a lot out of that did we
54) Sam: noo huh
55) Ian: I don’t understand that . how it can be under title but not under . author-title
56) Sam: author-title
57) Ian: it just seems
58) Sam: yeah
Ian and Sam go to locate and retrieve the items

In the above sequence of talk an audit bibliography furnishes known-and-sought-after items. Members frequently employ such bibliographic resources (including reading lists) in catalogue searches. Alternatively, known-and-sought-after items are things ‘that I heard about in a lecture or seminar’, ‘something I read in a book’, or ‘something someone told me about’. Regardless of the source, the above sequence of talk shows ‘just how’ members actively establish the presence and availability of items. Knowing-what-is-wanted, members orient in the first instance to the OPAC menu and constituent search options as elementary categorisation devices. This enables them to ‘fit’ (or attempt to fit) the known details of the sought-after item ‘into’ the catalogue. A bibliographic resource entry providing item title and author name ‘fits’ with search option No. 3 (‘author-title’) just as a bibliographic resource entry providing journal name ‘fits’ with search option No. 6 (‘serials / titles’).

While methodical in undertaking OPAC use, members are not necessarily ‘rigorous’ in accomplishing fitting - i.e. they do not always implement the ‘best fit’ but often elect instead to implement an ‘adequate fit’. Searching can be a ‘satisficing’ activity. They may, for example, select a ‘title’ search or an ‘author’ search rather than an ‘author-title’ search (which is not to say that a ‘best fit’ would necessarily produce the required results as the talk above makes perfectly clear). Typically however, members do implement best fits, employing the other search options in problematic circumstances (see utterances 42-49 for example). Regardless of fitting method members not only employ OPAC as a means of putting their information needs to the catalogue but in doing so, employ OPAC search options as problem solving resources for actively establishing the presence and availability of known-and-sought-after-items. Members thereby observably employ OPAC search options as traversable structural pathways.

A search or ‘attained fit’ - i.e. a formulated information requirement that is accepted by the catalogue but that does not necessarily provide the sought-after solution to that need (see utterances 10-12 or 19-22 for example) - yields, in most cases (except for ‘keyword’ formulations) an organised retrieval list. Users actively employ a retrieval list’s organisation, whether it be an alphabetical or
classmark structure, as a means of establishing the presence of known-and-sought-after items. The organisation of the retrieval list effectively ‘tells’ members where the item ‘should’ be within-the-catalogue. An attained fit that fails to establish the presence of an item furnishes grounds for re-formulating the fit. A ‘successful fit’ - i.e. a formulated need that provides the sought-after solution to that need – also yields an organised retrieval list which is employed to establish the presence of the known-and-sought-after item. The retrieval list displays the item’s presence in and as its organisation. Having established the presence-within-the-catalogue of known-and-sought-after items through orientating to and employing OPAC’s ‘terrain’ facilities (its search categories, lists, and displays, etc.), members similarly ‘call-forth’ a ‘baseline’ display that furnishes details of the items location and availability.

In summary, users actively establish the presence and availability of known-and-sought-after items through

- Fitting source information into the catalogue through accomplishing elementary categorisation work made possible, and at the same time constrained, by search option categories providing for the formulation of the fit.
- Through employing a retrieval list’s alphabetical organisation to establish the presence of known-and-sought-after items
- Through re-formulating the ‘fit’ in problematic circumstances where the presence of known-and-sought-after items is not displayed, but should be, in and through traversing the structural pathways provided by OPAC search categories.
- Through interrogating an item’s baseline display to establish its location and availability.

Collaboration in establishing the presence of known-and-sought-after items consist of members concertedly ‘working up’ the re-formulation of the fit. It might otherwise be said that when people are seen ‘huddled around’ OPAC terminals in libraries ‘discussing things’ in the course of searching, then it is the work of re-formulating the ‘fit’ that is often being observed. The above description details how users produce and accomplish that activity on any occasion, although it may also be noted that formulating the fit may occasion collaborations between users and staff (see Crabtree et al., 1997 for details of that accomplishment).
OPAC Embodied: Establishing the Existence of Unknown-but-Possibly-Suitable Items

Members establish the existence of unknown-but-potentially-suitable items in much the same way as they establish the presence of known-and-sought-after items. The production and accomplishment of either type of work relies on the same terrain facilities and thus relies on the employment of the same structural means. There are, however, some subtle differences. Again, the talk below takes place between a library user and the ethnographer:

Fieldnote extract #2.
1) Andy: so what’s the mission then
2) Joe: the mission is er . just find out as much as I can about Dada
   . specifically like what the roots of Dada were
3) Andy: yeah .. as in Dadaism
4) Joe: yeah .... so I’m going in on number eight (subject index)

The ‘subject index’ search yields an alphabetically ordered retrieval list which Joe Browse and then selects the 'Dadaism' option (No. 2 on list). This yields another, randomly ordered, retrieval list of specific 'Dada' items. Joe Browse this list at some length evaluating the titles, selecting ‘baseline’ displays of specific items in and as his evaluation of those items
5) Joe: go back a bit see if there's anything behind

Joe scrolls back up the list checking for further ‘interesting’ titles as he does so
6) Andy: are you looking for something specific there
7) Joe: not really . no
8) Andy: no
9) Joe: that looks like a decent book .. I'll try those two . 3 & 4 ... VLED .... VLPD .... YUPD .... try that first . number seven

Joe selects ‘baseline’ displays for the specified items and writes down author and classmark details on a piece of scrap paper
10) Andy: yeah
11) Joe: just go back to the list for the others ... I'll have a look for them when I get up there

Joe Browse the list again; again selecting ‘baseline’ displays and again recording author and classmark details
12) Andy: so you’re just browsing around to .. see if there’s anything else there
13) Joe: yeah .. its going into expressionism man so I don’t want to go into that one
14) Joe: try that Ritzer as well

Joe selects ‘baseline’ display, writes down author / classmark details, exits OPAC and then sets off to locate the items
This sequence of talk exhibits the constituent differences between the practised activities of establishing the presence of known-and-sought-after items and establishing the existence of unknown-but-possibly-suitable items. In the first instance, what occasions the latter type of search is a members concern with a ‘general interest’, ‘broad area’ or ‘topic’ which, while ‘general’ (concerning Dada for example), may of-itself be quite ‘specific’ (concern the roots or origins of Dada for example). The problem in-the-doing of this kind of search is one of establishing whether or not items exist within the catalogue that may possibly satisfy members information requirements. That ‘possibility’ is produced and accomplished on any occasion not only through the employment of terrain facilities and associated organisational means (as discussed above) but also through members orientation to item ‘titles’ and other substantive bibliographic components. These bibliographic components are specifically the features of a ‘titles’ construction. In orientating to the features of a titles construction members attend to sub-titles in particular - which are only available on baseline displays - and to the topics and / or areas the item’s title / sub-title suggestively covers. Users orientation to other substantive bibliographic components consists in attending to the author(s) name and journal name. Users attend to a journal’s name or title not only in the same ways as they attend a book’s title but also in respect of a journal’s ‘relevant prestige’. (Students for example, may select journals on the basis of their intellectual popularity or authority - the same criteria are applied by knowledgeable users to author names). Knowing members – persons familiar with OPAC and the physical catalogue’s organisation - also orient to an item’s classmark in evaluating its bibliographic components. Classmarks ‘tell’ members who are familiar with the catalogue’s organisation the subject area an item covers: the philosophy of Dadaism, the psychology of Dadaism, the history of Dadaism etc.

To sum matters up, members actively establish the existence of unknown-but-possibly-suitable items through

- The employment of terrain facilities.
- Simultaneously, through attending to, and evaluating in relation to topical search interests, item titles and other substantive bibliographic components.

Collaboration in establishing the existence of unknown-but-possibly-suitable items consist of users concertedly formulating categorisable ‘expressions of topical interest’ or ‘suggestive’ items that are intelligible in terms of the catalogue’s organisation in problematic circumstances. It might again be said that when persons are seen ‘huddled round’ OPAC terminals ‘discussing things’ in the course of searching, then it is the work of formulating expressions of topical interest and identifying possibly suitable items that is often being observed. Finally, and in a fashion already commented on, establishing the existence of unknown-but-possibly-suitable items may occasion collaboration between users and staff, especially when formulated expressions of the topical need fail to
produce possibilities (see Crabtree et al., 1997 for details of that accomplishment in addition to the following section).

Establishing the Whereabouts or Location of Known and Unknown-Now-Known Search Items

Having completed their search and established the presence of known-and-sought-after items or the existence of unknown-but-possibly-suitable items, the users task is to locate them. The talk in the following fieldwork extract is initially between a library user who has just accomplished an OPAC search and the ethnographer, and later on in the proceedings, between the library user and a librarian:

Fieldnote extract #3.

63) Dave: time to go hunting eh.
Anne and Dave go to B-floor and commence the first search
64) Dave: what are we after
65) Anne: Robertson
66) Dave: what is it
67) Anne: K.
68) Dave: KDD
Anne and Dave locate the KDD section firstly by orienting to, and following, the generic catalogue signs displayed in the library’s walkways - e.g. [SOCIOLOGY K] [PSYCHOLOGY I]. After following the generic catalogue signs, Anne and Dave scan the specific contents lists on the end of the shelves - e.g. KD, KDD, KDN, KDP ...

Having located the KDD section, Anne and Dave begin to scan the books on the shelves

69) Dave: KDD
70) Dave: can’t see anything. can you
71) Anne: there’s some more round here
72) Dave: they should be in alphabetical order shouldn’t they
73) Anne: yeah but they’re not
74) Dave: yeah
75) Anne: there’s P R (inaudible). but he’s not here
76) Dave: so it’s not in then
77) Anne: no it’s not here
78) Dave: did it say it was in as well
79) Anne: well it said it was overdue
80) Dave: ah . that’s the overdue one
81) Anne: yeah . hmm ... Anne reviews her reading list ...

In searching the shelves in the KDD section Anne and Dave firstly browse the items located there by classmark1 - e.g. KDC, KD, KD. f3, KD. s5, KDD - and then by author’s last name - just as in browsing OPAC retrieval lists, Anne and Dave browse either side of where the item should be but notably, far more extensively, covering the entire contents of the KDD section

82) Anne: KBK
Anne and Dave locate the KBK section as above and browse the shelves accordingly

83) Dave: who’s this one .
84) Anne: its er . Wilhelm
85) Dave: Wilhem
86) Anne: this is supposed to be here (inaudible)
87) Dave: right ...

Anne and Dave browse the whole section

88) Dave: that’s half the problem isn’t it . people take them away and stick them somewhere else
Anne and Dave can’t find the item so they abandon the search
89) Dave: what’s next .
90) Anne: hmm ... Anne reviews reading list ... journal
91) Dave: journals
92) Anne: W6
W6 is on C-floor; Anne and Dave go upstairs locating the section as before - this time they are looking for the European Journal of Communication
93) Dave: W
94) Anne: W6
Anne quickly scans the shelf picking up a journal which she also begins to scan
95) Dave: got it .
96) Anne: no
Anne replaces the journal and the two then begin to browse the entire W6 section
97) Dave: you’d think it would be here somewhere
Anne picks up a small serials catalogue attached to the end of one of the shelves in the section, the catalogue lists journals and there location in the library; Anne scans the catalogue
98) Dave: got it .

1 The library operates on a standard UK cataloguing system - items are arranged in sections, for example, in the following way: KDD, KDD 1. KDD 2, KDD 3, and more complexly, KDD 1. a2, KDD 2. b3, KDD 3. c4, etc.; within these categories items are arranged by author’s last name in alphabetical order.
Anne shows Dave the catalogue, pointing to the item
Dave means that the item isn’t listed by the search name Anne has got written down
Anne browses the section again, locates the ‘journal of communication’ and scans it
Anne goes over to a nearby librarian who is reshelving books
Anne shows the librarian the reading list
The librarian begins to browse the section shelves with Anne
The librarian and Anne continue to browse the section shelves for a time period of approximately two minutes
The librarian returns to her work
The librarian asks Anne to check the computer again just to be sure its W6

The library abstract eSCAPE demonstrator
22 eSCAPE Deliverable 4.1
This sequence of talk makes observable in fine detail the real-time, real-world work of locating search items. Locating items consists in navigating the physical catalogue. Like the electronic catalogue (OPAC), the physical catalogue is an organised or orderly entity. Just as members orient to and employ the orderly features of the electronic catalogue so too it is in orienting to and employing the orderly features of the physical catalogue that members routinely navigate and reflexively locate search items. The primary organisational element employed by members in locating search items is a required item’s classmark, which is typically furnished by a prior OPAC search.\(^1\) Classmarks indicate to members ‘just which’ section of the physical catalogue an item is ‘placed’ within. The use of classmarks as navigational / locational devices trades on a whole host of socially organised artefacts. The work being done in utterances 68-69 shows that the use of classmarks as locational devices consists in the employment of generic catalogue signs (which are displayed above the walkways of the university library).

The use of generic catalogue signs presupposes that members have located or are otherwise ‘in’ the part of the physical catalogue within which the required classmark section is located. OPAC furnishes floor details (A-floor, B-floor, C-floor etc) on baseline displays. It does not, however, furnish details as to just where the classmark section is located. Establishing ‘just where’ a classmark section ‘is’ is typically accomplished through reading the floor-plans displayed at the entrance to each floor. Members familiar with classmark ‘layout’ obviously

\(^{1}\) Again there are exceptions, namely occasioned by members who are using ‘reference’ books who are familiar with the catalogue’s organisation and who can, therefore, go straight to the required section. Some reading lists also provide item classmarks.
go straight to the required section. Floor-plans are nevertheless employed as problem-solving resources by familiar and unfamiliar members alike when they encounter ‘novel’ locational situations. Having located the part of the physical catalogue within which the required classmark section is located, members then orient to the content lists displayed on the flanks of section shelves. These lists detail the classmarks and associated subject areas contained in this part of the section and are employed by members as navigational ‘sign-posts’ providing for the ‘narrowing down’ of the search - and thus the location of the required search item.

Having located the required part of the catalogue and the required section within that part of the catalogue members ‘scan’ the section shelves looking for the classmark in question. Members locate the required classmark in active relation to neighbouring classmarks - i.e. they employ the classmarks displayed ‘within’ a section, and specifically the classmarks’ alphabetical and numerical organisation, as navigational ‘sign-posts’ providing for the further ‘narrowing’ of the search. When the required classmark is located, members ‘scan’ the items there ‘placed’. Placed items are organised both by classmark and alphabetically by author’s last name. In scanning placed items members orient firstly to classmark in order to locate the ‘specific place’ (e.g. KDD 3. c4) and then to the organisation of items there-placed by author’s last name, employing that organisation to locate the required search item.

It is not an infrequent occurrence for search items – books, journals or whatever - to be ‘elsewhere’ - i.e. to be replaced randomly by other members, to be in-use by other members, to be ‘placed’ on re-shelving trolleys, or to be hidden. Members’ first course of action in solving this problem is, typically, to scan the contents of the whole classmark. If this is unsuccessful members may abandon the search or alternatively, find some other means of solving the locational problem. This may be accomplished through

1) employing organisational resources to hand (section catalogues for example) to check ‘navigational co-ordinates’ (i.e. verify that the right classmark is being sought-after);
2) returning to OPAC to check navigational co-ordinates;
3) collaborating with other users in formulating potential solutions to locational problems (such collaborations may be with a co-searcher or user and trade on details of prior OPAC searches and organisational knowledge);
4) collaborating with locally available staff in locating the search item or formulating potential solutions to locational problems;
5) formulating potential solutions to locational problems with service desk and / or other members of staff such as specialist librarians.

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1 Items are sometimes ordered alphabetically by title rather than author’s last name - when this is the case the item is marked with a red spot.
In summary, members actively establish the location of known and unknown-now-known search items in orienting to and employing

- floor-plans;
- generic catalogue signs;
- section content lists;
- catalogue sections classmark organisation;
- ‘placed’ items alphabetical organisation;
- doing ‘broad scans’ of classmark sections in problematic circumstances;
- using organisational artefacts to-hand to check navigational co-ordinates;
- using OPAC to check navigational co-ordinates;
- formulating potential solutions to locational problems with other users;
- formulating potential solutions to locational problems with members of staff;
- the use of previous search histories in formulating potential solutions.

These observations of embodied practices for accomplishing ‘finding the location’ of items ‘within’ the library serve to elucidate two important points of particular relevance to the eSCAPE project.

1) Although only briefly manifest in the sequence of talk above (utterances 103-111), the formulation of potential or candidate solutions to locational problems consists of utilising details of prior OPAC searches.1

2) The practical achievement of searching in the library (and thus, of the retrieval of relevant information) can clearly be seen to rely on the social organisation of the physical space and the objects ‘within’ it.

Searching cannot be divorced from the orderly features of the physical space and its objects. It is within the matrix of orderly arrangements of physical places and objects, and the practices in and through which those orderly arrangements are embodied in the course of their use, that searching observably ‘gets done’ time and time again as a matter of course. As observable features of embodied practice, orderly arrangements of physical places and objects there-in constitute a distinct ‘scheme of interpretation’ which members employ to make sense of the setting and thereby accomplish the activities to hand (see Deliverable 4, Chapter Three, for a more through-going discussion of issues here). The next section explicates some orderly features, and embodied practices of their use, of objects or items ‘within’ the physical space in the achievement of information retrieval.

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1 The use of prior search details is endemic to search and retrieval work in the library, being employed not only in the attempt to resolve locational problems but also, in the attempt to establish ‘just what’ will satisfy users information requirements whether they be known or unknown (Crabtree et al., 1997).
Accomplishing Information Retrieval - Establishing Whether or Not Located Items Will Satisfy Information Needs

Having established the presence of known-and-sought-after items or the existence of unknown-but-possibly-suitable items, and having located those items, the task for the user then becomes one of establishing whether or not those located materials will satisfy information requirements. Just as locating items is a socially organised accomplishment, so too is the practical determination of the satisfaction of information requirements. The following sequence of talk (between a library user and the ethnographer) details some of the orderly features of that achievement:

Fieldnote extract #4.
1) Jack: right . what are you looking for
2) Craig: er . I’m looking for stuff for my employment law seminar
3) Jack: yeah .
4) Craig: just like . read some cases and things and then I’m going to try and er . get on the er . law computer
5) Jack: yeah .
6) Craig: and try and get some articles in legal journals about the criminal justice and public order act
7) Jack: right
Craig and Jack go upstairs to B-floor, Craig leads the way to the law section, specifically, the legal reference books section
8) Jack: so . you know the stuff up here . you know what you’re after already or .
9) Craig: more or less yeah
10) Jack: yeah
11) Craig: (inaudible) (tape interference - library construction work)

Craig explains that the section contains standard reference books citing legal cases. The seminar reading list provides Craig with the title of the cases to be read, the title of the reference books those cases are to be found in, the classmark of the reference books, and the questions these items are to used to answer. Craig locates the required section by classmark and browses the sections contents by title; upon identifying the required reference books Craig browses the index of each one respectively in order to locate the specified cases. Craig then briefly and respectively browses each case. Having located and identified the required cases, Craig takes the reference books over to the nearest available reading desk, takes out pen and paper and begins to read the front page of the first case. In doing this Craig explains that this type of legal reference book has a specific kind of ‘layout’ starting with brief summaries or abstracts describing ‘the facts’ of the case and ‘the decision’ which are followed by a more detailed description of the case itself. Craig reads ‘the facts’ and ‘the decision’ of each case and parts of the more detailed case descriptions,
writing verbatim quotes and references down as he does so. Craig explains that the more detailed case description contains references to other “relevant” cases in which the legal precedents outlined in ‘the decision’ have been used.

12) Craig: these things here give like relevant cases . so I can go back and check these cases and see if there’s anything in them

Having retrieved the specific information he requires from the specified reference books in the form of verbatim quotes, Craig commences a new search for the “relevant” cases. Again, he does not perform an OPAC search but instead goes back to the reference section and searches by title, explaining as he does so that he doesn’t need to use OPAC because he uses these ‘a lot’ and is thus or thereby pretty ‘familiar’ with the section’s layout.

13) Jack: so things like this are like a general sort of reference than er .

14) Craig: sorry .

15) Jack: these things were looking for . there more like general reference .

16) Craig: yeah . yeah

17) Craig: you’ve got ... [Craig picks up a reference book, glances at the details he has written down and then browses the index] ... the er . actual substances case and its decision . and also you have er . where that’s actually been used

18) Jack: cases its actually been used in .

19) Craig: yeah

20) Jack: yeah .

21) Craig: ... [has selected and is now browsing a case in the reference book] ... so . there very helpful these

22) Craig: right

Craig closes the book, keeps it in hand and carry’s on searching for the other “relevant” cases; again he searches by title and on locating the required item browses the index and case. Craig then takes the reference books (No. 2) back to the reading desk. This time Craig only writes verbatim quotes down. He then returns the books to the shelves and commences a new search for a reference book cited on the seminar reading list. Again no OPAC search is performed - the reading list provides the search item’s classmark - and again Craig browse by title. This time the reference book cannot be located, however, in browsing the section shelves Craig retrieves and browses items with a similar title. Craig decides that the someone must be using the book and that he will look for it later after doing some research for his dissertation on the criminal justice and public order act.

Perhaps the most striking feature of the above talk is that searching or navigating doesn’t stop at locating required search items. Having located search items members routinely orient to and employ item ‘layouts’ such as indexes and content lists. A search item’s own organisation in the form of ‘layouts’ provides, and is used for, the identification of materials that (may possibly) satisfy the information requirement. In cases where the information requirement is not rigidly specified, item indexes and content lists furnish titles, author names and topic areas and thus provide members with resources for establishing whether or not the-material-in-hand-may-possibly-satisfy the information requirement. Members evaluate the possibility of satisfying materials, and accomplish
information retrieval, through orienting to and employing an item’s internal organisational arrangements. These features are standard features of books, journals, documents etc. (although as the sequence of talk above makes clear, some of those features are unique to particular practices such as legal practice). Other common organisational features notably include ‘abstracts’ - the reading of which warrants, on the basis of current search relevancies, further inspection of that material - and ‘section headings’ - which warrant the continued inspection of the material in-hand on the basis of what the headings suggest the material is ‘all about’. Having narrowed down the search to particular pieces of text through inspecting and evaluating section headings, members typically ‘scan’ the texts presented. In doing ‘scanning’ members attend to relevant keywords, phrases, names, references, and the rest.\footnote{Members rarely read the text thoroughly in the first instance: ‘scanning’ provides for thorough reading and in so doing provides for retrieval.}

In summary, members actively establish whether or not located items will satisfy information requirements through orienting to, and routinely employing, the orderly internal arrangements of particular items:

- Item indexes and contents lists are employed to identify (possibly) satisfying materials furnished by the item.
- Internal titles, sub-titles, author names and topic areas are employed to establish the prima facie possibility of the material in-hand satisfying the information requirement;
- Abstracts and section headings are employed to evaluate prima facie possibilities.
- The satisfactory character of material is firmly established in ‘scanning’ texts under ‘relevant’ section headings.

Thus, information retrieval is organised in real-time and thus, the information requirement is satisfied in practice in the real-world. Collaborations in establishing whether or not located items / materials will satisfy information needs consist of formulating ‘relevancies’ and ‘satisfactions’. This work often occurs between co-searchers, although in some particularly problematic circumstances it may occasion collaboration with members of staff. In doing individual or collaborative searches with other users or with members of staff (especially subject librarians), members employ located items as artefacts for ‘working up’ formulations of relevancy and satisfaction: ‘this is okay . but what I really wanted was something more to do with ....’, ‘that isn’t bad but . er . we need to find something that tells us more about ...’, ‘this is useless . it tells us nothing about ...’ and such like are frequently heard comments in the library.

\footnote{References provide for the ‘refinement’ of the search and thus or thereby, in their employment, for the satisfaction of the information requirement.}
They occur in the course of the work of trying to find satisfying materials, and are a product of doing that work (which may go on for days, even weeks, due to the immediacy of requirements satisfaction, or constraints of time, or other untold contingencies). Such utterances indicate problems which are often mundanely, but nevertheless artfully, resolved in and through using items that ‘aren’t bad’, ‘good but’, ‘useless’, etc., to specify criteria of relevancy and satisfaction and thereby, to ‘refine’ the search through developing increasingly more precise formulations of the information need.

Understanding Searching as a Socially Organised Achievement in the Library - The Occasioned Corpus

Ethnographic studies of the real-world performance of search activities in the library suggest that the satisfaction of information requirements is a socially organised achievement through and through. This section assembles the ‘corpus’ of embodied practices in and through which search activities in the library are observably organised in real-time on occasions of their performance (Zimmerman & Pollner, 1973).

In approaching the library for purposes of information retrieval, members have two fundamental types or kinds of information need or requirement that they wish to satisfy. On the one hand some members know exactly the materials that will satisfy their information requirements. On the other hand, other members don’t know exactly what materials will satisfy their information requirements. With regards to the latter, this is not to say that members do not know their information requirements, but that they don’t know ‘just what’ materials will satisfy those requirements. These two types of searches are accomplished in distinctly, albeit subtly, different ways.

In the case of retrieving ‘known’ items or materials, the initial problem to be solved is one of establishing the presence within the catalogue of the required item. Members ‘go about’ accomplishing this kind of search in and through using the library’s on-line catalogue (OPAC). In using the on-line catalogue to this end members employ the OPAC menu’s ‘search options’ as elementary categorisation devices. The item they seek can be specified as a ‘title’, an ‘author’, a unique ‘number’ etc. These devices allow members to present their information requirements to the catalogue in terms that are intelligible within the catalogue’s organisation. The problem here is one of making, in the active sense of the word, the information requirement ‘fit’ into one of those organisational categories so as to produce a ‘successful result’. This means that the presence of the required item may be clearly established from the results furnished by the system on the basis of the formulated ‘fit’. While it is ‘simple’ to categorise information requirements in so much as one has a limited number of options to-hand with which to accomplish that work, categorising information requirements is nevertheless
frequently problematic and thereby becomes ‘complex’. It is complex precisely
because the on-line catalogue’s organisation or structure affords only limited
categorisations. The sought after item becomes quite literally a ‘title’, an ‘author’
name, a unique ‘number’ etc. - and the system operates rigidly within those
limits. The system is, furthermore and from the members perspective, all too
frequently incoherent - an item may be found by doing a ‘title’ search but not by
doing an ‘author-title’ search for example. In so much as members do resolve the
problems they encounter in using the system, then they do so through traversing
the options or (structural pathways) in re-formulating the fit. Having formulated
an acceptable fit yielding a successful result, members establish the presence of
‘known’ items by orienting to and employing the systems indexing structure. This
structure furnishes orderly lists of catalogued items that display
the required items
presence or absence within the catalogue. From this point members can select
details of the required item’s availability and retrieve details of organisational
artefacts providing for its location.

OPAC’s employment in seeking ‘known’ items contrasts with its employment
in seeking ‘unknown’ items. Members still employ the system’s structural
pathways in formulating acceptable fits. However, in so much as this kind of
search is relatively unfocused, though specifiable nonetheless (being directed
towards particular topics such as the origins of Dadaism, for example), then it
entails a greater attention to and utilisation of the system’s organisational features
(or terrain facilities). The task to be accomplished here is one of establishing the
existence within the catalogue of items that may possibly satisfy the information
requirement. Having formulated acceptable fits, members routinely accomplish
this task by selecting items whose titles ‘sound relevant’ to the satisfaction of the
information requirement. In selecting relevant items, members employ the
bibliographic details of items to further ‘evaluate’ the relevancy of the selected
item and thus, to further establish the ‘possibility’ of the item satisfying the
information requirement. Members use item sub-titles, author names and
classmarks in order to evaluate that possibility. The evaluative properties of those
bibliographic components consist, respectively, in suggested areas or topics
covered; intellectual popularity or authority provided; or the perspective from
which the suggested area or topic covered is presented. In selecting an item’s
bibliographic details members also establish details of availability and location.
Members frequently collaborate in formulating categorisable articulations or
expressions of topical interests, particularly in establishing the ‘possibility’ of a
selected item satisfying the information requirement. Collaborations may be user-
to-user or user-to-staff depending, notably, on degrees of intractability: naturally,

1 In many respects the system’s ‘simplicity’ is its strength, however, in problematic circumstances that
‘simplicity’ becomes its weakness in so much as its ‘structure’ severely constrains the formulation of the
‘fit’.

2 ‘Keyword’ – or ‘topic’ - lists in the university library are the exception here, being random in their
organisation.
the more intractable the problem becomes, the more like users are to seek assistance.

Having established the presence of ‘known’ search items and the existence of ‘unknown’ search items, and furthermore established the availability of those items and details of their whereabouts within the physical catalogue, the task to-hand is one of actually locating the required items. This task is accomplished in and through the employment of classmarks as navigational ‘sign-posts’. The use of classmarks as navigational sign-posts trades on other organisationally provided navigational resources. Specifically, members must be able to locate the part of the library within which the classmark section is located and they must be able to do so routinely, and un problematically. To this end members orient to and employ the item’s floor details, as provided by OPAC, and library floor-plans displaying section arrangements diagrammatically. Members familiar with the library ‘layout’ need not orient to floor-plans in order to locate the relevant parts of the library within which the sought after classmark section is located, however, they still routinely employ floor-plans as first-step-locational-devices in novel circumstances.

Having discovered the relevant part of the library within which the required section is located, members must then find the required section itself. This is achieved in and through orienting to generic catalogue signs displaying the subject area and first case class marker [for example, Sociology K]. Having located the specific section required, members employ the first three case markers constitutive of the sought after item’s classmark in conjunction with section content lists which display shelf contents [KD: Social Change / KDD Developmental Sociology / KDN Crisis and Violence etc] to ‘narrow down’ the navigational area. Having narrowed the navigational area down to a finite number of shelves within a classmark section and having located the shelves ‘holding’ the required classmark itself, members then employ the classmark in full to navigate the area within the classmark where the required item is located [KDD ⇒ KDD. c3]. Members then orient to and employ the alphabetical arrangement of items there ‘placed’ to locate the required item itself. All members, even those familiar with specific classmark sections and specific areas within those sections, have occasion to employ section content lists and the other organisational features of the physical catalogue’s layout in locating ‘placed’ items. It may be noted that members - both staff and users alike - frequently collaborate in showing or ‘teaching’ each other how to navigate the system and in formulating candidate solutions to locational problems. The formulation of candidate solutions to locational problems, or problems arising out of locational work, consists of the concerted elicitation and utilisation of prior search details.

Item-in-hand, so to speak, the next task to be accomplished is that of establishing whether or not the located material will satisfy the information requirement - and if it doesn’t, either supplementing that material or finding something else. Members accomplish this task by employing the item’s internal organisation. In orienting to an item’s index or content list in cases where the
item currently provides possibilities, members orient to and employ the titles, sub-titles, suggested topics covered and author names furnished in order to identify *prima facie* possibilities. Such possibilities are concretised through selecting items that ‘may well do’ and employing as evaluative devices the item’s ‘abstract’ and ‘section headings’. Abstracts, read in relation to the search relevancies (the topical interest), provide for the further inspection of the material in-hand. That further inspection consists in reading, again in relation to the search relevancies, the item’s section headings which furnish further ‘suggestive’ criteria warranting or not warranting continued inspection of the material in-hand. Members establish whether or not material in-hand will satisfy the information requirement through ‘scanning’ the texts presented under relevant section headings. In the course of establishing the satisfactory character of the material in-hand, members attend to relevant keywords, phrases, names, references, etc. References are often employed to supplement materials satisfying the information requirement, or otherwise, to formulate alternate solutions to the information requirement problems in locating other ‘possible’ materials. Collaboration in accomplishing information retrieval consists in formulating ‘relevancies’ and ‘satisfactions’ which are ‘worked up’ incrementally. This is accomplished in and through using located items as artefacts and/or resources for specifying criteria of ‘relevance’ and ‘satisfaction’ and thus for ‘refining’ the search through the concerted formulation of increasingly more precise articulations of the information need.

**Summary - ordinary, artful practices for achieving searching in the library**

The abiding concern in this chapter has been to make observable the embodied practices in and through which members or ‘users’ practically accomplish the search for, and the location and retrieval of materials that satisfy their information requirements. Our interest has been limited to the use of on-line public access catalogues. What follows is a summary of the practices of searching in the library. Searching in the library notably consists of the following activities:

- Formulating expressions of the information requirement that ‘fit’ into the on-line catalogue.
- Identifying potentially satisfying items as provided by OPAC.
- Locating identified items.
- Establishing the satisfying character of located materials.

These activities are socially organised and achieved respectively in and through:

- Categorising information requirements in terms of OPAC search options.
- Evaluating bibliographic components as furnished by OPAC.
- Employing bibliographic details provided by OPAC in conjunction with orderly arrangements of the physical catalogue.
• Using a located search item’s internal organisational components to establish whether or not said item satisfies the information requirement. These practices respectively consist of:
• Using OPAC search options as traversable structural pathways affording the formulation and re-formulation of the fit
• Using item titles/sub-titles/author names and classmarks as evaluative devices ‘suggesting’ potential satisfactoriness
• Using floor-plans/generic catalogue signs/section contents lists/classmarks and placed items alphabetical organisation as artefacts for locating search items
• Using located item indexes/content lists/abstracts/section headings/scan techniques as means of establishing the ‘satisfactoriness’ of items in-hand

Collaborations in accomplishing search practices notably consist of:
• Formulating categorisable articulations of search topics
• Identifying potentially satisfactory items
• Formulating candidate solutions to problems arising out of locational work
• Establishing the satisfactory character of potentially suitable items

Some considerations for design

Studies of the embodied practices of technology usage highlight two issues of particular relevance to the design of abstract electronic spaces. These two themes underpin the design outlined in the following chapter of an abstract electronic landscape suitable for use by citizens in the library setting.

The importance of history

The studies presented in this chapter make clear that OPAC is a reasonably effective (but by no means perfect) tool when users are engaged in search activities for known items. There is, then, little point in trying to develop further support for such activities – effective technology already exists for purposes of their accomplishment. However, whenever OPAC proves ineffective, then users either abandon their efforts or turn to librarians for help. A persistent feature of intermediated assistance in these cases is an appeal to the search history. In and through eliciting previous search details, librarians often establish ‘just what’ the user is looking for. Furthermore, the use of previous search histories is a common feature of intermediated searches for unknown items. In this instance they are employed to ‘work up’ a sense of what kind of things might satisfy the users information requirement. It would appear, then, that search histories are important resources in the achievement of search activities in the library.
Browsing based on topics

When users seek to retrieve unknown items, which is often the case, searches are characterised by a concern to identify and retrieve materials addressing particular *topics*. Of all the existing OPAC functions, topic-based (or ‘keyword’) searching receives the least support. Indeed, on executing OPAC searches, anything and everything that is vaguely related is ‘lumped together’, so to speak, in a randomly ordered list with little to show groupings or structures (and there are parallels here with searching on the world-wide-web). On the one hand, the ‘problem’ here is the classical one of articulation – of formulating the information requirement in a way that fits the catalogue. Articulation will always be a problem, however, as particular queries can be expressed in a huge variety of ways. On the other hand, the ‘problem’ here can be seen to be one concerning the *ordering* of the catalogue – the catalogue’s organisation constrains users, demanding of them that they articulate their information requirements in terms of the ordering of information collected ‘within’.

Topic work is fundamental in the library and a primary candidate for technological support. That work may be supported through novel orderings of information. Lessons from library practice - particular the embodied ordering of the physical catalogue – suggest that novel orderings of information should categorise any information generated in the course of topical searches into discrete topical groups and sub-groups thereby allowing members to pursue topical interests in a more orderly and effective fashion. Topical search activities may be further supported through the utilisation of search histories converging on the search topic, and even particular items identified as potentially useful in the course of interrogating and / or evaluating search results.

These two key elements provide the driving motivation for the development of a novel abstract electronic landscape. In developing this demonstrator we wish to support the integration of the history of previous searches and the development of facilities that allow topic based searching and navigation. In the following chapter we outline the development of an abstract electronic landscape that seeks to provide just this support.

References


Chapter Two
Learning from the Studies

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Introduction

In the previous chapter we considered how a community of users locate information within a library and the forms of cooperation and interaction that took place among users in this traditional information corpus. In this chapter we wish to reflect on the real world lessons from the study and consider how these may be used to help us exploit the concepts underpinning electronic landscapes within a real world context.

At the centre of our endeavour is the migration and use of electronic landscapes to support the everyday needs of citizens using an abstract on-line information repository. In the previous chapter we presented extensive ethnographic studies of how the general users of the library made use of an interface to allow public access to the library catalogue. The study allows us to now consider how we may exploit the results of these studies to inform the development of cooperative electronic landscapes made up from abstract information.

In this chapter we outline the development of a design of a supporting electronic landscape informed from these studies and undertaken in cooperation with the library and users. The focus for the design has been the development of an environment that integrates with the real world data within the libraries own catalogue. The development of the abstract landscape complements the social science studies undertaken in the previous chapter with a range of artistic and technological explorations of interface.

The core of the demonstrator developed in the library is the use and extension of the libraries OPAC system. Library Online Public access Catalogues (OPACs) allow users with a well-formed query to retrieve information concerning the availability and location of books within the library. In using OPAC however, users are forced to repeatedly reformulate and refashion their query into something that can be expressed appropriately in OPAC. That is, in terms of the library catalogue’s organisation. Where the query is initially very well defined (such as when users have a reading list or a bibliography detailing specific items) this process works reasonably well (Crabtree, 1998a; Lamont, 1995).

When the query is far less well defined, however, such as when a user wants to know about a broad, albeit particular, topic or area such as ‘Dadaism’ for example, but does not know how to more precisely specify that query and thereby locate useful items in the library, he or she must currently rely on some other
means of producing the search. Faced by such a situation, users typically resort to the ‘help desk’ (Taylor, 1968; Crabtree et al., 1997) whose staff have a broad working knowledge of the catalogue’s organisation and its various contents. If the search cannot be accomplished by help or service desk staff, then users are referred to specialist subject librarians, providing enough knowledge of the search area or topic has been established to warrant that course of action. Users may, of course, go straight to the subject librarian, although the same practical problems maintain.

It is this second problem which the demonstrator wishes to address – how a user can move from an abstract and uninformed search ‘topic’ to more precise and well-defined queries which fit into the OPAC’s method of information location. We hope to support the work of accomplishing querying the database by exploiting the emerging notions underpinning the development of electronic landscapes. In particular, we wish to focus on the techniques used to structure the electronic landscapes and the use of others peoples activities within these environments to allow the construction of search trails that display the history of previous interaction.

A central premise used in the demonstrator is the notion of a search trail as a means of representing and conveying the previous actions of users in the environment. This notion of search trail builds upon some of the speculative investigations within Nuzzle Afar reported in the next chapter. In Nuzzle Afar as users moved through the shared virtual space they left a trail of their places they previously visited allowing an awareness of the previous action of others. Search trails provide a similar service for the corpus of data making up the library catalogue.

In the case of the library we define a ‘search trail’ as the sequence of actions and searches performed by a user on the database (through OPAC) to iteratively refine some initial query in order to locate books which ‘satisfy’ that search. By presenting and amalgamating previous searches, new users can exploit the ‘memory’ of other successful searches in the same or similar areas. Thus, ‘search trails’ furnish search categories whereby users can formulate and reformulate their queries. By providing visual cues for the previous search trails, an electronic landscape will not only provide category information, but can evolve the very terrain or arrangement of information within it. This arrangement is not specified using existing categories of the library such as ‘title’, ‘author’, ‘serial’ etc.,¹ but is based upon the ‘topics’ of previous searches.

In essence, we would like to provide a system that tries to present a representation of the library catalogue that is not based upon any existing categorisation. Rather we wish to allow the emergence of new classification structures that match the needs of users and allow these to be presented to users. Although existing categories in the physical library, represented by ‘classmarks’ in OPAC, must be used for accomplishing searching in the library and may, in

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¹ Although it may utilise ‘classmarks’ transformed into publicly intelligible ‘topic’ categories.
light of users reliance on their existence in the physical space and in being converted to publicly intelligible categories as in the physical space, be used as an initial method for ‘laying out’ the information terrain where large numbers of ‘hits’ are returned on queries.\(^1\) Rather than emulating OPAC then, the demonstrator builds upon the notion of electronic landscapes to provide a space, or collection of 3D spaces, which contain information (books etc.) whose placement and connection is based upon how the objects have been identified and retrieved by previous users. The structure of the space and the arrangement of the sub-spaces and information within it will evolve and change as users interact with it, or the web-based OPAC interface. This evolution of the space will provide cues for users to follow well-trodden paths that depict previous searches by other users.

Our vision of this abstract space then is that the information space becomes organised by emergent ‘topic’ categories rather than by any particular pre-defined categorisation such as ‘author-title’ or ‘classmark’. This will allow users to search or browse the space in a manner that may support more abstract or less-well defined searches without having to re-formulate them to fit the existing OPAC interface (and thus, its categories).

Further, we do not consider the provision of such a system would replace the existing OPAC interface. Indeed, when users have re-formulated their queries, or have very well defined goals, such as a reading list or bibliography, the OPAC system works reasonable well. Instead, we envisage this application running along side existing interfaces, augmenting them to provide an alternative ‘topic’ based method of visualisation and query.

Of course, one of the major points of undertaking the project is to involve users in design of the electronic landscape. By developing a grounded electronic landscape with a real world purpose and content we can place a demonstrator in front of users to allow them to experiment with the demonstrator and to further inform the development of electronic landscapes from the use in practice of this demonstrator. In this chapter we wish to report on the emergence of the design of the demonstrator by considering some of the rationale to emerge and the initial visualisations’ of what designers felt the first versions of a prototype might consist of. These visualisations and the overall design provided the framework to allow us to integrate and extend our existing corpus of work in the electronic landscapes.

**Identifying well-trodden paths: Search Trails**

As we have said in the previous chapter an understanding of the history of the actions and activities of others played a key role in how people developed

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\(^1\) This ‘feature’ of the prototype would be triggered by a pre-specified ‘thresh-hold’ and be configurable by the user.
strategies to uncover information in the space. A central feature of this was a consideration of how people got to a particular reference through a series of searches. Essentially, we can consider people forming a trail through the information space as they uncover a book and that this trail provides a resource for other users to make sense of the overall information landscape.

We define a search trail to be a sequence of search type/term statements and successful match selections. The trail is ordered according to time – in the sequence the user performed the operations. So for example the trail:


Is understood to mean the user first performed a keyword search on ‘dada’ and from the resulting list selected the book identified by ‘abc’ as a successful match. They then proceeded to search by classmark on ‘XN123’, and subsequently by author ‘smith’ before finding another match on book ‘def’.

It is worth noting that trails are constructed from the execution of searches to explore new parts of the abstract information space. Other browsing operations such as scrolling backwards and forwards through the results list, and browsing the details of certain books which turn out to be unsuitable for their search criteria are not recorded in the trail. Rather, trails represent an ordering of the sets of books found in the catalogue as users sought to find particular items.

Storing, Retrieving and Operating on trails

In order for trails to be of maximum use to the information landscape and users they need to be stored in a database as multiple sequences of linked lists, one list per trail. Trails can then be queried using simple list manipulation. So given a trail:

- trail_from <search term/select>
  returns the trail after a given search term or select operation in the trail.
- trail_to <search term/select>
  returns the trail up to (before) a search term or select operation occurs in the trail.
- contains <search term/select/trail>
  returns true or false if the trail contains this sub-trail or term

The database of trails itself supports more general multiple trail querying operations that return one or more matching trails:

- trails_from <search term/select>
  Returns all trail segments of trails occurring after the search term or selection
- trails_to <search term/select>
Returns all trail segments of trails occurring before the search term or selection
- containing \textit{<search term/select/trail>}

Returns all trails which contain the search term or selection or sub-trail

The database also maintains an index into the various lists it contains for fast retrieval of these types of operation and query. The demonstrator reported in chapter 5 uses a relational database called mySQL to store search trails alongside the results of OPAC queries displayed in the shared abstract electronic landscape.

Capturing trails

One of the largest problems for this application is in capturing a user’s search trail. Ideally this would be done implicitly. That is, through the user’s normal interaction with the existing OPAC system the information can be extracted. Some portion of this can be accomplished through the OPAC’s web-based interface. A user’s interaction can be replayed simply by capturing the HTTP requests sent to the OPAC web server, via a special proxy server which the user’s browser is configured to use, or simply by looking at the server’s web logs.

Unfortunately, two main problems need to be considered with this approach. First, the current system doesn’t provide any easy mechanism for users to ‘mark’ successful matches for a given search. As we have seen in the previous chapter users normally jot this information down on a piece of paper and continue looking (Crabtree, 1998). Secondly, the system has no mechanism to identify the start of a search or its completion. For example, when a second query is performed at the top level interface (title, author, keyword etc.) is that still part of the original search, or a new one, or even by the same user? Whether it is or it isn’t, we have no way of knowing.

One solution to this problem may be to extend the normal web interface to provide this information. For example, with an initial log in screen, or ‘topic’ start/stop buttons, and by allowing users to mark a book as useful within the context of this topic or search. However, our early prototyping investigations suggested that this was a heavy handed approach that most users felt uncomfortable with. Alternatively a solution might be to simply to preserve all ‘trails’, successful or not, and let users establish pathways - commonly traversed pathways or ‘trails’ are maintained, those used infrequently are not (they become ‘overgrown’ to use a metaphor, and thus disappear back into the landscape - the catalogue). That way, the landscape evolves according to its use.

Our solution to this problem is to apply some heuristics over the OPAC web logs in order to try and extract trails of the form defined at the start of the section. This is certainly not an ideal solution but is simply most appropriate for the data at hand.

We determine that a book was ‘selected’ if the user had the information about it on their screen for a given amount of time (which could equate to them writing
the details down). A second method of identifying ‘selection’ would be if a user added the book to their personal bibliography.

The start and end of individual trails are again identified based on the amount of time which has elapsed between the last search term or selection being performed and the next keyword being entered.

By using data already available (the library web logs) we can ‘populate’ the information landscape before it is first used. The landscape can then evolve based upon information implicitly gained from searches being recorded from the web interface to the OPAC system, and searches performed in the demo system itself.

Putting electronic landscapes to work

In order to develop the demonstrator reported in chapter five the project undertook a series of design meeting where developers, artists and those engaged in the study of the users met. These design meetings were given the explicit task of developing an electronic landscape of utility to those involved in searching the library that drew upon the work of the project and allowed this work to be demonstrated in practice in front of real world users.

In order to try and illustrate what the system would actually look like and how it may be used a number of scenarios were used to drive the design. In this chapter we shall focus on the following scenario, where the system starts out without having recorded any previous searches.

A user view of the landscape

A user performs an initial search using the keyword ‘dada’. The user is presented with two different windows – offering different ‘views’ on the data being returned. One view is based around an abstract electronic landscape that displays the structure of the information. The second window presents the trail view showing the various actions and activities of users related to the information in the abstract information landscape. Interacting with one view will effect the other.

The OPAC system will return a potentially large number of matches or ‘hits’. The prototype is configured to group hits in the information view according to their classmark (although classmarks are normally cryptic sequences of letters and numbers the system should be able to expand these into more meaningful identifiers). Common groups of data (with the same classmark) are represented as solid ‘clouds’ whenever the number of matches reaches a certain threshold (which is possibly user configurable and may also depend on system performance). In this example the threshold is passed and the system starts creating various clouds for ‘dada’ as ‘history’, ‘art’ and ‘philosophy’ for example. The categorisation used to form the clouds is user configurable (not necessarily by classmark). Thus a user may select some general attributes of the resulting hits (like classmark or author etc.) or some other available metrics available may be
employed, like popularity (how many times have certain books been accessed before). In Figure 5 the clouds are defined using converted classmark topic categories forming several areas, including ‘art’, ‘philosophy’ and ‘history’ – all of which contain books on ‘dada’:

![Figure 5. Clouding by classmark convention](image)

The electronic landscape provides a meeting of each of these different electronic spaces and depicts these as clouds. A user chooses one of the clouds, history say, and flies into it as depicted in Figure 6. Here the system generates a new sub-cloud topic space again using the converted classmark categories as there are still too many books to display at once. At any time the user may choose to ‘generalise’ or ‘specialise’ the rules used in constructing the clouds. For example, in Figure 5 the user could have specialised the clouds further, producing the three clouds in Figure 6 for the history cloud and several more for the other two clouds.

![Figure 6. Sub-clouding by classmark conversion](image)

The user continues to fly into the categories into the ‘surrealism’ cloud which contains a number of books within the cloud threshold value. The system presents the books (or objects) in the space, shown in Figure 7, and arranges them in three dimensions based upon some appropriate Q-PIT like criteria. For example, the popularity of use insofar as the object has been marked as (potentially) ‘satisfactory’ by users. The same criteria will have been used to arrange the clouds in the previous figures.
Within this final sub-cloud, the user ‘flies’ into several of the books, identifying two potentially suitable matches for their ‘dada’ search, and marks them for later physical retrieval from the library itself.

These marked books are added to a session ‘bookmark’ list which can be printed out by the user at the end of session. In terms of this scenario the first user has shown how the system lays out library data using data clouds and how a user can choose to structure these clouds and fly in and out of them. This abstract electronic landscape focuses on showing the emerging structure and classification of elements in the electronic landscape based on the needs of the users searching for information in the electronic landscape. In the following section we consider how the landscape may be experienced by a second user and how this user may draw upon the action of others to inform their search for material.

The use of the electronic landscape by a number of users

A second user starts to use the system and enters the same keyword search on ‘dada’. This time the returned space is augmented by the system to highlight objects (books) which have been previously marked as successful matches,
possibly using several emissive (bright) shells around them. Previous search trails which have a large percentage of matches in the current search (like the previous search) are assigned much more prominent visibility than searches which found only a small percentage of suitable books within the confines of the current search space but found a majority elsewhere. Effectively, *the more times a book has been matched with similar books in this search space, the more it is highlighted*. This highlighting draws upon a centralised repository of search trails to understand how often a particular item has been involved in searches.

The second user chooses to enter the same sub-clouds as before based on the objects ‘glowing’ in the particular cloud. Each sub-cloud is also augmented to show the previous matches. Finally the user enters the surrealism cloud which displays the same objects shown in Figure 8. However, this time both A and B will glow to indicate they have been part of previous searches.

The user then decides that only book B might satisfy their search. They mark the book and then exit the system. This ‘mark’ effectively strengthens the glow over book B more than Book A and is made visible, throughout the prototype, through standard variations in the visualisation of the path, such as colour, width, intensity etc.

In this scenario the second user has shown how previous user trails within can be used to guide subsequent users to potentially useful information, and how those indicators may evolve over time.

A third user now starts to use the system and enters a different search, this time a title search on ‘dadaism’, and is presented with a similar general space. In this instance, only 1 of the 2 marked books from the previous searches occurs in this search and therefore only 1 object in a cloud will glow. In addition, since only 50% of the other objects marked with that about appears in this search its slow is less than it would have been for the second user.

As with the previous two users, this user navigates down to the individual book level from the initial search, which presents a glowing book ‘B’. The user selects this object as being a match for their search but wants to see what other books and search topics are related to the book, so they click on the object. This causes the second trail window to become populated with a visualisation of the search trails which have this object in them.

One possible display for these trails is to arrange these as connected lines between each stage in the trail that are focused at the ‘centre’ of the space with the selected objected. One possible way of showing this space may well look like a figure of 8, shown in Figure 9. However, one of the major concerns here is how to manage the complexity of these displays. In fact, the explicit display of the trials detracts from the significant resources making up the trail.
Clicking on each object or search in a particular trail will overlay that trails information into the current information space. How that information is overlaid may depend on the users preferences. For example, selecting the right-most trail in Figure 10 would cause all the objects in the information space to ‘fade’ apart from those appearing in the trail (A and B). In addition, objects common to both windows (the trail and the information windows) should be indicated through the use of shared colours, or joined lines etc. Users may jump onto a particular trail by choosing a search term from that trail. After being selected the trail window will be updated with that search term as the centre point of the trails (and therefore displays all trails containing that search term) and the main information window will display the search results for that new search term as before.

In this example, the third user sees that two other searches on ‘dada’ rather than ‘dadaism’ resulted in an object in this space being returned (B which they clicked on to bring up this trail plan) so they click on the dada search box for the rightmost trail which brings up the information display in Figure 5, and the new trail window below.
The third user continues to browse this space and selects object A as also being a good match for their original search on ‘dadaism’. *In effect, the user discovered another successful match for their search which was not originally returned by their initial search, but was part of a separate, but connected, trail.*

**Summary**

The design scenario and the suggested solutions outlined here provided input into the eventual development of the demonstrator reported in chapter 5. This development was augmented by the emerging results of the explorations reported in chapters 3 and 4. This scenario attempts to exploit three concepts in order to drive the design exercises used to develop the eventual demonstrator.

- The use of ‘data clouds’ which obscure large number of objects and present pieces of data together which share something in common. This technique is especially useful in the library where any given query can return hundreds of matches. The cloud effectively sorts these matches according to some secondary criteria in order to assist users in ‘narrowing down’ their search. As mentioned above, secondary criteria may consist of the conversion of classmarks into publicly intelligible categories, and user categories employed in doing previous searches (these categories constitute the emerging spaces: e.g. dada).

- User ‘search trails’ constitute the second key concept informing the prototype’s development. The trails help to organise and structure the information space of the library catalogue in a novel way, highlighting possibly connected and popular information.

- Deriving from the ‘trail’ concept is the notion of individual objects being ‘inter-connected’ to a multiplicity of other spaces. Thus, particular objects as well as general topics mediate connections between spaces.

The combination of these three concepts allow us to focus on the construction of an abstract electronic landscape that provides the convergence of a number of different abstract electronic spaces where different features of an information space are displayed.

Much of the functionality suggested in the design session trades on users ‘marking’ particular objects. Marking has to be readily apparent - visible and intelligible at a glance (it might be a case of ‘mark to retrieve details’ in the example) - and easy to do then, i.e. one simple click. A method of ‘encouraging’ this type of marking in users is to give rewards. One simple ‘reward’ that is not currently available is to record a each subsequent and related match in a single list which can then simply be printed out at the end of a users session.

This chapter has considered how we may move from the demands and needs of actual users to develop an abstract electronic landscape that allows a community of general citizens to exploit and use a shared information repository. In this case the electronic landscape in question is informed from the way in which users explore an on-line public access catalogue system. In order to explore the
development of this landscape a number of design sessions took place to outline the design scenario described in this chapter. This design scenario highlighted the need to convey both the overall structure of the information being accessed and used and importance of the activities and effects of others when accessing this information.

Two displays were suggested an information display that conveyed the structure of the information as a series of interlinked information spaces and an overall search/activity display that conveyed the actions and effect of other users. One of the difficulties outlined was the problem of conveying the effects of the actions and activities of others in a manner that was did not confuse or overload users.

In order to support the development of the demonstrator a number of speculative interfaces were development with artists, programmers and social scientists working in partnership. These speculative investigations represent an exploration of different ways of conveying and interacting with this information and provided a resource for the development of the eventual demonstrator. Some of these speculative explorations are described in the following chapter. These explorations were complemented by the development of an abstract information space that extended the work on the web planetarium and Q-PIT undertaken in the first year of the project (reported in chapter 4). The demonstrator that is reported in chapter 5 of this deliverable represents an integration of the different strands of project work. This integration seeks to meet the needs of a real world community of user that share a connected on-line repository

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Chapter Three
Informing the Demonstrator

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In the previous chapter we considered how we might exploit the core electronic landscape concepts to support a community using an on line public access catalogue. The design scenario used to drive the development of the supporting landscape resulted from dialog between developers, artists and social scientists and builds upon the ethnographic study of the users of the library briefly reviewed in chapter one. It is also informed from a number of parallel artistic endeavours that sought to explore speculative interfaces to abstract information spaces.

A distinct working style adopted in the project was to allow freedom to explore around the theme of the demonstrators for a number of artistic pieces and to then harvest these pieces by migrating the core concepts and ideas into the eventual demonstrator. This style of working allowed us to both provide the freedom needed to artists and to explore different methodological approaches to incorporating artists into the development of IT centric applications. A central aim of the work in developing the demonstrators was to form an integrative partnership between computer science developers, real world citizens and artists. Consequently, it was important that we should learn directly from the different artistic explorations placed in front of the general public in a number of settings. Much of this learning took the form of empirical studies of the use of the artistic installations and is reported in deliverable 4.0 where we consider the core methodological messages to be gained from the work of the last year.

The move toward the support of the real world citizen requires us to develop landscapes that are informed from artistic endeavours while supporting real world activities. In this chapter we wish to consider the different artistic endeavours and activities that contribute to the development of the demonstrator and how they have been integrated to meet the demands of a real world setting. The aim here is to move from the isolated concept demonstrators of the first year of the project to develop demonstrators that have significant application semantics. In order to allow us to focus on this transition we focus in this chapter on brief outlines of these installations. More detailed descriptions are provided in deliverable 5.1 while the studies of these installations are given in 4.0. In particular, we wish to focus on three activities that directly informed the development of the abstract electronic landscape:

- The work on the Web Planetarium and Eve on the display of abstract structures
- The work on Nuzzle Afar on the exploration of representing the activities of others
- The work on IO-dencies in using animation and self organising models to show the emerging relationships between information.

Each of these three different explorations provided a resource that was drawn upon in development of the real world demonstrator. This harvesting of the artistic pieces took the form of migration of concepts, learning from use and the movement of code and interfaces. In the following sections we shall explore each of these three different activities in turn and the lessons learned from them.

The Web Planetarium in the EVE dome

The first speculative interface build upon by the abstract information landscape demonstrator is the development of the Web Planetarium within the EVE dome explored by both SICS and ZKM. This work build directly upon the Web Planetarium developed during the first year of the eSCAPE project. The Web Planetarium was developed as a conceptual demonstrator for how hyperlinked information sites can be presented and navigated in a “meta-space”, using the metaphor of outer space for presentation and navigation. The basic concepts were described in eSCAPE deliverables 2.1 and 3.1. The web planetarium presented information as a series of linked nodes and allowed users to enter and explore these different web nodes (Figure 11).

![Figure 11. Screenshot from the Web Planetarium prototype, incorporating a series of interlinked information sources](imge)

The Web Planetarium provided mechanisms to allow the automatic placement and linking of information based on the content of the web pages and the links they have to other pages. This linking was augmented by some structuring of the
information space and this general algorithm and approach provided the key aspects of the original electronic landscape developed in the first year.

As described in deliverable 5.1, the Web Planetarium has during the second year of the project been integrated with the EVE dome, and thus been extended with new techniques for interaction and navigation. In this section, we will describe the presentation, interaction and navigation techniques used in the Web Planetarium / EVE demonstration, and describe how these may be used or extended in the Library demonstrator.

We will start by shortly describing the major features and some observations made regarding the actual use of these interface elements.

Interlinked graph

The Web Planetarium consists of spheres, representing documents or sites, interconnected by arrows, representing the hyperlinks between these sites. This results in a three-dimensional graph that can be navigated by the user. The graph can be extended with new sites and links by interacting with the contents of the sites, found inside the spheres. This linking of graphs offered users the ability to understand the overall structure of the information as well as the details of links between different parts of the information.

Click-and-zoom

When roaming the planetarium constellations, the user can zoom in on a particular site, and enter it, by “clicking” on it (or any link leading to it) at any distance. This produces a “click-and-zoom”-like way of navigating the existing graph of sites. The core of this navigation technique is to adopt an object centric philosophy where users were explicitly freed from the overhead of having to manage their navigation and movement in three dimensions. This restriction of the overall freedom of movement meant that users were able to focus on the exploration of the information space.

Choosing new sites

When viewing a specific site, a link leading to a new (previously undisplayed) site can be selected, upon which that site will be brought into the site graph, and the user transported to it. This dynamic movement and the animation of the bringing to the user of the site provided a cue of the way in which users manipulation with and use of the information was effecting the space. The selection here focused on the oriented toward the next site to be explored and the space surrounding the user was reconfigured around this object.

Observations and Discussion

In addition to the movement patterns observed and described in Deliverable 4.0 and 5.1, some additional observations has been made on the tendency to fetch new sites into the visualisation. During the public exhibitions the state of the Web
Planetarium was logged after each application run. The information logged consisted of the sites and links displayed and navigated during the session. Using these logs, observations could be made on how many sites and links were visited, and how many new sites that were fetched and displayed in addition to those already present in the visualisation.

The logs show clearly that the user very rarely fetched a new page/site using the HTML link icons displayed inside the currently visited site, even though this is one of the primary ways of navigation – and the only way to incorporate new parts of the Web into the visualisation. Instead, an usage session would typically consist of the user flying around exploring the structures already visible. This suggests that users seemed to distinguish between the generation of the space and the exploration of components in the space.

This could be due to several reasons:

- **Unawareness of the possibility of clicking on objects to navigate and fetch new sites.** This seems to be contradicted by the fact that users navigated the existing landscape elements by clicking on the visible planets.
- **Unawareness of the purpose of the icons inside a site.** This is possible, but depends on the level of instruction by the museum guide and has not yet been verified but it does seem that clear instructions were given.
- **Intuitively perceiving that "what I see is what there is".** Fetching new sites, and thus planetary structures, into the landscape on the fly would break the "landscape metaphor" – which, upon straightforward comparison to real landscapes, certainly does not involve new parts of the landscape just popping into view in front of you where you happen to be standing.

The last reason provides both an interesting reflection on the difficult of the metaphor and the lead to the need of a reconsideration of the Web Planetarium and an important lesson for the abstract demonstrator. It would, supported by the second reason, imply that the method of presenting links and navigation points as links to be activated, and then viewed as a new landscape element (an extended link and a new planetary abstraction) does not work well in practice. There is a range of changes to the design to the Web Planetarium that could be applied to remedy this fundamental problem. This includes different ways of pre-fetching sites, encouraging new content design methods that take spatial properties directly into account when a site is built and linked to other sites, and so on. However, in terms of the abstract landscape demonstrator it suggests the need to consider the generation of the landscape and its exploration as two distinct activities. It also suggests that exploration and understanding tends to focus on exploring a relatively stable structure where changes are clearly made visible.

**Suggestions for the Demonstrator**

The Web Planetarium experiences provide us with some distinct lessons that can be directly build upon in the construction of the abstract information
electronic landscape. The general layout and placement algorithms provide us with a useful starting point for the generation of the abstract information space. However, a number of other important additions can be incorporated into the abstract information landscape from this artistic exploration.

Object Selection and transportation

The method of selecting an object of interest and thereby being transported to it for further inspection and navigation was found to be intuitive enough to be quickly learned by the audience, during the public display of the Web Planetarium in the EVE dome. Thus, to use an elaborated version of such a scheme could be useful in the Library Demonstrator as it seems to readily accessible to the general citizen.

Stability and a separation between generation and exploration

The problematic issue in the Web Planetarium of bringing new sites into view, and the confusion that follows needs to be considered. One advantage offered by the concept demonstrator is that in the Library setting the set of data viewed is more well-defined and a result of searches through a corpus of material. Essentially, we can maintain a clearer separation between landscape generation after query and the exploration of the landscape. This separation allows us to focus on the issues of exploration.

Rotation and manipulation of the space

A direct elaboration of the click-and-zoom method of the Web Planetarium is to combine it with an “external” rotation to allow exploration of the surrounding entities rather than an "internal" approach to rotation. By “internal” in this sense, we mean rotating the eye of the user when navigating the landscape – this method is preferred when viewing a model “from inside”, and gives the intuitive head-like movements when using “immersive” display techniques such as a CAVE-like set-up or the EVE dome. The “external” rotation refers rotating the object (or world) being inspected rather than the viewing point itself. The difference may seem subtle, but becomes important if the object being inspected is spatially limited, such as a ball or a box. External rotation can be intuitively performed with a trackball or a SpaceOrb, and is more suitable for desk-like display of less immersive nature. (See deliverable 5.0 for a taxonomy of different display and interaction techniques).

Developing a new exploration vehicle

The display techniques to be used in the public setting of the Library demonstrator will be screen-based. Consequently, some form of “external” method of interaction must be found. This should ideally be combined with an intuitive “click-and-zoom” interface, reminiscent of its “internal” counterpart in
the Web Planetarium. The interaction with such a set-up could thus be something like:

1. **Zoom in** on a document by clicking on it. The document sphere is now centred in the view, with neighbouring documents laid out around it at roughly equal distance.

2. **Rotate** the view *around the selected document*. This will bring different neighbours into and out of the immediate vicinity of the user.

3. When one of the neighbours is found to be interesting, click on that to zoom in on it. Continue as above.

The exploration of the Web Planetarium in Eve and its use by the general public represents has informed the development of the demonstrator both directly through the adoption and use of portions of the placement algorithm and indirectly through the development of new exploration and interaction techniques inspired by the experience of the Web Planetarium. In the following section we shall briefly consider the development of an installation called Nuzzle Afar by Masaki Fujihata.
Nuzzle Afar

“Nuzzle Afar” is the extended version of an earlier interactive environment by Masaki Fujihata, “Global Interior Project” (1995-1996). As a full description of "Nuzzle Afar" is provided in deliverable 5.1, in this section we shall provide only a basic overview. At four locations the same arrangement has been set up. A dark abstract space is visible on the projection screen. The visitors are invited to explore the virtual space using a trackball. By means of the interface the participants control their own movement and perspective in the computer-generated 3D environment. The temporal movements within the space leave traces behind them, which can be followed by the other participants. Spherical objects serve as avatars and visualise the current virtual location of the individual visitors. (Figure 12).

In “Nuzzle Afar” different worlds exist within the same space. However, even though the differently shaped worlds of the piece exist in one space, the actual navigation within them has to be handled each time individually. While the visitor in one room hardly needs to move the trackball in order to move through the entire room, in the next room it seems to take several minutes to understand its dimensions.

The spaces within "Nuzzle Afar" are essentially only defined to allow users to move through them and to discover other users which whom they can communicate. The movement through these different spaces provides a sense of action and activity and this is reflected through the avatars representing the users. These avatars lay out a long tail (or trail) that represents their previous movements through the space and consequently provide a history of the users actions in the space.
It is possible for each visitor to observe the other participants in one of the other worlds because of the traces they leave. However, it is striking that these traces are sometimes not directly presented but rather are transformed to given a sense of activity rather than being used to convey the details of the movement and activity of the user in the space.

Whenever two avatars meet the users are drawn into a space formed by merging the two avatar spheres and a direct video link is provided to allow these to communicate with each other. Users terminate this interaction by moving out of the sphere. When the interaction is terminated a small sphere is left behind as a trace of the meeting. On touching this sphere, users are drawn into a space that then shows a recorded version of the interaction that took place. The creation of these spaces becomes a means through which users start to shape their virtual space. The space receives a definite history. Not just a disappearing trace remains for a certain time frame, but a captured moment of time. In “Nuzzle Afar” the meeting environment is created through the moment of the encounter itself. Through seeing and interacting the visitor understands the general conditions of the abstracted virtual reality. Experiences adopted from reality simplify the process of understanding.

Observations

With “Nuzzle Afar” Fujihata provides a model of a three-dimensional communication and experience space that offers different levels of encounter and possibilities of shared experience. In contrast to the classic conceptions of virtual environments enabling shared experiences as for instance those used in MUDs and MOOs, Fujihata’s system does not only permit the simultaneous exchange of position and orientation data, but also of the entire visual and acoustic material. In “Nuzzle Afar” curiosity and a sense of discovery and willingness to communicate are the fundamental elements for orientating oneself in the (virtual) world.

As in most of Fujihata’s works, “Nuzzle Afar” can be understood as an experiment and also here - as in most of his earlier works - the fundamental conception of storing and mediating information are explored. He wants to create a space of interaction within which the relationship between user and objects are described dynamically. The complexity of these worlds is not defined by the number of polygons, but rather by the network of relations of the worlds’ various components. These networks focus on showing the history of interaction users within the system in terms of trails and the continual laying down of trails provides a growing complexity for the environment.

Suggestions for the Demonstrator

When we consider "Nuzzle Afar" as a source of inspiration for the development of the demonstrator we are immediately struck by the importance of history and
remembering users navigation through the space and interaction through the space. These are represented to the user in "Nuzzle Afar " as a serious of trails and these trails may be used as a means of accessing the avatars of other users in the space. The obvious concept to be migrated to the demonstrator is the notion of trails and the means by which success actions can be used to develop a trail through an information space.

In addition, to the notion of the trail the experiences of "Nuzzle Afar" also provides us with a point of reflection on how we may wish to present and use these trails. In particular,
- Trials provide an indexing mechanism allowing other users to access the users who made them and to review the history of their experiences in the space.
- Trails are interlinked and the effect of subsequent users actions and interactions is that the network of trails grows in complexity

This suggests that the demonstrator may need to consider the development of appropriate presentation techniques for trails that allow trails to be used as a means of indexing related material. It also suggests that the direct presentation of these trails is likely to lead to growing levels of complexity and that ultimately we may end up with a system that becomes increasingly difficult to use. One approach to this is to consider means of presenting the aggregated effect of these interdependencies rather than trying to display them directly. Our final artistic investigation seeks to explore the linkages between different discrete pieces of information and how they may be displayed. The work of Knowbotics in the IO-dencies piece in San Paulo seeks to explore how the different relationships between material may be exploited in practice.

**IO-dencies**

The IO_Dencies project is an art installation by Knowbotic Research undertaken within the context of the eSCAPE project. Knowbotic Research focus on the dynamic nature of information and the means by which information is continually processed amended and constructed. As a consequence the focus of their work is not on an information-environment as a static landscape but rather as a dynamic, disconnected and continually evolving environment. The work seeks to present the interactions and links between different information entities as different forces acting across and between different information entities.

This view of an electronic landscape focuses on a dynamic, continually modifying information terrain where the entities are continually open to forces of change. The work is strongly motivated by a consideration of space a being socially organised and constructed.

The IO_Dencies system is a prototype electronic landscape intended to implement and explore these concepts. The IO_Dencies work allows the project to explore the situation where elements of an electronic landscape are generated
and amended by the on-going effects of its inhabitants rather than the consideration of more static spaces.

Essentially, the 10_Dencies system is structure as a self-organising collaborative information environment. The environment is based on the input of specially selected editors who incorporate core documents into the space of Sao Paulo. The dynamics of users and user interests about the continuously updated material and a real-time component drives the self-organisation the data that is present. The installation also provides an experimental environment which takes another approach to engaged discussion areas (i.e. Internet Newsgroups) by visualising the evolving zones of interests, and the intensity of that interest. Furthermore, it offers a hybrid environment in which human and machine (systemic) interactions cooperate through the application of dynamic self organising models acting on the information. The developed e-scape is acted upon by three distinct entities:

- Editors who place information in the space and construct links between different information nodes.
- Users who traverse the space expressing interest and following points of interest to them.
- The system that continually organises and reorganises the information to reflect the different strengths of relation expressed between the displays.

The presentation of IO_Dencies is primarily 2D in nature. Editors add documents to the 10_Dencies document landscape. Associated with each document is meta-data, including a keyword which is available to the 10_dencies e-scape as a means or organising the space. Based on this information, a self-organisation algorithm creates local behaviour rules for each keyword. These rules are realised as a set of spring forces whose motion equations are solved by integration of total acceleration over time. This spring force dictates the location of keywords in the space presented.

Force fields are generated for each keyword based on a number of variables (such as age of keyword, number of selections, etc.). The 10_dencies force fields can be represented visually, textually and audibly. The visuals representing the force fields are to be particle streams affected and modified by the force field. When one zooms in on processes in the visualised particle streams, the representation will become more textual and keywords appear. By choosing those keywords, the actual documents that make the information space are accessible to the user of the IO_Dencies system. As the variables that govern the force fields change dynamically (due to the actions of users within the space), so too does the particle stream visualisation.

The user is not directly represented in the e-scape by avatars, but is represented indirectly by the visualisation of his/her browsing activities (i.e. moving a IO_Dencies-browser window), which are unfolding the processes inside through force fields that are generated from each document in the information environment. The general arrangement of the system is as a dynamic presentation of a considerable corpus of stored on-line material.
Keyword Browser

Users are presented with an overview of the keywords through a keyword browser. A number of particles are driven from the self-organising model based on the forces between keywords. A cloud-like visual style is exploited with the intensity of a cloud structure increasing wherever the density of particles is very high. The result is that at areas with a total force of approximately zero, the velocity of the particles is low but their density is high, hence the particles are blended to black clusters. At areas with high acceleration, the particles gain more velocity and hence their density is low, resulting in a very light rendering of the fast moving particles. Figure 13 is a display of the keyword browser with keywords and the cloud structures showing the strengths of relations between the keywords displayed. The corner in the top left hand also shows the views of other users.

![Image of the keyword browser]

Figure 13. The keyword browser

Discussion

One of the main features of the 10_dencies installation is that it seeks to make the dynamic and evolving nature of information available to users. Rather than present a static and structured corpus of material with predefined relationships between different elements made visible in the presentation of the interface, the Keyword browser of the 10_dencies installation presents a dynamic and emerging body of information. The different and complex inter-relationships between information are used to drive a self-organising model. This model then allows the
calculation of different forces and these forces bring keywords into different clusters as the relationships change. Thus rather than provide an overwhelming detail of all the relationships users are provided with an aggregate effect with clusters of information keywords suggesting related information to users.

This overall effect of the 10_dencies installation is to convey the dynamic effects of a connected community of users on an electronic landscape. As users interact with and alter the relationships between the different information entities these effects become manifest in the interface in terms of strengthening forces and reconfigurations of keywords. Exploration is thus much more experiential in nature and move away from the tradition information content focus as the information is presented through the lens of the effects of different users on the information.

Suggestions for the Demonstrator

The work of the 10_dencies installation allows us to consider the ways in which we can show the aggregate effects of multiple users. The 10_dencies installation grew from a motivation to show how the combined effects of a disparate collection of real world users may be reflected on a real world electronic landscape as different users manipulation and use of the entities in the landscape demonstrated different effects on users. This indirect reflection of the contents of the information space focused on the dynamics of the interaction of users.

The presentation of action and activity in 10_dencies is analogous with the need to consider the search effects of users on the abstract electronic landscape demonstrator. In fact, the 10_dencies interface provides us with an opportunity to present the overall action and activities of other searches through the 10_dencies keyword browser. Thus we can exploit the browser interface to overcome the effect of growing complexity of trails experienced in the "nuzzle afar" situation where the landscape became filled with the trails of others.

The architectural arrangement of the 10_dencies software is based on a clear client server model with the a central database being access for keywords and inter-relationships and allowing a self organising model to drive the arrangement of keyword. This server is then used by the keyword clients to drive the dynamic flow of particles and the arrangement of clouds. The focus on a central server and the ability to use this central body of information as a point of integration allows us to migrate the keyword interface to present the search trails identified in our design and offers a direct integration between a system initially motivated by artistic concerns and real world demonstrator of the electronic landscape concepts.
Summary

In this chapter we have considered the various artistic investigations that have been undertaken in this year of the project to inform and provide inspiration for the development of the abstract electronic landscape. In the previous chapter we outlined the results of our design sessions where we highlighted the need to allow users to simultaneously be able to access and explore the repository of information based on the structures to emerge from its content while also having available to history of the action and activities of other users.

This separation between the structures based on the content and relationship of information and the activities of users is also reflected in the artistic explorations reported in this chapter. In particular:

- The web planetarium work provided an exploration of new layout algorithms and techniques for navigating though and interacting with this form of structured information.
- The work on "Nuzzle Afar" allow an exploration of the use of trails as a means of developing history and suggested that presenting these histories may become confusing as these trails grew in number.
- The work on 10_dencies allowed us to explore how we may present dynamic activity information and complex inter-relations at an aggregate level and offer us a direct migration to allow the presentation of search history information.

These three separate explorations also demonstrate different ways in which the exploration of art pieces can be used to support the development of applications. In terms of the work on the web planetarium we can see the migration of algorithm and techniques into the demonstrator while "Nuzzle Afar" provides us with a test bed for considering the use of a particular technique. Finally, 10_dencies demonstrate how we can integrate an artistic piece into a setting for which it was not originally intended to exploit its interface and approach.

In addition, to these explorations of artistic developments one of the central features in the development of the abstract information demonstrator was the extension and development of the Q-PIT system at Lancaster University. In the following chapter we consider these developments and extensions before considering how it was integrated with an existing on-line public access catalogue and provided the core of the demonstrator in chapter five.
Chapter Four
Extending Q-PIT

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The previous chapter briefly reviewed the different artistic explorations undertaken as part of the work of the eSCAPE project and considered how these were harvested to inform the development of the concept demonstrator presented in the following chapter. The core of the demonstrator is an electronic landscape that uses the layout and placement of objects in three dimensions to convey aspects of the information content. The development of the demonstrator is centred on integrating with and extending the Q-PIT system originally developed at Lancaster University and presented in deliverable 3.1.

Most of the Q-PIT developments over the last year have also been made in response to the design discussion on the Library Abstract Information demonstrator and address areas of concern for the general Q-PIT visualisation system. Many of these issues were raised in the last set of deliverables and this chapter reports on the progress made in these areas. Among the areas explored in this chapter:

- Q-PIT as an e-scape: visualising the information contained within the Registry Service
- Moving towards legibility: the identification of regions within the data
- The Scatterplot problem
- A new layout algorithm: using force directed placement
- Parameterising the layout process

Q-PIT as an e-scape

This section reports on work carried out shortly after the submission of the year one deliverables and before the beginning of the "data cloud" work reported in the rest of this chapter.

In simple terms, we decided to use Q-PIT as a visualisation tool for presenting the contents of the eSCAPE registry server. The registry server stores information on what e-scapes we know about: this includes a set of attributes which describe aspects of the e-scapes. By taking the data to be visualised from the registry service instead of a database, we can map the e-scape information onto a 3-D space. The server also maintains (where possible) a static image of each e-scape and we use this to texture map points in the Q-Space thus generated. By selecting a point, we can in fact connect to that particular e-scape.
We would thus argue that this use of Q-PIT represents one of the first technological embodiment of one aspect of what an e-scape could be: a place where places meet. From the Q-PIT visualisation, a user can find out which available e-scapes are similar, derive information from placement and appearance, and indeed enter these electronic spaces.

**Figure 14.** Extract from a Q-Space representing the eSCAPE Registry Server

**Figure 15.** Close-up of a Q-Space entry
Data Clouds

Work in two- and three-dimensional visualisation systems which present points in space has identified the problem of a “point cloud” whereby the data is presented as a vast, amorphous collection of objects with no easily discernible features. These point clouds are often static and uninteresting. There is little to be learned from examining a seemingly random collection of dots in space.

Problems such as these have led researchers such as Chalmers [Chalmers 92] to move from a 3-D to a 2.1 D (and indeed, to a 2D view [Brodbeck 97]), in order to move from the “point cloud” scenario.

Attempts have been made to impose some kind of order onto the point cloud by introducing some cityscape concepts (typically those of Lynch [Lynch 60]). For his PhD research, Ingram [Ingram 95] imposed regions, paths and landmarks onto abstract data spaces, Q-PIT included.

The work reported here has thus far singled out the concept of a region as the basis for a “data cloud”. While Ingram represented regions by introducing barriers (abstract walls placed as required) within a Q-Space, we wish to explore the idea of an enclosing space to represent a region. The introduction of further graphic objects to a Q-Space can be seen as merely cluttering up an already confusing point cloud. We wish to exploit a well-known feature of information modelling and handling, that of abstraction. Can we enclose a region of Q-Space, thus hiding the often confusing point clutter, in such a way as to make more sense of the underlying data?

One of the main purposes of data visualisation is to make use of the human ability to extract information visually, to locate patterns and groupings in a way that would not be possible when examining screeds of text representing the underlying data. Point clouds, as a visualisation technique would seem to make matters worst rather than better. Our hope is that by adding some computer-based techniques to identify regions within the data, and then presenting those regions (or indeed, using similar techniques to remap the point cloud into a more meaningful space to begin with), might bridge the cognitive gap between apparent chaos and order.

The move towards regions, as an aspect of city building, may also provide a path for the realistic cityscape work of Manchester. If there is a way for combining the “data cloud” generating algorithm with the existing cityscape generating algorithm, this could prove a powerful mechanism for producing meaningful visualisations that can be usefully explored.

We also wish to increase the interactivity of the generation of space and regions to further validate the data visualisation approach. As we shall see, there appears to be an obvious place where we could interactively affect the region generation process to reflect our particular interests. If this interactivity was to include the deformation of regions via the graphical representation (as well as more
convention form-based interactions) this might provide us with a useful (and unusual) mechanism for interacting with the data and its visualisation.

While not fully clear as to how this activity would feed back into the process, it could offer an exciting prospect for effecting how the data is laid out and the regions formed via a very interactive process. It may even be possible to think of mapping individual clouds onto SICS’ Blob installation, associated with a more conventional display. By selecting a cloud and allowing the Blob to represent it, moving the Blob could be reflected on the screen and the deformation of both the Blob cloud and any other clouds affected by the deformation similarly displayed.

This approach would require further work on real-time algorithms for generating regions and on the semantics of such manipulations. In the short term, based on the future directions proposed later in this document, we envisage movement of data items in a Q-Space to reflect our desire that such items (or similar items) should be located in the same region. In essence, we would be increasing the attraction between the items and this in turn should have an effect on the overall space and regions therein.

Technical Details

In this section, we describe the technical work carried out so far in our attempt to realise the Data Cloud concept.

Identifying Regions

We have closely followed the work by Ingram as reported in his PhD. This involves treating the data space as a graph, whereby every object in the space is connected by an edge to every other object. In other words, every tuple or object in the database is considered to be a node in a graph. The next step is to apply a similarity measure between every node in the graph; this produces a result of 1 for equality and 0 for no similarity whatsoever.

Constructing the Similarity Matrix

In the current implementation, we use the existing Q-PIT approach of constructing ordered domains of values for each field or attribute of a tuple. When considering the similarity between values in two tuples, we use the distance between the values as the basis for the result. We then sum the similarities between the fields to give us a final similarity result. These results are considered to be weightings on the edges that link the nodes. They are stored within a similarity matrix.

Even at this stage of the process, there is a great deal of scope for improving the interface between the user and the visualisation system. The user may wish to increase the importance of some domains and decrease the importance of others, and we can use this to influence the similarity measure. For example, in our “FilmFinders” data, we could say we are more interested in the actor and the kind of film than we are in the director and the date when it was made. We could
accordingly influence the similarity measure to reflect the user’s concerns. A conventional “slider”-based interface would be a nice way to allow the user to input their choices.

At the end of this process, we have a similarity matrix which represents the complete graph formed by linked each node to every other node, along with similarity measures.

The next step is to examine this huge graph and to generate a minimum spanning tree (MST).

**The Minimum Spanning Tree: Kruskal's Algorithm**

This algorithm (as described in [Weiss 93]) begins by considering every node to belong to a tree of its own. Adding an edge merges two trees into one. When the algorithm terminates, there is only one tree, and this is the MST. The order in which edges are considered is important. In our case, we order the edges according to highest similarity first.

The algorithm proceeds as follows. We take an edge (u, v) and find out if the participating nodes are already in any sets (when we begin, each will be within its own, single member, set). If they are both already in the same set, we reject this edge (if we were to accept it and add it, it would cause a cycle within the graph). If we accept the edge, we perform a union on the two sets that already contain u and v.

**Constructing sub-graphs**

Our next task is to convert the MST graph into a group of sub-graphs, which will form the basis of our regions. We do this by considering each edge in the MST and comparing it with its nearest neighbours. We calculate the total weighting of the neighbours and divide it by the number of neighbours to give us an average. We then calculate the ratio of the current edge’s weight versus the average for the neighbourhood. If this ratio falls beneath a set threshold, then the current edge is deleted from the MST.

Clearly, by deleting edges from a graph, we convert it into a forest of (sub-)graphs. The final step in the process is to extract each sub-graph from the remnants of the MST, and to generate a group of nodes from each sub-graph to give us a region of the Q-Space.

**Displaying a Q-Space region**

Now that we have identified regions that should represent similar nodes, how do we display then within a Q-Space? Throughout this section, we use as our example a portion (50 tuples) of the “FilmFinders” database.

**Coloured Objects**

Our first approach was to use colour objects. Until now, as part of its collaborative aspects, Q-PIT has used colour to represent users and the objects
they have selected. In this version, we use colour to represent membership of a region of Q-Space (Figure 16).

![Figure 16. Coloured Objects](image)

Translucent Coloured Boxes

To assist with the perception of regions, our next intermediate step was to encase regions in translucent boxes, coloured again to show region membership (Figure 17).

![Figure 17. Coloured Boxes](image)
We believe that this approach isn’t wholly satisfactory because, from this particular layout, we can draw an inference that is not strictly true. This is because we would tend to extract a subset or intersection relation between contained or overlapping boxes. All the points in the light blue box contained in the dark blue box are not also members of the set of points in the dark blue box.

It isn’t the approach that is wrong (that of identifying regions by “boxing” them), it is the layout of the points in the Q-Space to begin with that raises this problem. Clearly the ability to infer such relationships is a valuable one, and we should reconsider the way in which points are laid out in the space so that region identification becomes useful (perhaps even a part of the “point layout” process itself).

![Figure 18. Close-up on boxed regions](image)

**Data Clouds**

Finally, moving closer to the concept of clouds, we generate "hulls" rather than boxes as a more "form-fitting" visualisation. The results of generating hulls are shown in the next two figures.

![Figure 19. Coloured Hulls](image)
We believe that these more tightly defined regions make this representation preferable to the “boxed regions” but we still have the problem of incorrect inferences from overlapping regions.

![Figure 20. A closer view](image)

**Implementation Issues**

Finally in this section we give details of how the generation of data clouds has been implemented. For ease and speed of development, a great deal of the processing involved has been done in “batch” mode.

What do we mean by this? The Data Cloud work has been done using the Q-PIT visualiser and the simple (very basic) tuple store (written in Java to support our prototyping work). The structure of a tuple has been updated to contain information aimed at increasing the processing speed (simply by allowing the storage of values in a permanent, safe place, rather than recalculate the value as required).

For example, hitherto the tuples contained no information relating to any aspect of Q-PIT. When mapping the contents of a tuple onto the Q-Space, we have to “calculate” the mapped value by comparing it with the Domain contents. This is acceptable when we are doing this only once (as in the past), but when we are using the mapped values to calculate the similarity matrix, this means we must obtain the mapped value each time we examine a tuple and compare it with another. In order to avoid this noticeable overhead, we now generate the mapped values once and once only, and store them as part of the tuple within the database.

To reduce any possible delays to the user, the generation of the similarity matrix, MST and final regions is all done “off-line” or non-interactively. A region identifier is now stored with a tuple. When Q-PIT processes the database and positions objects within the Q-Space, it also calculates the “region box” and/or the “region hull”.

This “batch” or “off-line” approach has enabled us to get a version of Data Clouds up and running. However, it has serious issues for the flexibility and performance of a fully interactive Data Cloud system. Consider simply the scalability of the approach; generating a similarity matrix for a million records is
an issue for both time and space. Clearly, more research is needed into the algorithms required to generate Data Clouds efficiently. It is also more desirable to have the region generation under interactive user control (as in changing the factors to be used in generating the similarity matrix), and to have any changes made animated so the user can watch the Clouds change and deform in response to the user’s actions.

Finally, we need further work to examine the possibilities of the user controlling the Q-space by moving objects (deforming the Clouds) graphically. For example, if the user wishes to state that “these here objects should be together in a region not separated”, this could be taken as a statement that the weightings of the links between these objects needs to be increased; this means a change to the MST and such a change should be propagated throughout the MST and new regions generated accordingly.

**Meaningfulness of a Q-Space**

Q-Spaces are generated by an application of what we have called the Benediktine approach. This involves providing a numerically based mapping over often non-numerical data. We have persevered with Q-Space as they currently exist with the argument that it provides a platform for exploring issues that, so far, have not been directly tied in with meaningfulness of space. For example, lots of the issues connected with CSCW involve the representation of users and their activities within the space. Other Q-PIT based work will be looking at subjectivity of the Q-Space. On a technical level, such developments are based on techniques and approaches that do not (strangely?) impinge on the meaningfulness of the space. They are hopefully approaches that can be applied to most other spaces regardless of how those spaces have been generated.

In terms of data visualisation, however, meaningfulness of the space generated must surely be a primary aim. The whole point of visualisation to provide a space which is legible and understandable by the end-user employing visual and cognitive skills that humans are much better at than computers; to detect patterns and regions.

It is this meaningfulness that makes the idea of virtual cityscapes so attractive; here is a visualisation that is already familiar and navigable. However, the drawback is in finding a meaningful mapping between cityscape and data that is being visualised.

The “box” representation of regions in Q-Space highlights a major problem in our Benediktine approach. Data, which is semantically similar (according to our similarity matrix), is still being scattered across a wide area. The size of a “box” does not reflect the amount of data within the region (as we would desire) but only the area across which the data has been spread.

It has long been recognised in other visualisation systems that objects within a space should be placed near related or similar objects. We can see examples of this approach in VR-VIBE, Bead, and the forerunner to the Web Planetarium,
WWW-3D. If we apply similar techniques to Q-PIT, then we believe that even the “box” regions would give a more meaningful interpretation of the space.

**Force Displacement Positioning**

To this end, then, we have implemented Fruchterman and Reingold’s [Fruchterman 91] Force Displacement Positioning (FDP) algorithm within the context of Q-PIT. This is the same algorithm used in WWW-3D, although it has been developed from scratch in Java. It forms part of the “batch” processing of the tuple store. Here again, we have changed the representation of a tuple to contain it’s current (x, y, z) co-ordinates.

FDP algorithms begin with the nodes having a “random” start position in space, so to this end we use the current Benediktine mappings to give us this start position. We then iterate through the FDP algorithm to use the concepts of springs, attraction and repulsion to reorganise the space.

![Figure 21. The results of a Library query in a Q-PIT using FDP](image)
It can be seen that distinct, clear regions are now being generated. We have eliminated the problem of meaningless overlap, and increasing the semantics of relative positioning in the space.

**Parameterising the Process**

Just as Benediktine-style mappings are provided to the system in the form of a "command line"-based file, we have added the ability to specify weightings for each field with respect to the similarity measure calculation. This allows us to set some field's contribution to zero (for example, the ISBN number of a book does not have any meaning in relation to others (at least, I don't think so!)) or to magnify the contribution for others (for example, we may be more interested in stars or genre than in directors in the FilmFinder's data).

This is done statically at the moment. However, it may be possible to provide a more dynamic interface whereby sliders are used to specify these weightings and the Q-Space subsequently regenerated. This is unfortunately at the first step of the Q-Space generation process, and we would have to "start again" with the similarity matrix calculation. Nevertheless, it should be a useful step.
Conclusions

In this chapter, we have reported on the development within Q-Pit that seek to provide a more intelligible landscape that focuses on the displaying the internal structure of the information being accessed. This focus on developing a structure landscape complements the more speculative explorations of new navigation techniques, the presentation of history and activity and the use of different devices reported in the previous chapter.

The landscape making up Q-PIT also provides a central point of integration for the electronic landscape developed as part of the demonstrator. The Q-PIT’s focus on information entities and exploiting the properties of these entities can be readily mapped to the information resources available via an on-line catalogue. In the following chapter we shall focus on how the different lessons from the artistic installations presented in the previous chapter are merged with the emerging Q-PIT to allow the development of our real world electronic landscape.

References


Chapter Five
The abstract electronic landscape demonstrator

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In the previous chapters we considered the various components involved in the development of an abstract information landscape demonstrator. Chapter one presented an ethnographic study of the use of a library by general citizens. This focused on the ways in which a collection of users searched for material and made use of the activities of others to co-ordinate their searchers. This study motivated the development of an outline design through a series of design meetings involving developers, social scientist and artist. This outline design was presented in chapter two. The development of the demonstrator draws directly on the artistic activities reported in chapter three and the extensions to the Q-PIT electronic landscape reported in chapter four. In this chapter we wish to describe the architecture and development of the actual demonstrator and the techniques used to integrate the various components outlined in the previous chapters. Several techniques and metaphors are brought together in the abstract information landscape used in the library demonstrator:

- The notion of search trains based on the actions of users investigated within "Nuzzle Afar".
- Particle animation of force fields, based on spatial ordering of keywords from the 10_dencies work.
- Spatial and interactive representations of hyperlinked structures developing on the work of Q-Pit and the web planetarium.
- Data clouds, enclosing documents of particular categories developed as part of the extensions of Q-Pit and the web planetarium.
- The construction of new interaction and navigation vehicles motivated by the work on the Web Planetarium.

The overall goal of the abstract information landscape demonstrator is to provide visitors to the library with an alternative search method, that will help in “fuzzy” searches. By this we mean searches that typically would require the visitor to speak to a librarian to get a grip of what to look for in the library. An example is a person wanting to look for “something on dadaism” without knowing in advance how the library is structured, what categories of books there are, and so on.
Rather than replacing the existing computer-based search methods, which work well for the initiated and focused users, we seek to provide a complementary means of searching, adapted to the users outside of this category. The developed demonstrator integrates directly with the existing OPAC system to allow landscapes to be directly generated from searches sent to the catalogue system. The developed demonstrator builds upon the separation between information content and user activity outlined in chapter two by providing two closely coupled displays.

**An activity display** based on the 10_dencies keyword browser that exploits the search trails to dynamically rearrange related materials

**A content display** that exploits the extended Q-Pit landscape to lay out the information content and allow users to browse this.

Essentially these two displays are concerned with visualising two distinct, but related, aspects of the OPAC data. These two displays are linked within the demonstrator to allow effects in one display to be reflect in the other display. The linking between these different displays is achieved by exploiting the client server separations central both of the original component systems and exploiting the on-line availability of the OPAC interface.

**Architecture of the demonstrator**

The demonstrator landscape interacts through the internet with the on-line public access catalogue (OPAC) provided by the library. The developed demonstrator draws upon the information resulted from issued OPAC searches to construct an electronic landscape, build search trails and drive the self organising model showing the activities of others. The main components of the demonstrator are briefly summarised in the sections below.

**OPAC and the wOPAC log**

This is Lancaster University's library search system. Implemented in Pick as a bespoke application, in order to aid integration it was decided to focus on the use of single shared repository. This was based on a standard relational database.

The Web-based version of OPAC, wOPAC, also maintains a log which records user's searches. This forms an important basis for the development of search trails.

**Trail Converter**

This application processes the contents of the wOPAC log and heuristically extracts sets of user trails through the OPAC database. These are then stored as a relations in the central data repository for further processing by the 10-Dencies system to allow the presentation of activities.
Data Extractor

This forms the main interface between the presented electronic landscape and the OPAC database. When the end-user of the landscape issues a request based on specifying a keyword, the Extractor first of all checks to see if such a request has previously been made and the results stored in the central shared repository. If so, it returns the associated query identifier. If not, it passes the request onto OPAC itself, captures the results which it parses and stores in the relational database. It then returns the new query identifier associated with these new results. This concludes the interaction between the electronic landscape and OPAC; all subsequent processing is based on the central relational repository.

MySQL database and ODBC/JDBC

To provide a central repository that both the two display components of the electronic landscape could use as the basis of their processing, we chose the MySQL relational database management system. This built upon previous experience of database use across the project and also allowed us to make use of the established ODBC and JDBC interface libraries for SQL server style systems.

Q-PIT and DIVE

To provide a visualisation of the results of an end-user keyword retrieval request, we adapted a version of Q-PIT with data clouds. This new version of the system provides a dynamically changing and animated display of the initial processing of the results of the request, arriving at a clouds-based representation for further browsing.

The requirements for the Q-PIT developments underpinning the demonstrator electronic landscape showed a need for a Java native interface to the DIVE visualisation system. This has been provided, and the technical aspects of this work are described in deliverable 5.1.

10-Dencies keyword browser

The 10-dencies browser provides an aggregated display that exploits the activity of users to highlight related keyword that may be of interest to the users of the system. The trails are used to rearrange keywords and show the strength of relations between these users.

The general architecture of the demonstrator and the relation between these separate components is shown in Figure 23.
The Q-PIT/Clouds and 10-Dencies components make use of the data stored within the MySQL database and process it to generate the visualisations presented to the end-user.

In the remainder of this chapter, we shall consider the interface to the OPAC system at Lancaster, the way in which trails are generated from OPAC interface and the visualisations presented to the developed users. In the following chapter we shall consider how the demonstrator is presented to users and the way in which they may interact with it. We shall begin by considering the on-line facilities provided by the University OPAC system.

**Populating the database from the OPAC System**

The Lancaster University's OPAC System provides a query-driven interface to the library's stock of books, proceedings and journals. Using this general interface, the user can give a set of values for author, title, keyword etc. and obtain a set of book records in return for perusal. A description of the use of this interface is provided in the studies described in chapter one. It can also be accessed via a Web-based interface that also generates a log file of user requests and these can be used to allow the formation of search trails.
The actual OPAC system currently used is bespoke software written using the Pick system -- this meant that there is no obvious route for building additional software to access the information stored within it. As a result we use a relational database to cache results of searches and have simple text based protocols for moving the information through the system. This meant that results of queries were parsed before being stored as relations within the central mySQL database.

The mySQL Database and ODBC/JDBC

The developers involved in this part of the work had prior successful experience with the mySQL relational database, a piece of public domain software and this was chosen as our central repository. Once the "pre-processing" of the OPAC and wOPAC log files have been done, the results are stored in a number of relations within the mySQL central repository. This then makes these available to both displays and allows these to be exploited across the sytem.

This arrangement allowed both the content display (based on Q-PIT) and the activity display (based on 10-Dencies) have a much friendlier repository to interact with on a regular basis, via established ODBC and JDBC SQL server style interfaces. Indeed, the 10-Dencies activity display need never contact the OPAC directly, and the Q-PIT interaction is limited to a single point of the process.

The mySQL database can also be seen as a "cache" for keyword requests and the resultant lists of book returned.

Populating the database

When the end-user issues a request to the Library demonstrator, it takes the form of providing a keyword (or search term). This is passed onto the Data Extractor. The Extractor talks to both mySQL and OPAC. It can check initially whether this request has previously been processed and the results "cached" within the mySQL database. If so, it returns the associated query ID to the electronic landscape.

If not, it passes the request onto OPAC via a socket connection. A query is issued on the OPAC and the results extracted using a simple text based protocol. The Extractor then parse the textual results returned from OPAC and converts them into a suitable record for storage in the mySQL database.

Finally, it returns the new query ID to Q-PIT/Clouds. OPAC conversation takes time, and the end-user will notice a considerable "speed-up" if their search term can be processed via the mySQL "cache".

The basic relation "books" (Figure 24) stores the information retrieved by the Data Extractor in response to a user query (which is simply the specification of a keyword). The returned results are parsed and stored in the MySQL relation. The fields "pub", "pubdate" and "pubtype" refer to the publisher, the date of publication, and the type of publication (book, CD, thesis etc.) respectively.
Each keyword request is given a unique number and stored in the "query" relation (Figure 25).

Finally, a list of books selected by that keyword are stored as (query number, isbn) pairs in the "queryisbn" relation (Figure 26).

When the prototype issues a keyword request, the query number it has been assigned is returned. Note that this might come from processing the query via OPAC and giving it a new number, or else it might be a stored query number arising from a search of the "query" relation.

Once the prototype has this query number, it can retrieve the set of appropriate book records using the following simple SQL statement:

```sql
Select *
from book b, queryisbn q
where b.isbn = q.isbn and q.number = query_number
```

### Acquiring the Trail Data

In addition to representing the results of queries within the database we also store a significant amount of information about the previous actions users on the catalogue. This information is generated from the OPAC log which maintains an anonymous list of previous searches. This log provides the basis for our development of trails in the demonstrator.

Every line in the log-file created by the web-based OPAC interface consists of seven fields, separated by the special character ‘#‘ and represents an answer of the OPAC database to the query of a user. Figure 27 shows an excerpt from an OPAC log file. The first field shows the ISBN of a found book, followed by date, time, IP number of the originating host and search type of the query. The last field shows the search term. In this excerpt, the logs from three hosts are interleaved.
Figure 27. An excerpt from an OPAC log file

The fields in an output line give information about:

1. the ISBN number, representing a book found for the query
2. the date of the query
3. the time of the query
4. the IP number of the host on which the query was issued
5. the search type of the query (title, author name, keyword etc.)
6. the users position in the menu tree at the time he issued the query
7. the query itself

If a query results in many books, every found book produces a separated line in the log file (in this case, the query field has the same content for each line).

Since many users can use the system in parallel, the lines, related to one user are usually interleaved with the outputs related to other users queries in the log file. Luckily, one of the logged fields is the IP address of the host on which the query was issued, hence it is possible to extract just the output produced by the sessions on one host (possibly held by many users). Of course, all queries logged for one host during the day, are usually not produced by the same user. To distinguish between one session and the next, a certain period of time is assumed to lie between consecutive sessions.

Creating the Trail Data

A JAVA application does the conversion and filtering of the OPAC log files and fills the trail and the searchterm table in the library database. The trail table basically represents the same data as the entries found in the log file. In addition, a trailid is assigned to every entry which belongs to the same user session. The trailid is also the primary key of the trail table in the database and allows for quick retrieval of individual trails (e.g. “select * from trail where trailid=67”).

The converter also tries to filter entries from the log-file which do not make much sense with respect to the intended user interaction with the visual client. Thus, entries with an empty search term or an empty ISBN (i.e. a number of 0000000000) are skipped during the conversion process. Additionally, during the same process, all search terms are uniquely stored in a separate searchterm table.
and only references to them are memorised in the *trail* table. Figure 28 shows the *trail* and *searchterm* tables of the *library* database. The *termref* field in table *trail* references a unique entry in the *searchterm* table.

<table>
<thead>
<tr>
<th>Field</th>
<th>Trailid</th>
<th>type</th>
<th>Termref</th>
<th>dtime</th>
<th>Ip</th>
<th>isbn</th>
</tr>
</thead>
<tbody>
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<td>Int</td>
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<td>char(10)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field</th>
<th>Termid</th>
<th>term</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Int</td>
<td>varchar(255)</td>
</tr>
</tbody>
</table>

Figure 28. The *trail* and *searchterm* tables of the *library* database

**Presenting the Information to Users**

The data extractor and the trails building software transform the information available in the OPAC system and place it within a shared repository. This shared repository is then used to present the information to the two main display components making up the abstract information landscape demonstrator. Each of these components interacts with the MySQL and generates an appropriate set of displays. In the following sections we provide a brief overview of each of the two major displays and outline how these present the information to users. Each of these displays are constructed from a search initiated from a display that prompts the user for the keyword they are interested in. In response to this, the keyword selected is passed onto both the content display and the activity display.

**The content display**

The central interface for the demonstrator is the content display. This display presents an information landscape constructed from the contents of the OPAC database. The contents of the landscape and display are constructed from the results of a user-initiated query. This is based on the developments made to the Q-PIT landscape presented in chapter four.

The Q-PIT landscape passes the keyword onto the Data Extractor and gets in reply a query identifier. It then uses this identifier to query the MySQL repository to obtain a list of books. This list is then to generate the data clouds. This general process is represented and animated as part of the DIVE visualisation. The steps which are followed include:

As before, the Benediktine mappings are used to generate "random" start positions for the representations of the books. However, these are now gradually added to the visualisation and are animated into position. Each book representation initially appears at (0,0,0) and is then set in motion towards its final Benediktine position. This process is also used to indicate to the end-user how far the system has progressed in building the initial similarity matrix. Each
point appears in the Q-Space once its corresponding entry in the matrix has been completed.

The user doesn't really need to know the details behind the similarity matrix but can still use this style of display to understand that some kind of processing is taking place and to appreciate how far along the processing is.

Next, the minimal spanning tree is calculated. At the end of this process, we add the links to the visualisation.

The sub-graphs are extracted as the basis for region identification. At this point, we introduce the use of colour to identify the regions, and we can colour the book representations appropriately.

The force-directed placement algorithm is now applied to make the regions appear more clearly. As the algorithm does its work, the book points are moved through the space towards their current (volatile) position, and undergo course corrections as and when required. The graph links follow this motion naturally. At the end of this process, the books are in their final positions.

The hull-based cloud generation algorithm is applied, and the clouds added to the display (Figure 29). This process is described in more detail in chapter six.

The Q-Space is now ready for browsing by the end-user.

![Figure 29. The results of a Library query in a Q-PIT using FDP](image)

Users can interact with this generated landscape using a set of specialised navigation facilities. The means of interaction and navigation with the environment are described in the following chapter. Users can interact with the electronic landscape through both the content display and the activity display.
The Activity Display

To give an additional way of interaction with the OPAC database into the hands of the user, the visual client component of the IO-dencies|Sao Paulo project was chosen to make relationships between different search terms visible, which already occurred in former OPAC sessions by other users (search terms are replacing the keywords from the Sao Paulo project). By utilising a new self-organisation algorithm, several search terms which have occurred in common trails, seek to cluster and form visual groups. Whenever the user enters a new search term in the main query window, this search term will be sent to the visual client. If the entered term already exists in the searchterm table, the user will be automatically presented with an updated view, centred around the search term. Related search terms will be visible and selectable in the immediate neighbourhood.

From the original IO-dencies set-up, the data browser and sound system sub-components from the visual client have been dropped together with the HTTP server and the CGI script (which were only necessary for the data browsing via standard Netscape).

![Figure 30. A snapshot of the visual client showing some of the search terms in the database](image)

In order to adopt the existing Visual Client component to the demonstrator, several changes and additions were necessary to reflect the changes done to the database and the nature of the acquired trail data on one side and the way how the interaction between the components and the user takes place on the other side. The following paragraphs describe these changes for every component.
Visual Client

To allow the exchange of search terms between the visual client and the QPIT component, a separate thread has been added to the main process, which waits for a TCP connection on a special port. Once established, whenever the user clicks on a search term in the client window, the selected text is transmitted over this connection. If the client receives a search term over that same connection, it queries the force-field server to lookup the term in the database. If the term exists, the force-field server sends an updated force-field back to the client, resulting in an automatically updated view on the screen, with the search term at the centre and the immediate neighbours around it.

Because of the much stronger clustering of the keywords, due to the different self-organisation, the stroked fonts, used in the original client turned out to be unsuitable because they scaled together with the zooming function, thus preventing to separate at some stage. Therefore, the rendering of text was changed to use bitmap fonts of a fixed point size. Now the terms become clearly readable at a certain zoom stage.

Force-Field Server

The only change necessary to do to the force-field server was an additional command to be accepted from the visual client and which allows to lookup a certain search term by it’s text string in the database. If the this term exists, the force-field server sends an updated force-field to the visual client.

Self-Organisation

The self-organisation, as in the Sao Paulo project, has the purpose to exploit relations between data objects and to group related objects as spatial clusters. In IO-dencies|Sao Paulo these relations where smoothly defined by the distances between any pair of keywords on the keyword maps by the editors. For the library demonstrator, these relations, in the form of attracting and repulsing forces, have to be defined and extracted (or exploited) solely from the available trail data.

For any possible pair of search term objects, the number of trails in which both of them occur is counted and stored in a two-dimensional lookup-table. During the numerical simulation of the motion of all objects, this number is used as the multiplier to a predefined base-force value. If for one object this multiplier is zero for all possible pairs, this object is said to be free-floating. Objects with a multiplier greater zero will be attracted by one or more other objects and, over time, will form spatial groups. To prevent a final, stable state, all objects are forced to maintain a certain minimum speed.

<table>
<thead>
<tr>
<th>field</th>
<th>oid</th>
<th>sotermref</th>
<th>posx</th>
<th>posy</th>
<th>Velx</th>
<th>vely</th>
</tr>
</thead>
<tbody>
<tr>
<td>type</td>
<td>int</td>
<td>int</td>
<td>real</td>
<td>real</td>
<td>Real</td>
<td>real</td>
</tr>
</tbody>
</table>

**Figure 31.** The soobjs table of the library database
Figure 31 displays the soobjs table of the library database. Shown are the most relevant fields. For every unique entry in the searchterm table, a corresponding soobjs entry exists. The search term objects and all related data are stored in the soobjs table in the database and there is a one-to-one correspondence between the soobjs and the searchterm table. The soobjs table remained unchanged from the Sao Paulo project and stores values as the current x-y position, velocity, direction etc. as well as a reference to the corresponding search term.

At the moment, interaction between the content display and the activity display is focussed on the initial keyword (or search term) entered by the end-user. If the end-user enters a new term, the content space is regenerated and the focus of the activity visualisation shifted towards the new term. It is also possible for the end-user to select a term from within the activity visualisation; this is then entered into the original keyword window and a new content space generated.

Conclusions

In this chapter we have considered the overall architecture and construction of the abstract electronic landscape generator. The demonstrator interfaces with the existing on-line catalogue and allows this information to be presented to users as an electronic landscape. The core of the architecture is a shared electronic database realised in mySQL. This database allows both the content of the catalogue and the surrounding activities to be represented.

The demonstrator electronic landscape is presented to users through two displays a content display focusing on the structure of the landscape and an activity display that shows related areas of the landscape based on the previous activity of users. These two displays are kept in step using a simple keyword based message system.

In the following chapter we shall briefly present the navigation and interaction facilities provided to users through both the content display and the activity display. This description will focus on how the system may be used to locate information in the library. This abstract description will be complemented in chapter seven by a brief review of the results of our initial studies of the use of the landscape by the citizens within the library.

References


Chapter Six
The Demonstrator in use

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In this chapter, we describe the interface presented to the user and the functionality provided to users of the thematic demonstrator. The previous chapter considered the overall structure of the demonstrator and the means by which the individual components communicate. We complement this architectural description by providing a description of the demonstrator in terms of how the user interacts with the system and how the electronic landscape appears to respond to these interactions. When necessary we will refer to what is going on behind the scenes, particularly where this affects the response and behaviour of the system but the overall description will focus on the interactive experience of the user.

Before we begin the description of the demonstrator in earnest it is worth stressing that the demonstrator (like the tourist electronic landscape described in Deliverable D4.2) is embedded within a strongly iterative development process. Consequently, the demonstrator is open to on-going and continued refinement as the demonstrator is exposed to users for testing and comment (see chapter seven) and the prototype is amended as a result of the comments from users and their debriefing meetings. As a result of this on-going refinement of the demonstrator what is presented in this chapter represents a snapshot of the demonstrator and a moment in time. Similarly, the assessment in the following chapter while drawing out general issues represents a study of the demonstrator at a particular point in time.

As a final caveat we would like to stress that the development of the Demonstrator continues apace (particularly that of the Q-PIT-based component), and the description presented here is actually in advance of the version of Q-PIT used as the initial user study. Indeed some of the lessons from the version of the demonstrator presented to the user have already been factored into the interface and we stress the points where lessons have been learnt from the on-going studies of use. In addition, where significant features differ from the user study are indicated. The interface presented here has also been refined from the version of Q-PIT presented as part of the eSCAPE CD-ROM. However, nearly all of these interface alterations represent incremental refinements rather than radical redesigns of the nature of the electronic landscape.
Starting Up

The overall architecture of the demonstrator is presented in the previous chapter of the deliverable and throughout the description in this chapter we assume that the architecture presented in chapter 5 (figure 24) is established and working. For example, the Data Extraction Module must be executing somewhere in the background. The user, however, should only be aware of three components: the DIVE visualiser; the IODencies display; and a single "Keyword Entry" window (Figure 32).

There are three ways in which the user can fill in the "keyword" slot:

a) by typing directly into the slot (e.g. “marx” above)

b) by using the pull-down menu to the right of the slot. This consists of a list of previously executed searches. This list is simply retrieved from the MySQL database "Query" relation. This feature has been added since the user trial.

Once a keyword has been chosen through interaction with the "keyword" window, it is transmitted via a socket interface to the IODencies system which then uses this new keyword as the focus for its display.

c) by interacting with the IODencies cloud display. The user can select a keyword from that window and it will appear within the "keyword" slot, transmitted to the Q-PIT system via a socket interface.

We can see then that, for the prototype, it is via this socket interface that integration between the Q-PIT and IODencies visualisers is achieved.

In Response to the Keyword

Now that a keyword has been provided, the two visualisers must respond and use this as the basis for their displays.

IODencies

The IODencies system responds to a new keyword input by searching for the keyword in the mySQL trails database for an exact match. If no match is made
(and therefore no trail in the current trails database has used this keyword before) then the system ignores the change of keyword command.

If the trails database has the keyword then the display is updated to “centre” on that keyword, showing the related keywords involved in connected trails around it.

**Q-PIT/Clouds**

This component has considerably more work to do to respond to a new keyword as it is the books which match the keyword that form the basis for the information terrain to be constructed. Because there is a non-trivial amount of processing to be carried out before the final “result” can be shown to the user, we wish to avoid the situation where the user sits watching an empty screen. Moreover, we do not wish to present the user with meaningless displays. We believe it is possible to provide information-carrying animated production of the space rather than have the final version suddenly appear, full blown without indication to users.

We have discussed the processing involved in producing a display elsewhere (chapters four and five), but we will briefly indicate aspects here to support our description of how the Q-Space is formed and how this formation is presented to users.

Our experiences with users highlighted the benefit of animating the formation of the electronic landscape as means of conveying the underlying algorithm characterising the formation of the landscape. To further support the animated production of the Q-Space, we have recently added animated progress bars and stage indicators to the 3D display (Figure 33). These animation facilities resulted from the trials and assessments reported in the following chapter.

![Figure 33. Progress bar and stage indicator](image)

These are used throughout the process, but are particularly useful during the initial data retrieval stages, as it is quite difficult to think of a meaningful space-based animation. The two initial stages are when we must check to see if a previous result is cached in the MySQL database; if not, we must ask OPAC and also add this new result to the database.

There are now two progress bars in use: one for telling us how many OPAC records we have processed, and a second one (which replaces the first) which tells us how many records we have added to MySQL.

Once the search results are in the MySQL database, we can retrieve them and store them within Q-PIT's own tuple store. It is from here that all further space
generation processing is carried out. A message is displayed to the user indicating that we have truncated the results of the search.

The next stage is the formation of the similarity matrix. Here, we "spit out" each tuple into the space once its similarity against all other tuples has been calculated. This is a two stage process. First of all, a Benediktine-based calculation of every tuple's position is carried out. This allows us to calculate the final position of each tuple's graphical representation in Benediktine space, and also the boundaries of an enclosing box for said space. Secondly, we calculate the three-dimensional centre of the bounding box. This is the start position for each graphical representation, and it is directed towards its final Benedictine position.

We feel that this initial presentation of the tuples (or books, in this particular demonstrator) gives the users a feel for how many books have been returned as part of the search, and also an initial glimpse of what is available -- for example, the title of each book is visible at a glance as a label for each graphical object.

The next stage is the extraction of the minimal spanning tree. This doesn't lend itself to a graphical animation, and so we use a progress bar. However, this currently appears to be a very fast process, and the progress is rarely shown for any significant period.

Following this, we identify regions within the tree. Again, it is difficult to construct a suitable animation to represent this and another progress bar is used. Once regions have been identified, we associate a colour with each object, and this allows us to simply colour in each region in the space.

The penultimate stage is the most process-intensive, and involves applying a force-directed placement algorithm on the minimal tree. Again, we use a progress bar, but we also animate the relocation of the objects within the space. This provides a pleasing (according to users) display of the objects “swarming” about the space. Because objects of the same colour should be positioned near each other, the users can observe this behaviour as the algorithm settles down the graph (see video segment in eSCAPE CDROM).

The final stage requires placing of links and clouds; as this involves adding 3D objects to the space, it is natural to simply watch this process occur. Originally, we displayed all the links in the space, but for objects within a cloud, these links are implicit. There is no need to clutter up the space, so we no longer show intra-cloud links. However, links between nodes in different clouds are important as they show inter-cloud connections and these are still displayed. It may be possible to think of such links as paths.

## Interacting with the Space

Once the space has been generated in the Q-PIT, or centred on in IODencies, users are free to interact and navigate with the display. The following sections describe how this is done in both systems.
IODencies

The IODencies system presents a two dimensional space where navigation and selection is entirely done through a two buttoned mouse (Figure 34).

![Figure 34. The IODencies system](image)

There are two types of navigation in IODencies – moving and zooming. Moving consists of moving the users “window” of view on the flat to a new position and is performed by pressing and holding the left mouse button. While the button is depressed an indicator appears around the last position of the mouse which “points” in a given direction (see Figure 35). By moving the mouse the user can rotate this directional indicator around the original mouse cursor position. When the left button is finally released the system moves the users view in the direction indicated by approximately one screen.

Zooming allows the user to zoom into or out of particular regions of the space and is performed by pressing and holding the right mouse button. While the button is depressed the user can select “zoom in” (Figure 36) by moving the mouse in the X-axis, and “zoom out” in the Y-axis. The amount of zoom is preset (it does not depend on “how far” the user moves the mouse) and when the user releases the right button the system updates the view with the new zoom factor.

![Figure 35. Choosing a direction to move in](image)
Once the user has reached a certain level of zoom he can choose to select objects in view by moving mouse over the text label and left clicking on it (Figure 37). Although the system itself does not perform any function in response to this click the Q-space application uses this action to receive a new keyword (as described earlier in this chapter).

Q-PIT/Clouds

Many users have difficulties navigating in a simulated 3D environments. In the “physical” type of e-scapes, like the TIC demonstrator described in deliverable 4.2, implicit affordances of the type of space can be provided to provide users with everyday cues for users to navigate by. For example, roads and paths on the “ground” and the different recognised communication paths discussed in the work of the first year of the project. Our first year work focus on understanding different style of electronic landscape and the extensive studies of users of the ZKM stressed the importance of the learnability of electronic landscapes and the need to provide mechanisms that provided familiar cues in order to mage the landscapes legible to users.
In more abstract e-scapes however, like the Q-Space, the development of appropriate cues is even often problematic and users often experience difficulties "getting to know the space". Features such as ground planes often make little sense in such an environment, as the data being represented often has no “right way up”. The experiences from our studies of users though the development suggest that these types of abstract spaces accent navigational difficulties for users – who experience disorientation and difficulties moving, locating objects and so on.

In an attempt to enable users to interact with the Q-space in a quick and easy fashion, a new “vehicle” was developed in Dive. The vehicle has two modes of interaction – “point and click” and “browse”. Users move between these modes by pressing the space bar.

In the first mode we can select a graphical object in the Q-Space by simple "point-and-click". Selecting an object causes its visual appearance to slightly alter (Figure 38) and causes a window to open up (Figure 39). Simultaneously, the HUD (Head Up Display) within the DIVE visualiser presents the same information (Figure 40). We feel it would be best to minimise the use of external (to DIVE) displays, allowing the user to focus on the Q-Space itself, hence the introduction of the HUD (and progress bars and stage indicators) within DIVE itself.

Figure 38. A selected object

Figure 39. The tuple display window
The tuple display window has some additional functionality, most of which we hope to replace with DIVE-oriented equivalents in the near future. For example, we can build a "shopping list" of books in which we are interested. This list can persist across different searches and so is session-oriented. We can also obtain a list of tuples that share the same region as the selected tuple (Figure 41).

We are free to "point and click" on any visible object in the 3D window; this centres this new object within the display and updates both the HUD and the tuple display window.

The second method of navigating using the vehicle - “browse” - alleviates many problems about users “loosing” the data in the space. This occurs when attempting to navigate around the space to locate objects that cannot be seen from their current position or objects that are obscured (being behind a cloud or another object for example). Unfortunately, mechanisms and vehicles traditionally used in very many other 3D environments become very complicated to use for true 3D navigation. These often requiring keys to look up-down-left-right; rotate left-right-up-down; move up-down-left-right, or permutations thereof. Not only is this difficult to actually use, even for “experts”, but users can easily become disoriented. Symptoms of this disorientation include looking away from the data (with no frame of reference to get back), or moved to a location where the data is completely above them or some distance away.

In browse mode, a user always moves in the space with respect to the last selected object (in the “point and click” mode). In this mode the mouse pointer disappears and all mouse movements allow the user to “orbit” around that selected object, maintaining the users view on the object. It is impossible for users to get lost and “look” away from the data because the view is always fixed on the central selected object. They effectively move around a sphere of a changeable radius which always points towards its centre. The distance away
from the object can be changed by pressing the cursor up or down keys. Users can return to the “point and click” mode by pressing the space bar again.

The HUD also provides us with a further point of interaction which was not available in version used in the user studies: by selecting one of the fields, the field becomes the label of the graphical objects (Figure 42). This turns out to be an incredibly useful function as it allows us to examine the contents of the graphically represented tuples as a group. For example, if we were interested in the authors of the books, it would be quite tedious to select each tuple in turn to uncover the names of the authors. With this functionality, we can see at a glance the authors associated with this search result. It can also provide confidence in the organisation of the space which has been returned by the system. For example, if the user has strongly weighted classmarks, then books with the same classmark should appear in the same region.

Figure 42. Q-Space labelled by classmark and author

Regenerating the Q-Space

The layout and arrangement of bodies within the Q-Space is also open to manipulation and alteration by users of the space. In fact, this very rearrangement is often a key resource in understanding the space. Once a Q-Space has been generated, users may cause the space to be regenerate by altering a selection of key parameters that affect the similarity measures calculated between the entities in the space (in this case the books being returned).

Initial layout of the space is calculated from a default set of similarity factors and the objects are positioned based on these initial settings. Users can then effect this similarity calculation by altering a number of key parameters that effect the similarity matches calculated between each object attribute. The two principle factors are central to the manipulation:

- The weighting factor allows matches between different attributes to be given greater or lesser importance.
- The exactness factor allows the precision of the comparison between attributes to be varied.
The weighting factor

The similarity measures used normally lie between zero (no similarity) and one (an exact match). The aggregate similarity measure between two entities results from summing the similarities between each field and dividing it by the number of fields. Each field is compared according to its type (a string of characters or an integer) and by the range of values stored (in the case of an integer).

We can stress the importance of particular fields by providing weightings factors that are applied to the result of the field comparison before the aggregate similarity is calculated. This factor could be zero (no importance), fractional (minimal importance), or a multiple (greater importance). For example, if we believe that authors of a book have no importance for the search result this field can be given zero weighting. If we are greatly interested in only specific callmarks this could have a maximum weighting factor.

As we had hoped in designing the system, different weightings produce very different displays of the same search space generated and these different displays often proved illuminating to users.

The exactness factor

As a direct result of our ongoing formative assessments we have complemented the weightings factor with the development of an exactness factor that allows us to relax the precision of comparison. Perhaps the best way to think of the exactness factor is to consider it as a threshold applied to the calculation associated with each field similarity calculation.

If we have a threshold of 0.8 (say), then all similarity calculations above this threshold are returned as normal – so if a match is 0.91 then we return 0.91 as the final similarity. However, if the calculation was less than the threshold, say 0.2, then we return 0.0 as the final similarity. We apply this determination after the weighting has been factored in.

Initial experience reported from our on-going trials suggest that this is a very influential mechanism for affecting the space layout, particularly where users are interested in ranged values like publication date.

Manipulating the comparison factors

These two factors in conjunction with changing the fields involved in the calculation of the aggregate similarity allow users to fairly radically alter the layout and position of objects in the space. In order to do this users must be able to apply each of these two factors to the different fields associated with entities in the space and consequently alter the positioning of entities in the space. Two dialogue windows are key to the manipulation of these factors, the advanced space which allows direct manipulation of these factors and the user window that provides access to a restricted set of profiles for these factors.
The Advanced Window

The user can directly interact with the weighting and exactness factors for each field via the "advanced" window. At the time of the trial reported in chapter seven, this window was known as the "weights" window and consisted only of the weights sliders (on the left), and the threshold slider (on the bottom left) (Figure 43).

![Figure 43. The advanced weightings window](image)

In this window the threshold slider is used to set a threshold to be used during the production of the minimal spanning tree determining the layout of objects in the space. It is normally 100 although we have found a setting of 75 improves the appearance of the tree at the conclusion of the force-displacement algorithm. Edges of the graph are normally only incorporated within the minimal spanning tree if they do not duplicate existing links (or would create a cyclic link). However, this often results in very flat 2D terrains where regions have a small number of members. These additional links, which do not contribute to the region identification process, appear to make regions more three dimensional - spheres and pyramids rather than circles and triangles.

The User Window

Our experiences of our on-going trials suggest that the advanced window is a complicated interface and can be difficult to juggle the underlying concepts of weighting and exactness. Essentially, it requires users to understand to some extent the nature of the calculations used to construct the space. Indeed, this started to manifest itself when trying to explain exactly what the “threshold” slider did in the user trials reported in the following chapter– and the problem was manifest even before a second set of sliders was added to control the “exactness” of each field.

In an attempt to simplify the complexity of manipulating the search a simper "user" window has been added(Figure 44).
This user window provides the user with three options which are mapped onto weightings and exactness profiles as follows:

<table>
<thead>
<tr>
<th>Setting</th>
<th>Weighting factor</th>
<th>Exactness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Medium</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>High</td>
<td>10</td>
<td>1</td>
</tr>
</tbody>
</table>

Undoubtedly these settings will require further experimentation and tuning. For example, we have equated "little" with no importance at all. Perhaps we need a "no importance" setting as well. Our fear is that users might worry that everything is slightly important and so would never actually use "no importance".

**Rebuilding the space**

Once the weightings and exactness settings have been determined, the user can click on the "go" button of the user or advanced windows (see Figure 43 and Figure 44) and the process of generating the space begins again. As it is the same search as before there is no need to add or remove objects representing the books again. The actual region clouds and links may differ from the previous arrangement of the search result so these are deleted from the space.

As the similarity matrix is regenerated according to the new similarity factors, each object loses its region colour. The removal of colour from the space acts as an animated indicator of how far along in the matrix calculation the system is. From this point on, regeneration continues much as for the original generation of the space.

**Conclusions**

In this chapter, we have attempted to describe how the Library Demonstrator appears to the end-user; the interface it presents to that interface can be used, and the behaviour of the system in response to user actions. The interface presented in this chapter represents a snapshot of an evolving on-going interface which is emerging in conjunction with a series of on-going assessments and trials of the interface in use.
These formative assessments play a central role in the development of the interaction approaches used to present the electronic landscape. These assessments have been undertaken in a highly situated manner with the combined involvement of the developers of the electronic landscape, citizens who regularly use the library and social scientist who have undertaken extensive studies of the nature of the library the activities of those who make use of the library. In the following chapter we present one of the assessment sessions that have been used to uncover the shortcomings and problems with the way in which the electronic landscape is presented to users and has driven the on-going amendment and development of the overall application.
Chapter Seven
Situated Evaluation of the Demonstrator

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Adopting the strategy towards evaluation emerging from the study of the artworks-in-use, the library demonstrator was studied under the auspices of ‘situated evaluation’ (Del 4. Chapter 3). This is a strategy directed towards elaborating technical designs through confronting computer-based artefacts with end-users and practical circumstances of use. In line with more traditional forms of ‘usability’ study, situated evaluation is an observational exercise oriented towards the performance of usability trials. Specifically, to the ways in which users accomplish the activities that they are asked to engage in; to the practical problems they encounter in doing those activities; to the confusions that arise in the doing; and the solutions devised to make the technology work in situ.

Formative and situated assessment

The principle aim of this form of evaluation is to provide formative feedback on the shortcoming of the interface and to uncover the issues that need to be addressed in the development of the application. This formative approach to assessment is somewhat in contrast to more traditional summative assessment. Consequently, the assessment reported here explicitly does not seek to provide any measure of the "success" of the application or the overall user acceptability of the application.

The overall acceptability and utility of the application form a small part of the general assessment of the application. The main focus of formative assessment is on uncovering those issues that are inhibiting the use of the application and to develop strategies that allow these barriers to use to be lowered to encourage the eventual uptake and use of the system. The report presented in this chapter reflects this role of assessment in design in that it provides fairly detailed accounts of how the system was used, the places where breakdowns and repairs occurred and identifies the issues which need to be developed to encourage the usage of the electronic landscape.

In addition to it formative role, situated evaluation unlike more traditional forms of usability study is not concerned with assessing abstract lab-based tests.
nor isolated user interactions with the machine. Usability trials consist of distinct sequential orders of work that are the socially organised cooperative achievement of the trail’s staff: users and demonstrators (or testers). It is an attention to the arrangements of cooperation whereby the technology is made to work by the trial’s staff that is largely overlooked in usability trials and which becomes the focus of situated evaluation as it is in and through the cooperative ‘work’ of the trials’ staff that use is engendered in real-time.

Insofar as the cooperative work engendering use is passed by in the course of conducting more traditional usability studies, then there is something ‘missing’ in analysis. The study of artworks-in-use suggested that the ‘missing what’ of the matter consists of locally produced ‘engagement sequences’ unreflectively, but nevertheless skillfully, constructed by demonstrators in situ and in the course of interacting with users in engendering use. Sequences of interaction engendering use are unique, tied specifically to the technology under evaluation. Furthermore, their construction consists of recurrent organisational phenomena which may be oriented to, documented, and analysed in conducting situated evaluations. Notably, engagement sequences consist of distinct courses of instruction, and each and every course of instruction consists of distinct ‘component events’; such as ‘introducing’ the user to the technology, ‘pointing out’ engagement features, training the user in competent use of particular engagement features, and so on.

Placing an emphasis on problems of achieving use, contingencies, confusions, and the like, the approach may appear to be unduly critical. Although a critical attitude is a practical feature of situated evaluation it is not Luddite in intent. On the contrary, attention to the ‘lived work’ of the component events comprising the sequence of engagement serves to elucidate the activities the system will be embedded within and in such detail thereby serves to inform design in a constructive manner. If the approach appears critical, then it is in elaborating activities the system should support and problems it should resolve – but does not yet support or resolve - if it is to be adopted and employed in real-world, real-time circumstances.

Real-world, real-time circumstances of use are the abiding concern of situated evaluation and as such the approach attempts to bring two distinct yet mutually compatible competences to bear on the invention and development of new technologies. On the one hand, recognising the irredeemable sociality of systems use, the approach attempts to apply (and further develop) ethnographic techniques to the study of technology usage. Here emphasis is on arrangements of cooperation, particularly the practices whereby activities are organised and accomplished so as to produce recognisable arrangements of cooperation – practices within which the system will be embedded and transform, an awareness of which is therefore crucial to successful design. On the other hand, recognising that end-users are the true experts in the accomplishment of activities (whether in the library, the home, or wherever), the approach attempts to apply cooperative experimental techniques in relatively novel circumstances: blue-sky research and development. Here emphasis is placed on enabling users to get ‘hands on’ the
future and on confronting visions of future practice embodied in prototypes with current practice thus bringing practical circumstances of use and end-user requirements to bear on design. In the meeting between current and future practice, problems, contingencies, confusions, and solutions arise and the future is ‘worked up’ iteratively and concretely here in the present in the face of current practice, its potentials and constraints.

The attempt to bring ethnographic and cooperative experimental competences to bear on the design of electronic landscapes of concretely indeterminate character, in contrast to work-oriented systems of relatively well-defined character, represents a significant challenge to the two approaches towards ‘user involvement’ in design. The challenge for ethnography might be characterised as moving from an ‘informative’ to a ‘formative’ (or constructive rather than sensitising) position within design (becoming a concrete member of the bricolage of expertise as it were in contrast to an occasional and often eclectic contributor). For cooperative experimentation, the challenge is one of moving from work-oriented to blue-sky development in which the approach has been construed as problematic due to the radical indeterminacy of the endeavour – as such, users are only to be consulted late in the design process. The effort here, by contrast, is to consult users fairly early in the design process thereby ‘working up’ designs, infrastructures, and techniques in cooperation with end-users and in the face of practical circumstances of use.

In attending to the practices whereby activities are organised, and distinct arrangements of cooperation produced, and in bringing end-user competences and practical circumstances of use to bear early in design, the aim is to reduce the risk of ‘failure’ – a refusal by end-users to employ new technologies in the course of conducting their everyday affairs (such as searching in the library). Situated evaluation constitutes one approach towards the systematic incorporation of both a social and cooperative experimental perspective into blue-sky research. The approach emphasises a shift in focus away from the user and machine *per se* to the *embodied work of the interactional staff* whereby computer use, with all its occasioned problems, contingencies, and confusions is observably achieved in and as the very course of accomplishing the ‘trial’.

**Library demonstrator-in-use**

The following (edited) sequence of talk was preceded by an introduction by the ethnographer (Andy) telling the users (Tina, Claire, Simon, and Vince) about the eSCAPE project in general, the library prototype in particular, and studies of search behaviour in the library. Emphasis was placed on the ‘topic’ based character of search activities which the prototype is intended to support, and the prototype as a means of exploring and experimenting with issues in the design of abstract electronic spaces (3D spaces having no resemblance to the physical world). The users were then informed that Jonathan (one of the designers and the
demonstrator on this occasion) would first do a walkthrough showing the users what the prototype is ‘all about’ and would then invite each user to ‘have a go’ with his support.

#1. Pre-engagement walkthrough

Jonathan: Right. I’m going to have to creep in a bit here (assuming position at keyboard – users gather round)

Jonathan: OK. what we’ve tried to do is when you normally do an OPAC search OK. you’ll normally get back say up to five hundred results on a particular keyword you type. and they’re not organised in any particular way. just a great long list which is obviously a bit of a pain if you have to browse through that

Claire: uh uh

Jonathan: and what we’ve tried to do in this 3D visualisation is to take those results that come back from an OPAC search and group them according to how similar they are to each other. so if you get lots of things in the same classmark. like it might interesting to see all the books that are in one classmark ‘cause they’re obviously related to each other in some way in the library

Claire: uh uh

Tina: uh uh

Jonathan: OK

Tina: uh uh

Figure 1. Introducing users to the machine: a 3D visualisation for doing topic based searches

Jonathan: erm. or you might want to see all the books of that keyword of a certain author. or authors put together. so the idea is that when we put these things into the 3D landscape they form. clouds or blobs of similar books and things together that come back from the search. and you can change how important certain factors are for how they cloud together. and then once it’s visualised in front of you. you can browse those results to get out information as you would do in a normal OPAC

Tina: brilliant

Jonathan: OK

Tina: uh uh

Jonathan: so if I start talking gobbledygook somebody tell me (user laughs lightly) and that will help. OK. so. what I’ve done initially here. we have a search that’s visualised on this display here. on Mariani as a keyword. so obviously you’d sort of expect that to come back with authors Mariani. and anything else that happens to be categorised with the keyword Mariani

Jonathan: so if we click on. the circles in the landscape represent the books that have come back OK. and the links between these circles indicate that there is some connection between them

Claire: uh uh

Jonathan: and when the connection is very high. they get grouped into these coloured regions
Claire: umm

Jonathan: so obviously these books here, here, here, and there’s one just behind there, are all very similar according to some categorisation which we’ve applied, so if we look at this, just by clicking on the button here. It tells us more information in one of the windows and you can also see some more information on the display, which can be a bit hard to read.

Figure 2. Pointing out basic operations: grouping objects into coloured regions based on similarity

Jonathan: if we just click on a few of these, this is all by. they’ve all got a very similar classmark which is VKI, VBI, and VCN. so these are probably very close to each other within the library.

Claire: umm

Jonathan: whereby these outriding things here have PR which is classmark. XMLA which has no other connections and so on. these are weighted strongly according to classmark. if we chose to change the weighting so we’re not very interested in classmarks anymore but we’re interested in the type of publication. that’s CD-ROM or book or something like that. so we’d like to see all the CD-ROMs together. then we can turn up the importance of CD-ROM. of the type of publication. then what it does is. it reorganises the space. er. not very well in this case. so that the green ones here are over-size pamphlets it looks like. you can see here and here. and the red ones are over-size books. so what. what its. its trying to draw together the similar things in the search that was issued.

Figure 3. Pointing out basic operations: windows providing information about objects located in 3D space

Jonathan: so that’s a very small search. if I do a bigger search. on java. then you do a search it starts pulling them back from the OPAC system then it populates the space by
sort of spitting them out at you. er. and then it’s going to crash horribly. I've got a feeling
Andy: ah
Tina: (laughs)
Andy: yep
Jonathan: and it’s a prototype
Claire: ‘cause there’s so much
Jonathan: look away now
Andy: this is going to happen quite a bit this morning perhaps
Claire: is that because of the amount of information it was pulling
Andy: yeah. well it's because. because it's a prototype and it's very unstable
Claire: right. yeah
Andy: and those kind of things kind of freak it out
Claire: yeah
Jonathan: some things. it runs periodically very well (laughs). and occasionally not very well. so we'll try that one again
Andy: this is reason why we didn't want to put in the library or something like that
Claire: uh uh. yeah
Jonathan (laughs) but we also wanted to get some feedback for how people actually find it difficult or easy to use or even to understand what’s going on. which is why you’re the guinea pigs here today

Jonathan: so. OK. I've a feeling this is going to work now. it's spitting out a bit more. OK. so it's put them all into the space and now it’s arranging them according to classmark which is the default arrangement. and you can see that there’s a lot of yellow blobs in the middle here which have got a very similar classmark apparently
Claire: um
Jonathan: and they’re all congealing together. and you’ve got some green ones going off up here. and eventually they’ll sort of stabilise to an arrangement you can browse
Jonathan: OK. that should. it’s drawing all the links. OK. so that was one on java and again. it was according to classmark. so all of these yellow ones here have a classmark which is AZKF which is the programming section in the library. so you can see. we’ve got seventy five results but it’s clustered together all of these. if you were interested in java programming then obviously these books are going to be very interesting to you. and these outlying ones will be things like. er. what’s that one on. designing web applications. yeah. aesthetic tradition and artistic transition in java that is. which is obviously about the place java rather than the language java (all the users ‘uh uh’ there understanding)
Jonathan: but obviously in OPAC they come back together and they’re grouped together. so here again it separates them out
Claire: uh uh

Figure 5. Pointing out basic operations:
what happens on executing a search – the observable grouping of objects

Jonathan: based upon classmark in this example. er. so one way of moving round the space and browsing these things is to use the forwards and backwards buttons. the keypad which turns you and moves you backwards and forwards
Figure 6. Pointing out basic operations: how to navigate using keys

Claire: um
Jonathan: and you can click on objects to centre them
Claire: um
Jonathan: and you can zoom in to get more information. That will come up here (points to text on 3D display). Another mechanism we’ve got to try and help you round the space is a free look, which is a bit like quake, for all those people who play quake, there might be one or two, which is basically, you don’t need to do anything to turn it now. It’s all based upon the mouse. When we put if we put something else into the view to highlight it, I think it, you can move around the space just by pointing things into the view. So here. I’m navigating just by putting anything into the cross hairs. And if we can get somebody in front of here, how easy they find this to use. Cause traditionally it’s very hard to navigate in 3D.

Figure 7. Pointing out basic operations: viewing regions and focusing on objects by rotating in freeview using mouse

Jonathan: right. I mean, so does everybody sort of understand what it’s all about now
Claire: um
Tina: um
Jonathan: is that um yes or an um not quite
Claire: I think so. Yeah
Tina: yeah
Simon: I was thinking, how do you zoom in and out, just click on what you want
Jonathan: you can click on each one to [inaudible] and that puts it in the middle and the zoom is just the forwards and backwards buttons
Simon: oh yeah
Jonathan: so that’s, that’s fairly simple
Simon: that’s pretty good
Jonathan: er, and then you hit the space bar to move between what this view is, the one that sort of turns you and you can look anywhere
Simon: yeah
Jonathan: and then you hit the space bar again and you’re just on the normal
Simon: oh. OK
Jonathan: backwards and forwards, and again, you can just click on whichever
Simon: right
Jonathan: particular thing you want to look at, like that
Simon: right. OK
Emergent features

The pre-engagement walkthrough was intended to introduce users to the machine and familiarise them with its basic operations and controls – to give users a sense of what the machine was ‘all about’ and how to ‘go about’ using it as it were. As with the artworks, this course of pre-engagement training was not meant be exhaustive but rather, only intended to furnish ‘just enough’ information about the machine so as to engender the undertaking of engagement. Again, like the artworks, this course of training began with a general description of:

1) the prototype: a machine supporting topic-based searching
2) what it was / is: a 3D visualisation of search results
3) what it does: a) groups search result objects together in discrete regions
   b) on the basis of how similar they are to one another
   c) given the specification of a keyword and distinct search criteria.

Following this brief introduction, the demonstrator proceeded to provide a sequentially ordered course of instructed actions. In sequential order, these actions:

1) Displayed a visualisation of a set of search result objects grouped in response to a query.
   This visualisation was employed to ‘point out’
   a) that search result objects are represented by circles
   b) that the lines between circles indicate that there is some similarity between the linked objects
   c) that objects are linked according to the search criteria specified
   d) that when the similarity between objects is very high they are grouped into coloured regions

2) The demonstrator then ‘pointed out’
   a) the operation for viewing information about a particular object (click here)
   b) where that information is displayed (in this window or on the screen in this text)

3) Ostensive definition of operational features continued in ‘pointing out’
   a) the mechanism for re-specifying search criteria
   b) (and shortly afterwards) that default criteria are at work
4) The demonstrator then executed the respecified search to display the regrouping of objects into different arrangements of similarity. This display was employed to ‘point out’ how objects are grouped by default into distinct topical regions (e.g. java the language vs. java the place).

5) The demonstrator then proceeded to instruct users in the use of navigational controls, ‘pointing out’ how to ‘go about’

   a) moving around the regions and objects through defining and demonstrating the use of specific keys (forwards, backwards, left, right arrows keys)
   b) selecting an object through defining and demonstrating the use of the mouse (just click on the object)
   c) zooming in and out through demonstrating the use of forward and backward arrow keys
   d) navigating in freeview through demonstrating placing objects in the on-screen cross hairs and rotating the view on to the space using the mouse
   e) zooming in freeview through demonstrating placing objects in cross hairs and using forwards or backwards arrow keys

In working up, and through, this distinct course of instruction, novice users were informed as to what the prototype was ‘all about’ and how to ‘go about’ using. In other words, the course of instruction served as a course of pre-engagement training providing for actual engagement. That course of training was ostensibly based on the method of demonstration-by-showing-and-doing.

#2. Drive One

Jonathan: so . does anybody want to have a first . drive
Tina: aye . I’ll have a do (swapping places and moving round)
Jonathan: may be we’ll just use this search for now and see how easy you find it to move around and search the space initially . unless you think it’s worth going for a full search (Tina doesn’t reply)
Jonathan: so . OK . so forwards and backwoods . the cursor keys here
Tina: yeah
Jonathan: obviously this ones forwards and this backwards
Tina: yeah
Jonathan: left and right
Tina: yeah
Jonathan: and then you just use the mouse pointer to click on various things . so . do you want to have a quick drive around the space . to examine it

Tina: so this is what I would be greeted with in the library then . yeah . that type of thing
Jonathan: yeah . this is a similar sort of thing . so what you’d normally do is . up here . this is the keyword that’s currently being visualised
Tina: alrighty
Jonathan: it’s all the things with java . this little window here is a . is a bit easier to read than this text but it’s displaying the same information
Tina: yeah
Jonathan: about what the current object that you've selected is

Andy: I think maybe . if maybe you do start from . you know . scratch
Jonathan: OK . what from a search
Andy: um . so Tina’s just walked into the library and she want’s to do a search
Tina: and I’m like . how I usually do it is to type in either an author that I’m interested in or . as it stands at the moment . certain keywords that I’d be interested in
Jonathan: OK
Tina: alright
Jonathan: well let’s just try er
Tina: just put in . erm
Jonathan: if you hit the delete . just er .
Jonathan: yeah . that’s right . er . it should give you a bit more progress but you can see it’s saying what it’s doing now . what it’s doing
Tina: yeah yeah yeah

#2.1 Crash and repair: formulating searches on the web-OPAC

Jonathan: this isn’t going to work actually
Tina: uh uh
Jonathan: I think . ‘cause retail is a bit too
Tina: a bit too much
Jonathan: a bit too big
Tina: erm

Jonathan: we need a bit more of specific search
Tina: er . shoplifting

Jonathan: OK . I’ll have to clear a few things off now I’m afraid . since it didn’t enjoy that very much
Tina: well it’s not good enough . that’s what I want to know (everyone laughs)
Tina: sighs (in mock resignation)
Claire: you’ve messed it up
Jonathan: we’ll just cheat to find out how many hits we’ll get and then I can guarantee if it will work or not (Jonathan runs an ordinary web-OPAC search to establish a search of manageable size – a search that will not crash the prototype)
Tina: what I tried to do yesterday actually was sociology and retail and it didn’t like that at all . you know down in the
Figure 9. Crash and repair: using web-OPAC to formulate manageable searches

Jonathan: right. this is your normal (web-OPAC)
Tina: or work and retail. wasn't thrilled with that either
Jonathan: OK. so. work and retail
Tina: would it work if you did work and [inaudible] and retail
Jonathan: it depends how it's stored in the database I think
Tina: OK
Jonathan: that will only give you two
Tina: grand
Jonathan: that wouldn't be very good to. don't look at this. don't look at this (everybody laughs). I mean that (the web-OPAC) is OK when you've got two hits but obviously if you've got several hundred. it's a bit more difficult
Tina: no. not DIY. no. no (everybody laughs)
Jonathan: it's only two
Tina: one of my supervisors thought it'd be a good idea for me to do that. no it wouldn't
Jonathan: now I'm doing title
Tina: shops and shopping
Jonathan: thirty. shops. is that interesting. is that a vaguely interesting keyword that you could possibly search on
Claire: what was that
Tina: shops
Claire: shops
Tina: yeah. yeah
Jonathan: well let's have a go for that one and see how we go
Tina: retail a bit too posh
Jonathan: no. it's just a bit too big
Tina: girls things
Jonathan: it's a bit too big for it to show. so off you go. let's type
Tina: shops
Jonathan: shops (Tina types in shops)

#2. Resuming the Drive

Jonathan: so. I think it should be spitting them in soon. so what happens now is the systems gone off and it's put them into its database and now its going actually put them into the space

#2.1.2 Problem: locating the objects

Tina: (sighs) will I get all those little starburst things
Jonathan: yes. you should
Tina: how nice
Jonathan: well you are doing but it's hiding them from you. OK (Jonathan uses navigation keys to bring objects into view)
#2. Resuming the drive

Tina: [victorian] (talking about objects on screen)
Jonathan: it basically shows a few letters from the title. er. OK. that's what the space looks like
Tina: right
Jonathan: these. these. let me click on the weights. the little box here. these are sort of showing what weighting it's applied to putting them in the space
Tina: I understand

Jonathan: the classmark is very important here. whereby other things like author and title
Tina: yeah
Jonathan: are slightly less important
Tina: OK

Jonathan: so. if
Tina: and the colours are similar
Jonathan: they're the ones that have been said to be very similar to each other
Tina: OK
Jonathan: if it has more than two in a region it actually draws a little shape around it like this
Claire: um
Jonathan: so you can see the edge of it here
Claire: um
Jonathan: but if it's only two it doesn't draw a shape. it just connects them with the same colours
#2.2.2 Problem: selecting objects

Tina: so I want to look at specialist . so I just whiz in and click on that yeah
Jonathan: yeah
Tina: twice
Jonathan: yeah . er I think it’s because it’s actually under here . try this one first then this one second
Tina: why would I do that
Jonathan: you shouldn’t have to . it should just be one click
Tina: OK

Figure 13. Selecting objects: experiencing difficulty in clicking on a particular object for viewing (and receiving instruction as to resolving the problem)

#2.2.3 Problem: seeing full title

Jonathan: drag that window over here . if you click on the title bar and just drag it over . put it over there for now
Tina: how would I make the title bigger
Jonathan: to see more of it
Tina: yeah
Jonathan: you can’t at the moment
Tina: OK
Jonathan: you can click on it and then press [inaudible] and that will scroll it but you can see a bit more of title here actually . but not all of it
Figure 14. Viewing the object’s title? Scroll along window using key or view text in 3D display

Tina: health and safety at work. OK I decide that that isn’t what I want at all
Jonathan: OK, so you probably decide that these two here aren’t interesting may be
Tina: right
Jonathan: so if you click just on the area, just to go back to the space. OK
Tina: right
Jonathan: and then you could maybe have a look at some of the other regions
Tina: ummm
Jonathan: that have come back
Jonathan: clicking is a bit hard. it’s ‘cause it doesn’t do it properly. it’s not anything that
you’re doing wrong. try the other green one
Tina: that’s alright. ooo. shops and science. not australia though. no you don’t want
that (laughs). would I close that (the object information window)
Jonathan: you can just leave that one open. it’ll just keep updating when you click on
new books

Tina: so how would get to know. would you have to rely on this then
Jonathan: you’d probably. I mean. that’s one of the things we’re looking at
Tina: ‘cause I mean really. normally I go by. er. you know. whether I think something is
going to be interesting or not. is by the title, you know
Jonathan: OK
Tina: if it’s an area I don’t know anything about
Jonathan: yeah
Tina: you think. oh well. that’ll do. you know what I mean. and if there’s any sort of.
disputing the matter. I go and have a look at the book itself
Jonathan: sure
Tina: right
Jonathan: sure
Tina: so, if this is just going to come up like that. depending on whether you’re tired or
not or whatever. you might think. oh well. fuck it
Jonathan: right. yeah
Tina: so that’s a bit of a worry isn’t it
Jonathan: right. OK
Tina: shoppers. ummm

#2.2.4 Issue: more information

Vince: do you use the keyword. er. at all. I mean. it’s not on the window there. you
know. like on the bottom of OPAC it’ll have keywords often or subject. things. you know
like shops. and it’ll have like shopping. consumerism. stuff like that down at the bottom
Andy: yeah. like. sub-categories as such isn’t it
Vince: yeah. right
Jonathan: no. we don’t use that
Vince: oh. OK
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Jonathan: but that would . I mean . that seems like that would be interesting . I suppose if you entered one keyword to lead you to the other
Vince: yeah . yeah
Jonathan: related keywords
Claire: um
Vince: or may be just tag it on that bar there . then you’d get a bit more information about what the book’s about . ‘cause as it is all you have is the title and the author
Jonathan: yeah . yeah these are the things that typically come back when you just do the initial keyword search . you know . the big list
Vince: yeah
Jonathan: that is not any more specific than that information . although we could get it . OK

#2. Resuming the drive

Tina: should I let someone else have a go now . ‘cause I’ll sit here forever
Andy: er . do you want to do some of the spatial stuff
Jonathan: the
Tina: ‘cause that’s how I would do it . OK
Claire: um
Tina: that’s how . when I go and look for a book . if I don’t actually go to the shelves themselves
Jonathan: yeah
Tina: which means that you’ve got some sort of fore knowledge of what you’re looking for anyway
Jonathan: um
Tina: I’ll go on . you know . title or something . I mean that’s the sort of basis of your research isn’t it . the . you know . like the keyword or something . and of course we then start frustration when . either too many come up or
Jonathan: well it’s too many that’s generally the problem isn’t it . ‘cause when it’s only ten or something . you can sort them in your head (Simon, Claire and Vince ‘um’ agreement)
Tina: that’s how I would use it
Jonathan: I mean . OPAC only gives you back a maximum of five hundred and obviously we’d like to show you big searches of five hundred but . with the current restriction . as we’ve seen it obviously doesn’t cope very well with much more than a hundred
Tina: well who’d do it anyway . you’ve only to see a list and . I start crying and wanting to go home
Jonathan: do you . do you want to try the other method of navigation before you just leave
Tina: sure
Jonathan: which is the one where you . if you hit the space bar now
Tina: the space bar
Jonathan: hit it once
Tina: yeah

Figure 15. Learning to navigate: emulating the demonstrator’s instructed action (using the space bar)

Jonathan: and then you just move the mouse . it sort of moves you around the space without . so you’re always centred on the object here
Tina: yeah
Jonathan: but it spins the other objects around it . so it’s may be a different way of viewing the space to see what . to see the groups . ‘cause obviously there’s a big blue group here that may be you didn’t see before

Tina: um
Simon: right
Tina: yeah . OK
Jonathan: and then you can move to other objects either by hitting space once to go out of it and then clicking again . like you were . have been doing before

Tina: I’ll try a little blue one shall I
Jonathan: yeah . and then if you hit the space once more you’ll become centred on it again . so now if you move the mouse you’ll spin around that object
Tina: ah . right . I see . yeah

Jonathan: so it’s a way of may be viewing the other objects that are very similar
Simon: actually that is . er . pretty cool
Vince: yeah, because you never saw all these objects behind before
Claire: um
Jonathan: erm, so you can either sort of, you can either move in and out of this
mechanism of moving by hitting the space bar, and then clicking and hitting the space
bar again, or, if, and it's a bit harder, if you rotate one of these objects into the circle, it
will automatically recentre on that new object that's come into the circle rather than the
old one you were on
Tina: that was quite handy, but I'd have to remember to use it probably, so you'd be
kind of, I can only talk for myself obviously, re-educating myself in how to use
whatever's there
Jonathan: umm
Tina: still, local shop, that's nice, OK (everyone laughs, Tina moves away from the
controls)
Tina: (talking to Claire)
Andy: would you like to have a go Claire
Claire: um. Yeah
Tina: 'cause you're probably far more computer literate than what I am
Claire: oh god, don't say that (Claire assumes position at keyboard)

Emergent features

In the course of undertaking and accomplishing engagement a number of notable
issues come to light. The first of these impacts on the real-world character of
usability trails and the need to ‘simulate’ actual circumstances of use. From the
users’ perspective, it is only against the background and context of real-world
activities that the prototype makes sense. Thus, there is a need to encounter the
machine as a machine for a real purpose - for doing real activities such as actually
searching - rather than merely exploring technical innovations for their own sake
- such as the efficacy of vehicles for driving in 3D space. The efficacy of the
matter can only be adequately addressed in the doing of real-world activities.
Hence, the need to undertake actual searches.

In attempting to accomplish searching as a real-world activity, the prototype is
encountered as a problematic instrument. A particularly prominent feature of use
in this respect is that the prototype continually ‘crashes’. While it might be
thought that this is a trivial issue – an endemic feature of prototyping activities –
in this case at least it transpires to be anything but that. Crashes are not simply
technical failures but interruptions in the production of social activities (of
searching for example) which have to be repaired if the activity is to proceed.
How crashes are repaired then, becomes a matter of some importance. In the case
of the library prototype, it is understood that what is causing the crash are
searches returning a large number of results. The repair consists of employing a
web-based online public access catalogue (OPAC) to formulate solutions to the
problem occasioning the crash. At a general level, the formulations the
prototype’s staff – demonstrators and users – produce as solutions to crashes –
things the prototype should do but doesn’t do – become a matter worthy of some
attention. At a specific level, and with regard to the library prototype, the web-
OPAC is employed to formulate search categories that result in manageable
searches. This is not simply to observe that in order to produce searches that the
prototype can handle, that the prototype’s staff engage in the formulation of
search categories – e.g. sociology and retail, work and retail, shops and shopping,
not DIY - that result in manageable searches for the purpose to hand however. Of much more significance, it is to observe that formulating search categories that result in manageable searches for the purpose to hand is work that the prototype must actually support: work that the prototype doesn’t do but should do. This is not to elevate the sociality of ‘crashes’ to an unwarranted level of relevance but simply to note that on occasion, the ways in which crashes are repaired in situ are of relevance, a matter settled by the attention given to crashes by the prototype’s staff.

Other notable problems emerging in the course of accomplishing engagement during drive one consist of 1) locating objects in space. Having executed a search, the user was confronted by a blank space:

Tina: will I get all those little starburst things
Jonathan: yes. you should
Tina: how nice
Jonathan: well you are doing but it’s hiding them from you

This problem suggests a need for a default view onto the space; one which automatically focuses on the search results. 2) Selecting particular objects for viewing. On browsing the search results, the user encounters difficulties in ‘clicking on’ particular objects

Tina: so I want to look at specialist. so I just whiz in and click on that yeah
Jonathan: yeah. er I think it’s because it’s actually under here. try this one first then this one second
Tina: why would I do that
Jonathan: you shouldn’t have to. it should just be one click

3) Viewing full title. This was perhaps the most significant problem encountered in the course of drive one. The problem is one of on ‘just what’ basis can users establish whether or not a particular object will satisfy their information requirements. The primary resource users employ for doing this is an object’s title and sub-title which suggest what the object is ‘about’. The prototype does not provide this information at-a-glance, providing only partial titles and sub-titles.

Tina: ‘cause I mean really. normally I go by. whether I think something is going to be interesting or not is by the title. if it’s an area I don’t know anything about
Jonathan: yeah
Tina: and if there’s any sort of . disputing the matter. I go and have a look at the book itself

Like the artworks, the course of instruction engendering use does not cease after the pre-engagement walkthrough but continues throughout use insofar as the user is a novice user. Instruction here, while obviously occurring in a sequential order of work (the initiation, execution, and accomplishment of a search), is not itself a sequentially ordered occurrence but issued as and when troubles occur, and that may be at any point in time and different from user to user. It might be noted, however, that the range of possible instruction in the course of engagement is not infinite but, on the contrary, very finite as there is
only so much that can be done with the machine, only so many operations that can be performed. The issue, then, is one of identifying the range and type of specific in-action instruction required to support use. Specific in-action instruction required in drive one consisted of 1) defining ‘just what’ visible displays are.

Tina: so this is what I would be greeted with in the library then. yeah. that type of thing
Jonathan: yeah. this is a similar sort of thing. so what you'd normally do is. up here. this is the keyword that's currently being visualised. this little window here is a. is a bit easier to read than this text but it's displaying the same information about what the current object that you've selected is

This suggests, perhaps, the need to mark or categorise displays very clearly so that users can make sense of visible displays easily. 2) Defining weighting and its relation to the arrangement of objects. Again, this particular problem suggests the need to display and categorise the weightings window clearly (perhaps renaming the slightly esoteric notion of ‘weights’ with ‘search options’ or ‘search criteria’).

Jonathan: these. these. let me click on the weights. the little box here. these are sort of showing what weighting it's applied to putting them in the space. the classmark is very important here. whereby other things like author and title. are slightly less important

3) Establishing the meaning of colours. The use of colour is central to the visualisation of objects in space yet the meaning of the colours was not immediately apparent.

Tina: and the colours are similar
Jonathan: they're the ones that have been said to be very similar to each other. if it has more than two in a region it actually draws a little shape around it like this. but if it's only two it doesn't draw a shape. it just connects them with the same colours

How the instruction might be delivered is an open question but the economy of the description provided here, and it’s relevance to understanding the visualisation, suggests that the instruction could well be a feature of the 3D space itself (placed as ‘hint’ at the bottom of the display for example). 4) Using the object information window. The issue here concerned whether or not the window was object-specific and thus needed closing after use.

Tina: that's alright. ooo. shops and science. not australia though. no you don't want that (laughs). would I close that (the object information window)
Jonathan: you can just leave that one open. if I'll just keep updating when you click on new books

It might be that the window is a static feature that cannot be modified or, given that the same information is furnished in the space itself, that the window removed altogether – there seems to be little point in duplication. 5) Accomplishing navigation. Navigation, while not particularly difficult to master, nevertheless required further instruction when actually confronted by navigational situations.
Jonathan: if you hit the space bar now
Tina: the space bar
Jonathan: hit it once . and then if you hit the space once more you'll become centred on it again . so now if you move the mouse you'll spin around that object
Tina: ah . right . I see . yeah
Jonathan: you can either move in and out of this mechanism of moving by hitting the space bar . and then clicking and hitting the space bar again . or . if you rotate one of these objects into the circle . it will automatically recentre on that new object that's come into the circle rather than the old one you were on

Once again, how such support is delivered is an open question although in practice navigational problems were resolved through the method of demonstration-by-showing-and-doing and the subsequent emulation of the instructed actions by the user.

Confronting the prototype with users and practical circumstances of use not only brings problems emerging from use to light but also, practical issues emerging in light of use. In the course of drive one, the issue of relating keywords to one another and displaying related keywords emerged as a potential issue to be tackled in design.

Vince: do you use the keyword at all . I mean . it's not on the window there . you know . like on the bottom of OPAC it'll have keywords often or subject . things . you know like shops . and it'll have like shopping . consumerism . stuff like that down at the bottom
Jonathan: no . we don't use that . but that would . I mean . that seems like that would be interesting . I suppose if you entered one keyword to lead you to the other related keywords

Further repairs, problems, instructions and issues emerged in the course of undertaking and accomplishing drive two.

#3. Drive Two

Claire: right . OK . so I can just click into keyword and change it again
Jonathan: yeah but it might be a good idea to just vet these keywords before we type them in because the big one's are going to crash the system

# 3.1 Crash and repair: bug in the system

All keywords are vetted through using the web-OPAC from here on in. Notably, in the course of vetting keywords so as to do searches with manageable results, a 'bug' in the system comes to light. When doing two or three word keyword searches — such as 'balance accounting' or 'double entry bookkeeping' (searches which Claire issues in trying to find a manageable search) — although the web-OPAC delivers returns, when the same searches are issued on the prototype it crashes. It transpires that the prototype cannot handle separate keywords in multiple combinations. It also transpires that placing a hyphen in between each individual keyword — e.g. 'balance-accounting' or 'double-entry-bookkeeping' — resolves the problem for practical purposes here and now. Thus the session proceeds insofar as multiple keywords are employed by the users.
#3. Resuming the drive

Claire has issued a search on bookkeeping – nine objects have been returned.

Jonathan: so . if we just want to try and click on a few of those to have a look at them . it’s not a very good search to come back I realise but

Claire: OK . so that (the text in 3D space) just gives you

Jonathan: it’s just a bit of a summary of the information

Claire: yeah . yeah (Claire is having difficulty clicking on a particular object)

Jonathan: it’s in the same circle . it doesn’t like it . it’s actually a little bug

#3.1.2 Issue: the positioning of object texts in space

Tina: see . that’s good . because there’s few to do . this has come up a lot clearer . when as I was doing mine on shopping or whatever . it was difficult to actually read this because there were so many things to have a look at

Jonathan: so . do you think it might be . it’s obviously a trade off isn’t it . because if you’re in the space and you click on one of these and you get all the text in the space . you can see the text but you obscure the other things behind the text

Tina: yeah

![Figure 20. The emergence of a problematic issue: the legibility of object text in 3D space.](image)

Jonathan: but . obviously I could make the background for the text solid black or something like that

Claire: um

Jonathan: but then you wouldn’t be able to see anything behind it though

Claire: I think it’s because the text is over the graphics

Simon: that’s OK . as long as you could flip back and forth

Claire: yeah

Jonathan: OK

Tina: but think about in it in sort of practical terms . if you had lots . at what point would you get fed up . I mean that’s quite nice to look at . but if you’ve got lots of little dots . which is good for you one way but you’re trying to look at the text in another . you know Vince: may be if when you called up . like if you’re talking about the text on the screen there . on the 3D stuff . I mean . yeah . I can see it being a bit of a pain if it’s right beside because that’s obscuring all the books that are right near you . right . which might be the ones you’re going to more interested in . so if you put it like . up here in the top corner or something like that
Jonathan: OK
Vince: so then it would be . covering stuff that may be you’re not as interested in
Claire: um
Jonathan: right . OK

Figure 21. Working up a potential solution to problem: repositioning the text in 3D space

#3. Resuming the drive

Andy: do you want to try sort of moving around in that space as well Claire
Claire: um . is it . did you say space
Jonathan: yeah . just try clicking on another one and then space
Claire: and the space . oh I see . yeah . ooo

Figure 22. Navigating the space – going solo

Jonathan: and then if you sort of . see if you can manage . if you centre that one into the
circle . just keep moving . keep waggling that
Claire: alright . I see
Jonathan: keep waggling the mouse

Figure 23. Refining navigation: from navigating the space to centring on objects

Claire: so . for example . that one you mean
Jonathan: or another one . yeah . and then you let go . and now if you move the mouse .
just keep moving your mouse . you see . you’ve moved . the object moved
Claire: oh I see . I see . yeah . so for example . if I do that one . oh yeah
Simon: umm
Claire: that’s good fun
Andy: do you want to run a slightly bigger search then we can experiment with navigating in space
Jonathan: yeah
Vince: how about juvenile delinquency. I've to find a video for the prison tomorrow any way. so (Jonathan vets search on web-OPAC)
Jonathan: that's quite an interesting search. so we'll try and visualise that one
Vince: I can make it more interesting as well. if you separate if for type. 'cause I need a video as well
Claire: oh right
Jonathan: well do you want to sit down here Vince
Jonathan: a man with a purpose
Vince: I didn't mean to kick Claire off though
Claire: no. that's alright

Emergent features

Drive two occasioned several practical issues not previously encountered. Once again, crash and repair was an issue for the prototype’s staff, this time revealing an unknown ‘bug’ whereby multiple keywords caused the system to crash. The problem was resolved for purposes of the trail by placing a hyphen between keywords. Of more concern to the further development of the prototype was the legibility of object information within the 3D space. Users found the text in the space itself difficult to read.

Tina: see. that's good. because there's few to do. this has come up a lot clearer. when as I was doing mine on shopping or whatever. it was difficult to actually read this because there were so many things to have a look at

Users suggested that the problem might be resolved by positioning the text at the top of the display, away from the search objects. Navigation was again an issue, but this time more a matter of refining navigational technique in contrast to learning navigational technique in the first instance.

Jonathan: if you centre that one into the circle. just keep moving. keep waggling that
Claire: alright. I see
Jonathan: keep waggling the mouse
Claire: so. for example. that one you mean
Jonathan: or another one. yeah. and then you let go. and now if you move the mouse. just keep moving your mouse. you see. you've moved. the object moved
Claire: oh I see. I see. yeah. so for example. if I do that one. oh yeah

The issue suggests a need to furnish reasonably detailed instruction in supporting the acquisition of navigational skills and competence.

#4. Drive Three

(Vince assumes position at keyboard and inputs keyword ‘juvenile-delinquency’)

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Jonathan: OK, that's quite interesting
Tina: that's nice
Vince: yeah
Jonathan: so did you want to apply the weights straight away. could try that
Vince: well I don't have to. I can noodle around with it first if you want
Jonathan: one's escaped actually but never mind (laughs). it's a delinquent blob
Vince: yeah (laughs). I mean I wouldn't mind trying the weights. yeah. if that's alright

#4.1 Problem: making sense of the weights

Jonathan: so if you click on the weights button over there
Vince: right. where are we (Jonathan points weights button out)
Jonathan: and obviously publication type is what I think was important
Vince: yeah
Jonathan: if you bring that all the way up to ten or something like that. you probably want
to lessen classmark as not being so important possibly. I don't know

Vince: umm. yeah. well. you know. well we'll put that about there I suppose. author we
don't need. so that's alright
Jonathan: if you don't need it at all just take it to zero
Vince: yeah
Jonathan: ISBN's probably irrelevant as well
Vince: yeah. ah . we'll leave it the way it is. OK. go
Jonathan: go. this is where it crashes dynamically as well. by the looks of it

Figure 24. Making sense of the weighs: categories that may be
selected and adjusted to suit search requirements

Figure 25. Search objects regrouping following changes in weights

#4.1.2 Problem: identifying 'just what' weighted objects are
(inconsistencies of colour)

Jonathan: ooo. it's a bit of a blob. it's congealed
Jonathan: if they're too close there are things we can do about that. they seem have put
them on top of each other
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Vince: right. well let's start. alright so blue is
Jonathan: book
Vince: book. OK. alright. what's yellow. book as well
Jonathan: often if you've put other weightings in. they've taken some effect on the er. when it decides what go together. so obviously you had various other things that were fairly important as well
Claire: what's green there
Simon: green. and grey
Vince: pamphlet. OK. we're doing fine
Jonathan: it doesn't necessarily mean that all the greens are pamphlets because you put weightings on some of the other categories as well

Figure 26. Browsing the search: trying to make sense of objects by (inconsistent) colour

Vince: oh. yeah. OK
Jonathan: obviously you can redo the weights again and see what the new space looks like. cause it's produced a remarkably messy space
Vince: yeah they're really grouped
Jonathan: on top of each other. yeah
Simon: ooo. you got reds up there
Vince: yeah. I thought saw red but I'm trying to find it now. ooo. it's like right in my face here
Jonathan: you can zoom in and out while you're in this view using the backwards and forwards keys
Vince: yeah. yeah. ah. there we go. OK. pamphlet. no
Vince: I like this 3D thing actually. this is pretty cool

#4. Resuming the drive

Jonathan: we could try doing the search again but just do it solely on the importance of the type thing
Vince: OK. I'll give that a shot (Vince alters weighting)

Jonathan: lets just try that. I mean. that's extreme. but lets. lets just see what that looks like
Jonathan: so what it does. it uncolours them and then it decides what colour they should be again
Vince: yeah
Jonathan: there's obviously two big regions here. there's a blue and there's a. humungous yellow region
Vince: yeah. well it could be that there are no videos as well
Jonathan: and that doesn't look good as well
Vince: no (prototype crashes – a 'dive' crash - Jonathan restarts on same search)

Vince: OK. so. how do you erm
Jonathan: move. centre on
Vince: oh . OK
Jonathan: clicking is probably the easiest way of doing it
Vince: yeah . OK . so that's book . OK . what have we got down here . pamphlet
Jonathan: blues are pamphlets
Vince: I think that's all the colours . right
Simon: there are no reds
Jonathan: white ones are the oddments that don't go into anything else . they could be
like an individual CD-ROM . that's a lancaster dissertation
Vince: yeah . OK . er
Simon: videos
Vince: uh uh . there we go . [inaudible] . aspects . signs of the troubled aspects of
delinquency . OK . I might actually write that down (everyone laughs – Vince writes
classmark and title down on a notepad)

Vince: yeah . OK . so you can really see three groups can't you
Tina: yeah
Vince: KCCN . [inaudible] and the social . control of juvenile delinquency . um . and if you
go over here . it's KBQ
Jonathan: obviously with your classmark . it's just random . it could be any old thing
Vince: yeah . I suppose it's probably more to do with the title . 'cause that what we left on
Jonathan: yeah . but what that would help to probably adjust is where these get
connected into the main regions . so what . you might find that . say this one and this one
. have similar titles or something like that
Vince: yeah . that's what I was just kind of wondering so I was kind of noodling around
with it

Vince: um . OK . so how do you do that thing where you switch from one to
Jonathan: you basically try and line another blob up in the centre and you see it get
highlighted and then it will just jump to it automatically
Vince: oh . OK
Jonathan: it did it then
Vince: oh yeah

Jonathan: actually . can I just do something . this might help a bit (turns sound on) . it's
because it crashed and we haven't . OK . off you go . that should give you a little click
now when things change
Vince: (moves to another object – prototype emits a clicking sound) oh yeah. yeah. so you can use that to sort of surf through similar groupings can’t y’

#4.1.3 Issue: individual item and classmark relation

Andy: so I guess now you could run a search on that (item). on classmark . and see if there’s anything else around that
Vince: yeah. yeah. around. yeah. actually. I should have. where is that. oh here it is. classmark KDQ. OJ
Jonathan: but you can do searches on classmarks
Andy: no. you should be able to search on that title. that author. or whatever it may be. and it should give you that back and other things
Jonathan: oh I see. in the same classmark . yeah
Vince: yeah. so now if we did one. yeah. so. where is it
Vince: is there. I suppose there’s not a way. but being as I know what that one is. you know. the troubles thing
Jonathan: you mean of following
Vince: yeah. like. so that when it comes up now. signs of trouble. is there. are all the classmark one’s around it

Figure 29. Formulating a design issue: locating related classmark items around a potentially suitable object’s

Jonathan: umm. that’s. there isn’t but that’s. that’s a sensible suggestion
Vince: (laughs) yeah. OK
Jonathan: I mean you could perhaps imagine may be marking this one and then going to the window and saying show me where the others are on the 3D perhaps

#4.1.4 Problem: relocating an object

Vince: yeah. so where is it. that’s the one thing. now I got to find it again
Jonathan: yeah. that’s clearly. that’s a problem
Vince: is this it. no. oh yeah. KDQOJ
Jonathan: so it’s probably all the K . oh there you go
Tina: yeah
Jonathan: it isn’t that one. but it’s the same classmark
Vince: yeah
Jonathan: so it’s the yellow one’s

#4.1.5 Problem: spatial distribution of objects

Vince: so. if we spin this around. may be if we zoom in we can er
Simon: there we go. you can see it
Claire: yeah
Vince: where
Simon: to your right and up
Vince: to my right and up . this one
Simon: no
Vince: no . I can't . I can't see it
Simon: up
Vince: oh . signs of . yeah (Vince is trying to click on the object)
Jonathan: um . I think that's because it's in the cloud and er . it's on the other side
Vince: OK

Figure 30. Encountering navigational troubles: negotiating the spatial distribution of objects grouped in tight clusters

Jonathan: I mean . there are lots of interface problems . watching you have trouble is actually helping a great deal
Jonathan: if you click on . on . if we just click off this temporarily . press the space bar . click on region here . drag this box a bit bigger . that actually shows you all the books that are in that region
Vince: (Vince has pulled up a box containing a list of all the objects in the cluster) oh . OK
Jonathan: it's not very particularly well structured
Andy: it's a bit dense isn't it
Jonathan: well it is but the idea is . the problem is when you do get them all in a big region its . very difficult to sort them
Andy: that is the problem isn't it
Jonathan: it is a problem
Andy: uh uh

Vince: OK . I'm just seeing if I can click on that video again . well . anyway . we know that these are other ones in that region . so that's alright . if we can see there . I think . gimme that one . (Vince is trying to click on the object but can't) so . that's because it's in the cloudy bit then
Jonathan: yeah . well . you can always sort of rotate to it and it will sort of show you it
Vince: yeah
Jonathan: or you can even rotate using the keys in the other . if you press the space bar now . you can rotate using left and right even in this view . if you press left and right
Vince: ah . OK . yeah . um . ahh!
Vince: I can't seem to get to it but I can see where it is , it's 'cause it's so close to the other two
Jonathan: yeah
Vince: OK . well . I think that's my go . if that's alright
Andy: yeah . brilliant Vince . [inaudible] . Simon
Emergent features

A significant set of issues emerged in the course of drive three. In the first instance, it is not at all apparent just what the ‘weights’ are or, rather, what the category means? Users had to be instructed in the use of weight box categories – which stands in sharp contrast to existing OPACs where users encounter ‘search options’ that are readily intelligible. Naturally, the search options provided by the prototype function in different ways to a standard OPAC – and it is this novel aspect of use that requires instruction in particular. Specifically, that the search option sliders allow the search to be dynamically (re)configured according to the search options the user considers to be of relevance.

Jonathan: publication type is what I think was important
Vince: yeah
Jonathan: if you bring that all the way up to ten or something like that . you probably want to lessen classmark as not being so important possibly . I don't know
Vince: umm . yeah . well . you know . well we'll put that about there I suppose . author we don't need . so that's alright
Jonathan: if you don't need it at all just take it to zero
Vince: yeah
Jonathan: ISBN's probably irrelevant as well
Vince: yeah . ah . we'll leave it the way it is . OK . go

That there are options available in the first place is not immediately apparent and users had to be instructed to ‘click on the weights button over there’ (as noted above, there would appear to be a need for the clear marking or categorisation of objects comprising the interface).

Following the re-organisation of search objects through adjustment of the weights a particularly confusing event occurs (this may just apply to the publication type weight but the issue is significant nevertheless). Users have previously been informed that objects of the same colour are similar yet – in the case of publication type for sure – it transpires that there is a significant inconsistency at work here

Vince: right . well lets start . alright so blue is
Jonathan: book
Vince: book . OK . alright . what's yellow . book as well
Claire: what's green there
Simon: green . and grey
Vince: pamphlet .
Jonathan: it doesn't necessarily mean that all the greens are pamphlets because you put weightings on some of the other categories as well

Rather than being an aid to searching, colour becomes a source of confusion in such circumstances. The issue suggests the need for the consistent use of colour as a means of browsing and interrogating search results.

Having managed to identify an object of potential relevance, the issue of being able to browse a particular object’s classmark relations emerged. Simply put,
having located an object of potential relevance, the user wanted to browse the
other objects in the same classmark – the rationale being that they too may be of
relevance – yet as the user had not issued a classmark search, he found that he
could not do so.

Vince: is there . I suppose there’s not a way . but being as I know what that one is . you
know . the troubles thing
Jonathan: you mean of following
Vince: yeah . like . so that when it comes up now . signs of trouble . is there . are all the
classmark one’s around it

The issue suggests that some function enabling users to view a particular
object’s classmark relations regardless of the search type issued be implemented.
Further problems occurred in the effort to re-locate objects that the user had
previously identified as potentially useful.

Vince: so where is it . now I got to find it again
Jonathan: yeah . that’s clearly . that’s a problem
Vince: is this it . no . but it’s the same classmark
Jonathan: so it’s the yellow one’s

Just what might be done to support the resolution of this problem is an open
question. Insofar as the problem was resolved then it was through the cooperative
efforts of the users; an effort which from out of which another significant
problem emerged. Namely that of negotiating the spatial distribution of objects.

Vince: so . if we spin this around . may be if we zoom in we can
Simon: there we go . you can see it
Claire: yeah
Vince: where
Simon: to your right and up
Vince: to my right and up . this one
Simon: no
Vince: no . I can’t . I can’t see it
Simon: up
Vince: oh . signs of . yeah (Vince is trying to click on the object)
Jonathan: um . I think that’s because it’s in the cloud and er . it’s on the other side

The problem here is not simply that the object is on the other side of the cloud
but that the cloud itself is densely packed with objects, making it difficult to
discern particular objects in the first place and subsequently, to achieve a position
in space whereby the object may be selected. As such, the problem is a
navigational one, which suggests that the tight grouping of objects is not
desirable.

One further navigational issue emerged in the course of drive three. This time
the occurrence reports a distinct success. Following the initial crash of the
prototype, the sound had not been turned on again. Sound had been employed to
indicate when a particular object had been lock onto or selected by the user. In
turning the sound on again, it became obvious that sound was a useful support to searching’s accomplishment.

Vince: um . OK . so how do you do that thing where you switch from one to
Jonathan: you basically try and line another blob up in the centre and you see it get highlighted and then it will just jump to it automatically
Jonathan: actually . can I just do something . this might help a bit (turns sound on) . it’s because it crashed and we haven’t . OK . off you go . that should give you a little click now when things change

Vince: (moves to another object – prototype emits a clicking sound) oh yeah . yeah . so you can use that to sort of surf through similar groupings can’t y’

The use of sound to support browsing (or ‘surfing’) was of clear benefit from the users’ perspective.

#5. Drive Four

Simon: OK . I’ll try some . we got to see if we can figure out a search yet
(Everyone laughs – Jonathan vets a search on the web-OPAC on ‘primary-care’ – the prototype crashes – ‘a bug, it doesn’t like changing between searches’ – Jonathan runs search again)

Simon: oh . colours . colours . alright . this is looking good . this is looking very good . alright . let’s see what we’ve got here . start on purple . OK . so this is [inaudible] . oh . OK . lets have a look

#5.1 Problem: clicking on objects in clouds

Simon: that one in the middle kind of always looks to be in the middle of the cloud

Jonathan: yeah well . it doesn’t cloud every object . objects can actually be in the centre of the clouds . they don’t actually have to be on the outside

Simon: oh really . so then does that mean that you can’t click on the object
Jonathan: it means . currently yes . you can . if you move the circle over like in this view you’ll be able to see the details on it because the circle does it in a different way to clicking
#5.1.2 Issue: making sense of weights (again)

Simon: um. OK. so let's try here. move this down. lets see if we can weight this differently by. oh. no. author would be too crazy wouldn't it
Tina: what does threshold mean
Jonathan: er (laughs) its an obscure thing that we've put in here for us. no. it. it's basically. when it tries to draw in all the links. and is grouping them together. it actually says. well at a certain level. don't bother connecting all of these things together because it's going to become really messy
Tina: I understand
Jonathan: and what that does. is sort of say. well at this point. don't bother anymore
Tina: OK
Claire: um
Jonathan: so some searches. if you alter that. you actually get a much. a slightly different look. because its having more links between them
Tina: um. um
Jonathan: there's another which we haven't actually got. which is sort of exactness. because it's not quite. it's sort of fuzzy. but you could actually say I want this to be really precise
Tina: right
Claire: right
Jonathan: because as far as it's concerned. 1991 and 1992 are very similar
Claire: yeah
Jonathan: but if you were really interested in 1991 things you wouldn't want them with 1992
Claire: yeah
Tina: yeah
Simon: let's see if it doesn't crash here. hopefully not. I've done it by publication date. which is what I'm

Jonathan: it's a big black hole
Simon: yeah it is isn't it. ah. there all published around the same time
Jonathan: yes. this is what I was saying about the dates. it thinks they are very similar
Simon: argh. it crashed anyway oh well
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(Jonathan moves to restart the prototype)
Vince: so presumably increase . no decrease . the threshold
Jonathan: well the threshold is something slightly different . you actually want another
little slider which is exactness . and then that would be how
Simon: you could set the parameters on the dates right . say you’re doing something in
sociology . often you’re looking at the distinction between dates . say 1950 to 1999 right
Jonathan: right
Simon: whereas if you’re doing historical studies of the english civil war . you get dates
from anywhere from 1700 to now . so you’d have to have very different parameters
Jonathan: yeah . yeah . it’s very important isn’t it
Tina: of course it is
Claire: yeah
Vince: yeah

#5. Resuming the drive

Simon: ooo . look at that . organisation . I know I want to look at that . OK . so
Jonathan: yeah . I mean . you’re right . you can’t actually see the text on the
display now . so after seeing it a bit more do you think this on-screen text would
be better at the top
Claire: yeah
Vince: probably . yeah . I figure it would may be make a bit more sense . ‘cause like I
said . they’re may be blocking stuff that you want to look if it’s right beside it
Tina: yeah . you could have it like a little . well like a little window or something
Jonathan: yeah

#5.1.3 Issue: process elimination

Simon: y’ see . this is great . this is great
Andy: what do you like about it Simon
Simon: well . what I like about it . in a sense . I mean . what it’s doing is it’s giving you
some basis for grouping things together
Andy: for seeing relations
Simon: it’s actually good . yeah . and it’s actually good for eliminate . process elimination
. rather than a process of finding . because in a sense you can sort of see . you click on
something and you have some idea that that’s not the area at all that you’re interested in
Andy: right
Simon: then you can just ignore that region completely right

Figure 34. Narrowing down the search by negation: employing distinct regions, and
objects there-in, in a process of elimination
Jonathan: it might be nice even to have . if we take that a little further . to sort of say . I’m not interested in that region . actually remove it completely . to have a little key . delete or something
Simon: yeah
Tina: so then you’re narrowing down
Jonathan: yeah . you’re actually narrowing down while you’re browsing the wrong things rather than browsing the right things all the time
Tina: yeah . as long as you could bring it back

###5. Resuming the drive

Simon: the actual . just the actual negotiation of the 3D stuff is a lot better than some other programmes that I’ve seen . it’s actually quite good
Jonathan: that’s one thing we’re very concerned about . I mean . it’s difficult for us to navigate in these and we’re using them a lot . so what we try to do is make things . almost to restrict you a lot more but to try make it easier because you can’t . you can’t face the wrong direction so easily
Tina: um
Claire: um
Simon: but the basic idea of toggling back and forth . I mean . that I like . ’cause it’s simple basically
Simon: alright . does anybody else want to have a go . or
Tina: no honey . thankyou very much . because I did what I wanted to do
Simon: OK . that doesn’t make any difference . so it’s basically the title doesn’t come up right . the whole title doesn’t come up
Jonathan: right . yeah
Simon: that’s nothing to do with the limit of your programme is it
Jonathan: well here it’s just a limit of how much space we’ve got to display it . obviously if we put up here in this top left corner or something then the title could run a long way across

###5.1.4 Issue: a perceived need for online instruction

Jonathan: do you think it might help if there was . I mean . if there was another key or something to
Tina: I think . with computers and programmes . the way things are now . is that people expect to be told . you expect to have something coming up . to tell you what to do next
Claire: um um
Andy: it’s not . I mean . well .yeah . I get your point
Tina: it’s a matter of knowing what you can do . if you know that’s the way it is . then you work accordingly . but equally . if you go into it with . well I wonder what this is . and it starts moving around . you might think . oh shit . I don’t know what to do
Claire: you don’t know what to do . yeah
Vince: um
Tina: because we’re used to things coming up . the minute you touch something . another keys going to come up to say . do this . do this . do that
Claire: yeah
Andy: like an OPAC now . if you want to go forward press F
Tina: that’s right . yeah
Claire: that’s it . it tells you what to do
Jonathan: OK
#5. Resuming the drive

Vince: what’s that line connected to the . it’s not connected to another thing
Simon: yeah
Jonathan: er . it probably means that the thing has actually escaped
Simon: oh really
Jonathan: occasionally . when it tells them to go to a particular spot . occasionally it just
forgets to tell one and it keeps going (everyone laughs)
Jonathan: so that means that we’ve lost one
Simon: see . this is a particularly good one . because it’s so spread out . you can actually
do quite a lot of negotiating just in
Jonathan: you can zoom in and out even in this view
Simon: oh . that’s great . yeah . actually I didn’t know that

Figure 35. Learning to browse the space: zooming in and out

Jonathan: that’s a really good space actually
Simon: yeah . it is actually
Jonathan: it really looks
Simon: cool . to browse around . right

Figure 36. A really cool space to browse: discretely proportioned clusters
support efficacious browsing
#5.1.5 Issue: relating two separate searches

Simon: I guess what you can’t do is that once you’ve got a keyword in and you’ve got a space set up, you can’t then put in a sub-category. To have sort of links right. That just sort of adds exponential complexity to the programme right.


Simon: do you know what I mean. Like if you’re here and here and I’m like. Oh well. That’s kind of neat. And I’ve got all these things.

Jonathan: um.

Simon: and then if you plugged in like you know. An and. An operator or whatever.

Jonathan: OK.

Simon: and then it would actually add in stuff. Or just. If it didn’t add in stuff, rearrange stuff. In relation to the. Like make the sub-category the dominant weighting.

Andy: refine your search around what you’ve got.

Simon: yeah.

Jonathan: that’s interesting. It’s certainly not impossible. I mean. That’s the whole point. I mean people will suggest things you haven’t though of. Good ideas.

Emergent features

In the course of drive four the user encountered the now familiar problem of selecting objects.

Simon: that one in the middle kind of always looks to be in the middle of the cloud.

Jonathan: objects can actually be in the centre of the clouds. They don’t actually have to be on the outside.

Simon: oh really. So then does that mean that you can’t click on the object?

Jonathan: it means. Currently yes. You can. If you move the circle over like in this view you’ll be able to see the details on it because the circle does it in a different way to clicking.

Unlike previous troubles, however, where difficulties were experienced in simply clicking on objects and in selecting objects at the other side of a cloud, the problem this time was one of selecting an object within a cloud. Although the user could use the ‘circle’ (or cross hairs) to view objects within a cloud, the point to note here is that users preferred, and indeed had a natural propensity, to use the mouse and cursor as the primary means of navigation and object selection.

In the course of using the weights to rearrange the relations between the search objects further problems regarding the intelligibility of search categories emerged, this time concerning the notion of ‘threshold’.

Simon: um. Let’s see if we can weight this differently by.

Tina: what does threshold mean.

Jonathan: it’s basically. When it tries to draw in all the links. And is grouping them together. It actually says. Well at a certain level. Don’t bother connecting all of these things together because it’s going to become really messy.

Jonathan: so some searches. If you alter that. You actually get a much. A slightly different look. Because its having more links between them.
Again, the occurrence points to a need to employ categories having a clear meaning to users – such as ‘object grouping’ (+ / –) instead of ‘threshold’ for example. In the course of clarifying the meaning of weight categories, the issue of ‘exactness’ or the ability to specify searches covering particular dates also emerged as a relevant issue for design.

Simon: you could set the parameters on the dates right. say you’re doing something in sociology, often you’re looking at the distinction between dates, say 1950 to 1999 right
Jonathan: right
Simon: whereas if you’re doing historical studies of the english civil war, you get dates from anywhere from 1700 to now, so you’d have to have very different parameters
Jonathan: yeah, yeah. it’s very important isn’t it
Tina: of course it is
Claire: yeah
Vince: yeah

Clearly, users agree that it is a concrete requirement to be able to specify date range in conducting search activities.

An interesting feature of drive four brought about further novel considerations for design. In getting ‘hands on’ the prototype and performing a search, the user employed the artefact to narrow down the search by a ‘process of elimination’.

Simon: well. what I like about it. in a sense. I mean. what it’s doing is it’s giving you some basis for grouping things together
Andy: for seeing relations
Simon: it’s actually good. yeah. and it’s actually good for eliminate. process elimination. rather than a process of finding. because in a sense you can sort of see. you click on something and you have some idea that that’s not the area at all that you’re interested in
Andy: right
Simon: then you can just ignore that region completely right

Narrowing down the search by negation led to consideration of implementing functionality enabling users to delete entire groups of objects from any current search, with the caveat that you should be able to ‘bring them back’.

The issue of instruction has been a recurrent theme throughout this and other evaluations in the eSCAPE project. Concern with the issue has been brought about by researchers but in the course of conducting the prototype session it becomes, for the first time, an explicit concern of users.

Jonathan: do you think it might help if there was. I mean. if there was another key or something to
Tina: I think. with computers and programmes. the way things are now. is that people expect to be told. you expect to have something coming up. to tell you what to do next
Tina: it’s a matter of knowing what you can do. if you know that’s the way it is. then you work accordingly. but equally. if you go into it with. well I wonder what this is. and it starts moving around. you might think. oh shit. I don’t know what to do
Tina: because we’re used to things coming up. the minute you touch something. another keys going to come up to say. do this. do this. do that
Claire: yeah
Andy: like an OPAC now. if you want to go forward press F
Tina: that’s right. yeah
Claire: that’s it. it tells you what to do

Users clearly perceive a need for direction in becoming users of new technologies. How to deliver instruction, the range and type required, is of course the central concern and one that may (perhaps arguably) be elaborated through the design of engagement sequences and further experimentation with end-users.

Bringing this explication of the usability trail to a close, we again return to the familiar issue of navigation. The 3D visualisation of search results produced in the course of drive four was discretely proportioned so that no tight clusters of objects were present and clusters were well distributed across the space. Discrete spatial organisation, or the proportionally distributed layout of clusters and objects in space, affords efficacious browsing and thus supports search and retrieval.

Jonathan: that’s a really good space actually
Simon: yeah. it is actually
Jonathan: it really looks
Simon: cool. to browse around. right

While not necessarily an easy problem to address, it would seem that proportional distribution, to call the efficacious layout of objects and clusters that, is matter of some not inconsiderable relevance to the continued development, and ultimate use, of the library demonstrator in particular and abstract eSCAPEs in general.

Emergent features of library prototype-in-use

As noted in the introduction to this section, it may appear that situated evaluation is unduly critical given its formative role in the development of the prototype. The trial and assessment reported here does not seek to provide a summative assessment of the overall utility of the prototype and the effectiveness of the prototype in use. Rather we are seeking to identify the problematic barriers to use and to remove these in order to improve the thematic demonstrator. The approach towards design we have adopted places an emphasis on understanding the problems to arise from real-world, real-time activities –. Not only did the prototype allow some initial support for searching in real-time, and thus for an explication of possibilities and constraints, it notably provided for the actual accomplishment of searching in real-time. In short, the prototype worked.

What worked? The grouping of objects by similarity according to specific search criteria worked. The use of colour as an organising device for discerning similarity worked. The navigational vehicle – a particularly thorny problem in the development of 3D spaces – worked and with a considerable efficacy and easy learnability. The use of sound indicating the selection of particular objects worked. The on-screen text and object information window worked. And the weightings box as a mechanism for reorganising search objects according to
personal requirements worked. That practical troubles, contingencies, confusions, and solutions emerged in the course of conducting the trail is not to be seen as a criticism of the prototype then, but as furnishing critical insights into ‘just how’ the prototype may be further developed and made to work better. Troubles, contingencies, confusions, and the rest, suggest how a successful product may be improved, and through a process of iteration and evolution, improved to a point where it may be adopted in practice by a distinct community of users. With the aim of improvement in mind, this section of the report presents a summary of the results of the prototyping session. The results might usefully be categorised and presented as ‘instructions’, ‘problems’ and ‘issues’.

Instructions

Practical instruction is an integral feature of the achievement of use of new technologies by novice users. Two basic types of instruction are evident in this usability trial: pre-engagement instruction and specific in-action instruction delivered during the course of engagement.

**Pre-engagement instruction.** Pre-engagement instruction is delivered so as to furnish ‘just enough’ information about the machine so as to engender use. In the absence of a demonstrator, it must be assumed that the machine itself must deliver adequate pre-engagement instruction to novice users if they are to become competent users. This course of instruction (see Section 1 of this chapter for a detailed account) constitutes a course of training which is issued in sequential order so as to introduce users to the machine, what it is, and what it does. The course of training concretely consists of discrete, interconnected courses of instructed action ostensibly demonstrating-by-showing what the machine consists of for the practical purpose to hand and what it does. These instructed actions ostensibly define the operational features of the machine and how they may be employed. Through instructed actions ostensibly defining the machine and its operations, users learn that the machine displays a 3D visualisation of a set of search result objects grouped in response to a query. In sequential order, the interface is employed to define the meaning of the representations displayed in the 3D space, the operations for viewing information about particular objects, where that information is displayed, and the mechanisms for re-specifying default search criteria. A re-specified search is executed to demonstrate the grouping of objects into distinct, topically and spatially distributed regions. This visualisation is further employed to define and demonstrate the use of navigational techniques.

**Specific in-action instruction.** Specific in-action instruction is required by users in the course of engagement in order to accomplish use. In the case of the library prototype, the accomplishment of use required specific in-action instruction
1) **(Ostensibly) defining ‘just what’ visible displays are.** This suggests, perhaps, the need to mark or categorise displays very clearly so that users can make sense of visible displays easily.

2) **Defining the meaning of colours.** The use of colour is central to the visualisation of objects in space yet the meaning of the colours was not immediately apparent. The economy of the description provided in resolving the problem, and it’s relevance to understanding the visualisation, suggests that the instruction could well be a feature of the 3D space itself (placed as ‘hint’ at the bottom of the display for example).

3) **Defining the notion of weighting and its relation to the arrangement of objects.** Again, this particular problem suggests the need to display and categorise the weightings window clearly (perhaps renaming the slightly esoteric notion of ‘weights’ with ‘search options’ or ‘search criteria’).

4) **Defining the use of the object information window.** The issue here concerned whether or not the window was object-specific and thus needed closing after use. It might be that the window is a static feature that cannot be modified or, given that the same information is furnished in the space itself, that the window is removed altogether – there seems to be little point in duplication.

5) **Communicating navigational technique.** Navigation, while not particularly difficult to master, nevertheless required further instruction when actually confronted by navigational situations. Once again, how such support is delivered is an open question although in practice navigational problems were resolved through the method of demonstration-by-showing-and-doing and the subsequent emulation of the instructed actions by the user.

6) **Refining navigational technique,** in contrast to learning navigational technique in the first instance, is largely a matter of repeating instructed actions until the ‘knack’ or skill is acquired.

*Engagement sequences.* As the studies of the artworks-in-use made visible (Del 4. Chapter 3), the course of instruction engendering use does not cease after the pre-engagement walkthrough but continues throughout use insofar as the user is a novice user. Instruction in the course of use is not itself a sequentially ordered occurrence but issued as and when troubles occur. Insofar as the range of instruction for the use of any particular artefact is finite (unanticipated uses aside) then engagement sequences may foreseeably be developed which incorporate the components of pre-engagement and specific in-action instruction. Embodied components of the current sequence of actions engendering use consist of: 1) introduction, 2) Ostensive definition of interface components, 3) Ostensive definition of 3D representations and their meaning, 4) Ostensive definition of object information, 5) Ostensive definition of weighting box and categories, and
6) ostensive definition of navigational controls and demonstration of techniques. These components feature in both the sequential order of the pre-engagement walkthrough and as particular troubles occur in the course of engagement. As discrete components, and insofar as the problems they address cannot be resolved through clear categorisation, they may be presented in sequential order or conceivably be selected individually by users under the auspices of ‘help’ as troubles occur. Whatever approach taken to the issue of engendering use, it is clear that users have an explicit practical concern with instruction and expect such support to be provided.

Problems and issues

A number of problems or practical troubles emerged in the course of attempting to use, and becoming users of, the prototype.

1) Crash & Repair. As noted in Section 2 of this chapter, crashes are not simply technical failures but interruptions in the production of social activities which have to be repaired if the activity is to proceed. How crashes are repaired then, becomes a matter of some importance. Two crashes of relevance occurred in the course of the prototyping session. One brought about by searches returning large numbers of results and the other by using multiple keywords. The first crash was repaired through the use of the web-OPAC to formulate acceptable searches – or searches of manageable proportion. Clearly, the formulation of searches of whatever size is something that the prototype needs to support. The second crash was repaired through the placing of hyphens between multiple keywords. Obviously this is not a matter of undue concern but nevertheless one which requires correction.

2) Locating objects in space. Having executed a search, one user was confronted by a blank space. Clearly the possibility of dis-orienting users exists and a default view onto the space - one which automatically focuses on the search results – may be desirable.

3) Negotiating the spatial distribution of objects. Three interrelated problems concerning the distribution of objects in space emerged in the course of use. Firstly, where objects are grouped into densely packed clouds and users are close to a cloud, some difficulty was experienced in discerning which side of the cloud an object was on. That is to say that there is some perceptual trouble here, which is a consequence of the density of the objects comprising the cloud. Secondly, insofar as objects are densely packed with objects, users found it difficult to discern particular objects. Objects overlap and obscure one another making searching difficult. Thirdly, and subsequently, having identified a particular object within a densely packed cloud, users experienced difficulty in achieving a position in space whereby a particular object may be selected. Although the
problems here are navigational ones, they are not ones concerning the navigation vehicle but the spatial distribution of objects. The dense grouping of objects is neither efficacious nor desirable – a matter confirmed in considering searches where objects and clusters were discretely proportioned and (thus) easy to browse. While not necessarily an easy problem to address, it would seem that proportional distribution, to call the efficacious layout of objects and clusters that, is a significant design problem.

4) Selecting objects. In the course of browsing search results, users encountered a number of difficulties in ‘clicking on’ particular objects. Firstly, there was the simple difficulty of clicking on an object (a small bug). Secondly, difficulties were experienced in clicking on objects on the far side of clouds. And thirdly, users found that they could not click on objects within clouds - although they could use the ‘circle’ (or cross hairs) to view objects within a cloud. The point to note here is that users preferred, and indeed displayed something of a natural propensity, to use the mouse and cursor as the primary means of navigation and object selection. Naturally, that propensity should be supported.

5) Re-locating objects. Further difficulties emerged in the course of trying to re-locate particular objects that the user had previously identified as potentially useful. Just what might be done to support the resolution of this problem is an open question. Insofar as the problem was resolved then it was through the cooperative efforts of the users.

6) Viewing full title. The primary resource that users employ in establishing a particular object’s potential relevance to their information requirements is an object’s title and sub-title, which suggest what the object is ‘about’. The prototype did not provide this information either in full or at-a-glance. Although a simple point, it is an extremely important one from the point of view of users and one which must be addressed.

7) The legibility of text. Insofar as some textual information about particular objects was provided in the 3D space, users experienced some difficulty in reading it. Consequently, the users suggested that the problem might be resolved by positioning the text at the top of the display, away from the search objects.

8) Inconsistencies in colour. In the course of the pre-engagement walkthrough, and in undertaking engagement, users had been informed that objects of the same colour were similar yet in the course of re-specifying search criteria, or weights (particularly publication type), gross inconsistencies in colour emerged. Rather than being an aid to searching, colour became a source of confusion in such circumstances. The issue suggests the need for the consistent use of colour as a means of browsing and interrogating search results. The organising principle of
same colour, similar object was an easy one to grasp and one that should be maintained.

9) The meaning and use of weights. Just what the ‘weights’ category means was a matter of practical concern to users and required some clarification. Understood as search options or search criteria, the weights category may well be substituted accordingly. Users also had to be instructed in the meaning of the individual weights categories or search options. Naturally, the search options provided by the prototype function in different ways to a standard OPAC – and it is this novel aspect of use that requires instruction in particular. Specifically, that the search option sliders allow the search to be dynamically (re)configured according to the search options the user considers to be of relevance. Some of the categories (e.g. ‘threshold’) were obscure and require re-categorisation and a search option enabling searching by date was considered a ‘must have’.

Issues

Several important issues to be considered in design emerged in the course of the prototyping session. These are not related to particular problems as such, but rather concern functionality that it would be ‘nice to have’ from a users’ perspective.

1) Relating keywords to one another. A desirable feature of a future prototype would be to display other keywords related to the search keyword employed by the user. This would support the performance of searching in furnishing more ‘topics’ of and for inquiry.

2) Being able to browse a particular object’s classmark relations. Having located an object of potential relevance through searches not based on classmark, users nevertheless thought it relevant to be able to browse the other objects within the same classmark – the rationale being that they too may be of relevance to the search. The issue suggests that some function enabling users to view a particular object’s classmark relations regardless of the search type issued should be implemented.

3) Narrowing down the search by a ‘process of elimination’. In the course of doing searching it transpired that users ‘narrow down’ the search not only by interrogating objects that might satisfy their information requirements but also by interrogating objects that obviously do not satisfy those requirements. Searching proceeds by negation as much as confirmation then, an aspect of search behaviour which leads to a consideration of implementing functionality enabling users to delete entire groups of objects from any current search, thus supporting searching through a ‘process of elimination’ (with the caveat that you should be able to bring deleted clusters and objects back).
The results of the prototyping session, like the trial itself, are a collaborative production. They emerged in the course of users and testers conducting the trial together. The cooperative ‘work of the session’ consisted in the giving and receiving of instruction both prior to and during engagement; in users learning from each other’s actions by watching on such that the need for instruction notably decreased as users became more familiar with the machine; in formulating search categories in concert just as users do in conducting searches in the library; in working up and elaborating practical problems in concert; and in formulating potential issues for design together. Usability trails are social accomplishments through and through and the embodied work of the trial’s interactional staff elaborates concrete requirements for technology design. It is to a consideration of future design work provoked in confronting the prototype with end-user requirements and practical circumstances of use embodied in the interactional work of the usability trial that we now turn our attention.

The formative assessment of the prototype presented in this chapter was undertaken with the view to informing the further development and refinement of the thematic electronic landscape. As we have already indicated in the chapter six the development of the feature of the landscape and the assessment of the landscape are closely interwoven. In the final chapter of the deliverable we wish to conclude by considering some responses to the issues raise by the assessment reported here and offer some future more speculative possibilities for the future of the library abstract electronic landscape.
Chapter Eight
Concluding remarks and Future Possibilities

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In this final chapter, we seek to conclude this deliverable by considering the future work of the project and what the future may hold for the development of the thematic abstract electronic landscape. A recurrent theme of the work of the second year has been the convergence of the first year work on social science studies, technical development and artistic explorations. This convergence has been instantiated in the thematic electronic landscapes allowing us to more directly involve users in the development of electronic landscapes.

One of the reasons that we have been able to involve the everyday citizen in the development of these electronic landscapes is that we have been able to ground the more radical explorations of interaction technology within the overall context of a real world application. In the case of the electronic landscapes developed the everyday practical purpose underpinning the thematic applications has given users a means of making sense of the nature of these landscapes and provide a sensemaking resource in interpreting these systems. In considering the future two distinct possibilities are evident and we would envisage both of these avenues of exploration being explored in the final year of the project.

A reactive future strategy would take as its starting point the issues raised by the ongoing situated assessment of the thematic space and directly respond to these issues in order to refine the emerging application.

A proactive future strategy would exploit the familiarity gained from using the developed thematic landscape to explore users to more radical interface approaches and techniques. The advantage of extending the existing thematic spaces rather than undertaking completely new development is that users are able to exploit the familiar nature of the information to develop a working understanding of the potential utility of the emerging interface techniques.
During the coming year of the project we would envisage undertaking the proactive and reactive strategies in tandem as we undertake further refinement and on-going assessment of the utility of the emerging electronic landscapes.

A reactive future strategy

The core to a reactive future strategy is the development of a series of responses to the issues that emerging from the on-going formative assessment of the thematic electronic landscape. The current formative assessment assessments sessions have raised a number of issues; some are more easily dealt with than others, but here we present our initial response, and outline how the issues can be addressed.

Fixing the default view

When the DIVE visualiser starts up, we generally have to manually reposition ourselves in the space so that we can watch the graphical objects as they originally tumble into the space. We need to make sure the default view (or position) is one that will allow us to watch the process of generating the Q-Space with no explicit user action. This problem has now been solved in the current demonstrator.

Enabling clicking to go through objects / clouds for selection

The issue of occlusion is one that is often raised about 3D spaces. It is clearly impossible for the system to deduce that the user in fact wants to click on an object that is hidden behind another (closer) object. Similarly, how can the system tell if it is the cloud rather than the object that the user wishes to select. Technically, it is possible to project a ray into the 3D landscape and to determine what set (rather than the nearest) objects the ray intersected with. We could then either rely on some “modality” of the interface to determine what the user actually wants to click on, or generate a list of graphical objects that could be the subject of the "point-and-click" selection. This list could then be presented as a pop-up menu within DIVE and the user could verify what they were selecting.

This actually raises an issue of cloud and region selection. It would be useful to be able to select a cloud and to obtain information about the cloud and its contents in general terms, as a collection of books. It is often useful to be able to reason about, and manipulate, collections rather than individual objects, and we would wish to exploit this functionality within the Demonstrator.

Selecting part of a cloud's "hull" should be interpreted by the system as selecting the cloud and thereafter allowing cloud-based interrogation to take place.
Marking and highlighting objects before relocation

This is an obvious improvement for the system. If we examine objects within the current topology, we might wish to "keep an eye on" or relocate the same objects following a regeneration of the Q-Space. To assist this, we need to highlight selected objects in a sensible way. This raises a number of interesting problems, most of which are connected to the issues of size and distance. An object which may be close to our view point now and is highlighted in some way (say with a bounding grid as was used in earlier versions of Q-PIT) may travel a considerable distance from our position and the highlighting may disappear with the object it is attached to. If we make the highlighting too prominent it may occlude the actual data it is attached to.

This is clearly an area for research. We must also take into account groups as well, as there may be more than one object we want to keep an eye on. It might be worth thinking about "slaving" our viewpoint to the set of objects we are interested and subsequently the system does the best it can to keep these objects in our view.

Viewing full text (e.g. titles) on a more legible HUD pane

Since the user trial the original HUD panel which used to be placed next to the centre circle where an objects details appeared when selected has been moved. It now appears on the top left of the display and has a mostly solid background to enable text to be always easily read on it (but obscures what is behind it in the 3D space). All the data associated with a selected object continues to be also displayed within the tuple display window.

Tool tips

This is a good suggestion and one which we will look to introduce. An immediate problem with the current system is that there is no obvious method of tracking the mouse cursor over rendering window when no button is pressed. This makes tool-tips which pop-up after the user leaves their cursor over an icon or object after a small period of time difficult.

Allowing multiple keywords to be displayed at once

This would allow the results of two or more keyword searches to be displayed within the same space. This could mean two distinct areas, one for each keyword, or one area where the results of both searches are simply merged and treated as a single result. Both of these approaches are technically possible. In the first case, we could build two distinct graphs within the current graph data structure (merely by not having a single link between them) and thereafter processing should continue as normal (the force displacement algorithm operates correctly for disjoint graphs and repels them). In the second case, merging would occur before
the similarity matrix was calculated and a single graph would be produced. It should be possible to even add the “keyword” which produced the match to the weighting categories to perform to different layouts of the space.

**Narrowing down the search by a 'process of elimination'**

In the course of doing searching it transpired that users 'narrow down' the search by viewing objects that might satisfy their information requirements but also by viewing objects that obviously will not satisfy those requirements. Searching proceeds by negation as much as confirmation then, an aspect of search behaviour which led to consideration of implementing functionality enabling users to delete entire groups of objects from any current search, thus supporting searching through a 'process of elimination' (with the caveat that you should be able to bring deleted clusters and objects back).

Here again we need to consider the ability to select groups of objects via clouds. We could envisage regenerating the space once objects have been eliminated.

**Subsearching and layout; Mechanisms to help the examination of packed clouds**

The concern here is one of what happens once we have found a large cloud of interest. The reference to "packed clouds" arises because we have found that clouds with large numbers of members tend to form up as a tightly packed ball. Reading the labels or selecting objects within such a ball is difficult.

However, this takes us back to one of the major aims of visualisation: to provide mechanisms for "zoom and bloom". It also returns us to some of the work carried out with Q-PIT as an interface to the Oggetto object-oriented database system reported in year one of this project. We can think of clusters of information within the data as homogeneous subspaces and thus of higher (or just different) levels of the space as an eSCAPE. This is analogous to types and subtypes in the Oggetto visualisation.

We are also still in the situation of considering clouds as "first class objects"; can we treat them in the same way as singletons? What do we display in the HUD when a cloud is selected? We would need to be able to generate meaningful statistics about the collection and display these along side the field names. For example, if a cloud contains all objects with a single classmark (due to the similarity factors associated with the particular search) then we could produce that single classmark. This would be useful for selection or removal if the user recognises that classmark as useful (i.e. these are the Java books which refer to programming rather than those that refer to the island's history and geography). For other multi-valued fields we could summarise these as best we could, indicating similarities and differences rather than single values.

Once a cloud had been selected for further exploration, we should treat it as a doorway to a new Q-Space that contains the objects of the cloud. This new space
would have to be generated from scratch but clearly it shouldn't reuse the same similarity factors - all that should happen is the same cloud would be generated (perhaps with a bit more room).

Our initial thought is that the space should be generated by "negating" the highest setting used in the original space, so that classmarks would now become the least important setting. This would let the second highest setting dominate the generation of the new sub-space. Thereafter the user could change the settings as required.

We think that this approach would address both areas of concern raised by the user trial. It would also allow us a closer similarity with the design presented in chapter two.

**Proactive Further Work**

The reactive future strategy outlined in the previous section can be complemented by a consideration of a more speculative future set of research directions. Many of these emerge from the experiences of the study and the overall strategy provides a way of exploring more radical and adventurous approaches within a context that makes sense to future users. In this section we briefly present some of the potential future directions that we currently envisage for the future of the work in this area.

**Multiple Q-Spaces**

As can be seen from our examination of issues associated with the preliminary user trial, there are a number of fruitful areas for further research. The primary technical work which has to be done centres on the use of multiple DIVE visualisations, in order to cope with the concept of clouds as subspaces. The existing Q-PIT/Clouds architecture would also have to be considered and partially redesigned in order to cope.

It seems clear that if stable multiple DIVE visualisations were possible, this opens up a number of areas of possibilities. For example, the "shopping basket" would become a 3D space of its own rather than the flat 2D list it currently is. As new books were added (from different searches or subspaces) they would be laid out within the shopping basket, allowing the user to uncover relationships therein. A variation on the shopping basket might allow the user to select and copy clouds from different, simultaneously visible search results, into another space -- this would address the issue of multiple keywords but allowing the user much more control over which books were to be part of the new space.

These developments would, in some senses, make the overall system look and feel more like a desktop environment. Windows would contain the Q-Space representing the result of an associated search; each space would offer the "user window" style controls and could be regenerated independently of the others.
Users could "drag and drop" (or at least, "select and copy") clouds or independent objects from one space into another, and a new Q-space generated as the result of these additions. Clouds could be "double-clicked" (like folders) and a new window pop up with that sub-space laid out within it. This similarity with a desktop style might aid users in their understanding and use of the system at this inter-space level.

**Beyond the library: Other Possibilities**

While Q-PIT/Clouds has become an integrated part of the Library Demonstrator, we have tried to maintain its independent status and through this, its genericity. This means that the techniques developed as part of the Demonstrator can still be applied to other bodies of data. The nature of the system, to group and organise according to similarities between data objects, lends itself to objects with many different properties which users could sensibly group together (to search on), such as books. As such it is unclear how the system could be used to represent things like web searches which have very few external properties per match. However, searching other web-based corpuses of information, like the books available on Amazon.com is clearly attractive – books could be grouped by price, availability, reviews etc.

Future work should see the current system extended to allow it to be “pointed” at different resources, like Amazon.com, or any library supporting the standard Z39.50 protocol for example. Indeed, if the system allowed the integration of multiple searches (as explained above), there is no reason why searches from different sources could not be displayed together in the same space, allowing comparisons and so on.

**Moving from the library to the CyberPond**

One alternative proactive future for the work of the thematic electronic landscape centres on the development of a future electronic landscape based on the notion of a CyberPond. This is essentially a pool of on-line information presented to users using the overall metaphor of a pond. The current abstract thematic landscape provides a familiar point of departure for the development of this speculative interface metaphor and associated techniques.

The motivation for the development of a cyberpond is much broader than an extension of the second year of the escape project. The last decades several alternatives to the conventional computer screen have been explored in order to increase the understanding of computer mediated information as well as involve and engage the user. Some examples are head mounted displays (HMDs), Caves, multi-panel widescreen presentation rooms, and various techniques for generating three dimensional images. Concurrent with this development there has been

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paradigm shifts in the methods users employ to control information and the mechanisms that connect computers. An example is the concept of the global electronic landscape were people collaboratively work and play together in a WWW and virtual reality based environment using various sorts of tangible and ubiquitous interfaces. This concept has recently been developed further by the introduction of the notion of an information ecosystem where complex assemblies of users, electronic agents, interface and communication resources are dynamically built and destroyed according to need.

The CyberPond is an effort to bring together a number of ideas from these different fields and further develop the concepts, technologies and design ideas central to eSCAPE including the Blob and the Web Planetarium. The CyberPond (Figure 45) is a multi user floor projection system for access and manipulation of fluid information elements as well as for communication and collaboration between users being present both remotely and physically. Initially the information currently used from the library to form the thematic space would be exploited as the raw material for the CyberPond.

![Figure 45. An vision of the CyberPond](image)

To enable intuitive spatial interaction with the pond, we take a number of unencumbered techniques into consideration:

- **Laser pointers** offer a way to let the user control tracked laser spots with hand-held or otherwise body-mounted pointers. This tracked spot can be interpreted in various ways, for instance as a point of interaction or to control the visualisation.

- **Electromagnetic systems**, such as the Ascension bird units, can be used to track user movements, which can then be mapped to pond-related tools such as a fishing rod or a trawling net.

- **Video tracking** of the user's movements offers a way of interaction that is completely unencumbered by physical devices, even though it puts higher
demands on the lighting conditions of the environment. With body tracking systems, such as the MIT pfinder system, the arm movements of the user could be detected and used as basic gestures for collecting a virtual fishnet, groping for projected data elements, and so on.

- \textit{Voice recognition}. Speaking is a natural mode of interaction and can allow intuitive and precise interaction. Specifying an object by speaking its shape, colour or if applicable its name is often a cognitively easier task than marking the object with a cursor or pointer.

A final important component of the CyberPond is the use of small handheld computers, i.e. PDAs, to store a users personal profile, and to serve as general information sources and sinks. The PDA’s will also be used as tools for navigation, interaction and manipulation, and thus deeply integrated into the environment. An example of a novel functionality enabled by the use of these portable information carriers is to allow entities or information units in the pond to be attracted or repulsed by a user's PDA profile.

\textbf{The Pond Pilots}

One of the initial devices currently developed that will provide the basis of the CyberPond are modified Palm Pilots called Pond Pilots (Figure 46). These Palm Pilots are "enhanced" with a built-in accelerometer or tiltsensor. The accelerometer can measure acceleration, constant and changing acceleration, i.e. it can also measure gravitation as that is constant acceleration. The acceleration is measured along two axis, x- and y-axis, which makes it possible to get the acceleration in one plane.

In the PalmPilot the accelerometer is mounted in such way that the y-axis is aligned with a line going from the bottom to the top and the x-axis from left to right. Therefore it is possible to measure the rotation around these axis if the Pilot is held parallel to the ground with no influence from the gravity being detected by the axis sensors.

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure46.png}
\caption{The prototype palm pilot interface to an electronic landscape}
\end{figure}

In some initial experiments the PalmPilot using the accelerometer was used to control an avatar inside a virtual environment. A more developed application is
The MidiShaker which is a combination of the accelerometer and a MidiInterface making it possible to use the PalmPilot to control music and sound generation. The Midishaker is described elsewhere in this document.

An idea currently being explored for use in the Cyberpond is to use the PalmPilot as a storage tool/virtual purse in order to collect information from one Virtual World and store it in the Pilot until it is released into some other world. A user can from his/her Palm Pilot send an information sucking tool into the Virtual World and control it from the Pilot. With this tool information can be sucked up into the Pilot or be placed into the world. The tool can have different appearance in the virtual world, such as a net, fishing rod or a vacuum cleaner. The accelerometer is used to control the rotation of this tool, it should be the same as the Pilots. And sliders on the screen of the Pilot is used to decide the length of the rod/beam and how much it is rotated to left/right. A button spits out or pickups an object from the virtual world which is temporarily stored in the Pilot.

The Pond Creatures

The choice of a Pond metaphor is deliberate in that it seeks to evoke the general concepts associated with evolutionary ecosystems and techniques associated with this. Core to this presentation of an ecosystem is the development of a series of pond creatures that allow activity and agency to be conveyed to users.

The pond will be inhabited by a variety of creatures (Figure 47) and information carrying structures. These inhabitants will be the focus of the user and will together with the user interfaces provide the channel between user and information. Possible ways conveying data states are through object colour, texture, size, velocity, and position relative to other objects but also through their motions. We plan to make these creatures move about in the currents caused by user interaction using flocking algorithms as a way of clustering data. We will also give the different types of inhabitants a unique way of moving making the pond a more visually appealing tool. This has the extra benefit of letting the objects themselves give rise to new ways of looking at the data being manipulated/created in the pond. The goal is therefore to empower the pond inhabitants with the ability to move and we plan to do it through procedural deformation techniques.
Other Future Artistic Commissions

On a final note we would like to briefly consider the commission of future art works within eSCAPE. One of the unique features of the work of the thematic space has been the migration of concepts and lessons from a series of artistic works undertaken by various members of the project. In particular, we have seen the work on Nuzzle Afar and 10dencies being commission at the ZKM with its results migrated to the library study.

In the final year of the project we would envisage commission a small number of additional works that would directly build on the experiences of the second year. These commissions would explicitly ask artists to extend the work of the project and provide a means of disseminating the experiences of building the thematic spaces in partnership with users. We have currently explored this possibility in terms of providing an extension to Nuzzle Afar that relates this work to the work of eSCAPE during the first two years of the project.