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Abstract

The paper briefly describes the concept and functional components of information environments and information landscapes, including the role of descriptions of collections and their catalogues. The paper then discusses the potential use of landscapes to support collaborative collection management across a range of processes and services, including resource acquisition, discovery, access, and preservation, and demonstrates the application of structured collection-level metadata to support a variety of consortium foci, including location, topic, educational level, and resource format. The paper describes several techniques which can be applied to collection-level metadata to provide landscaping services at regional and national level, including the application of functional granularity from the analytic model of collections and their catalogues, collection hierarchies, and controlled vocabularies. The paper presents examples from the Scottish Collections Network, a national operational information environment and landscaping service, including consortia based on collection subject (Scottish Visual Arts Group) and location (Glasgow Academic Libraries Together). The paper concludes by discussing the extension of information environments to incorporate archive and museum collections, and the potential impact of new and emerging collection description standards.

Information environments and landscapes

An information environment has been defined, in the context of higher education in the United Kingdom, as "an integrated set of networked services that allow the end-user to discover, access, use and publish digital and physical resources as part of their learning and research activities" (Powell, 2006). This definition can be generalised by extending the scope of learning and research activities to encompass all levels of education in formal and informal modes across all age groups. The functional model of an information environment identifies a number of processes with which an end-user must engage, from the stage at which they identify a need for information to

eventually obtaining a resource that they can use (Powell & Lyon, 2005). There are four main sequential stages:

1. **Entry:** the user is presented with an initial set of collections of information resource based on a personal or group profile or local service defaults.
2. **Survey:** the user modifies the set of collections by removing those irrelevant to their specific information need, and adding from a wider pool of collections excluded by the Entry stage profile, if any.
3. **Discover:** the user searches and retrieves metadata for individual resource manifestations contained in the set of collections.
4. **Detail:** the user identifies specific manifestations and items with particular attributes relevant to their need, such as availability.

Each of these stages can be further subdivided. The Entry stage, for example, might consist of an authentication process followed by a choice of standard user profiles before the initial set of collections is presented.

The Entry and Survey stages are required for large-scale information environments containing resources covering a broad or diffuse scope. It is assumed that most individual resources will be gathered into collections for reasons of functional granularity, defined as the level or focus of item aggregation which an organisation or service thinks is useful or necessary for the purposes of resource discovery or collection management (Heaney, 2000). Thus the catalogue of the library of an institution can be used to infer the existence of a corresponding collection of items described by that catalogue: the institutional library collection. The same reasoning can be applied to union catalogues of all types; there is a corresponding collection, even though its physical items will be distributed across multiple libraries and locations (Dunsire, 2005). It is further assumed that not all collections will contain items relevant to every specific information need of the user, and that it will save time if such collections are excluded from the Discover stage. For example, it is a waste of time to search for items about the Internet in a collection of classical Greek and Roman texts, or to identify items for same-day use when they are located a thousand kilometres away.

The set of collections offered at the Entry stage and subsequently amended by the user during the Survey stage is known as an "information landscape". Most landscapes will consist of a subset of all of the collections available within a specific information environment, although some user needs might require everything to be included in the Discover stage.

Collection-level description

A large-scale information environment will contain multiple institutions and services which are likely to organise their collections for a variety of functional purposes. These can include collections based on resource manifestation to collocate specific information carriers, for example tape cartridges or HTML files, or based on expression to collocate specific types of content, for example images or foreign-language translations. Then there will be special named collections, often based on items owned by a particular person or organisation, and collections managed by specific curatorial practices, for example a manuscript archive. Many of these collections will have their own specific finding aids such as special catalogues and

indexes, shelf lists and inventories which may or may not be fully or partially duplicated in a higher-level institutional catalogue. Information landscapes are more effective if they lead to specific item-level finding aids which are co-extensive with the selected collections in the Discover stage. General finding aids are likely to cover many collections which have not been selected by the user, resulting in more false-drops and an increase in response time during searches. This implies that the metadata used to create Entry and Survey landscapes must be capable of describing collections across a wide range of sizes and scopes, and reflect super- and sub-collection hierarchies arising from multiple and overlapping functional purposes within a single institution or service and between multiple institutions with a shared finding-aid such as a union catalogue.

As with item-level metadata, such collection-level metadata best meet these requirements by being based on a formal data model and schema with appropriate rules for maximising consistency in the content of data elements. The entity-relationship model developed for the UK's Research Support Libraries Programme (Heaney, 2000) provided the basis of several data schemas subsequently developed in the UK (Dunsire, 2002a). More recently, a Dublin Core collections application profile for collection-level description has been published (Dublin Core Collection Description Task Group, 2007), and a NISO draft standard for trial use for collection description has been available for field testing (National Information Standards Organization, 2005).

The entity-relationship model identifies three basic entities required to describe a collection:

- Collection
- Location
- Agent

Some of the relationships between these entities are:

- Collection **is located in** Location
- Collection **is collected by** Agent
- Collection **is owned by** Agent
- Location **is administered by** Agent

Landscapes and collaborative collection management

An Entry landscape in an information environment is a pre-selected sub-set of the collections described in the environment. The sub-set may include one, many, or all of the collections available for item-level resource discovery. The criteria for selection will reflect the functional aims of the landscape which may be dependent in turn on the functional aims of the environment. An environment can also allow the creation of Survey landscapes matched on user-selected values for similar selection criteria, for example all collections with titles containing a user-specified keyword. This is referred to as "dynamic landscaping" (Dunsire, 2004a).

A number of related projects in the UK have identified selection criteria appropriate for landscapes in information environments with a regional or national geographical scope (Dunsire, 2002a, 2002b, 2004a). These include:

- Highest-level of collection granularity (without super-collections)
- Persons and organisations (Agent entities) related to a collection as owner, collector, etc.
- Subject of collection
- Physical location of collection, down to the level of city, town or village
- Language of items in collection
- Education level supported by collection

Landscapes based on these criteria can be used to support collaborative collection management across a range of processes and services.

The following examples are taken from the Scottish Collections Network (SCONE) and the Co-operative Information Retrieval Network for Scotland (CAIRNS). SCONE is a collection-level descriptions service (SCONE, 2007b), while CAIRNS is a distributed union catalogue (CAIRNS, 2007b) using the Z39.50 protocol (Library of Congress, 2006). SCONE and CAIRNS have been developed as an information environment focussed on Scotland as a result of several research projects (Dunsire, 2002a, 2002b, 2004a, 2006b; Dunsire & Macgregor, 2003; Nicholson & others, 2001a, 2004a). Each service offers a self-contained information environment. SCONE supports several types of Entry and Survey landscape, including static sets of collection-level descriptions selected by a variety of third-party services, static landscapes based on Scottish regions, and dynamic landscapes generated by end-users using the full range of criteria listed above. The Discover and Obtain stages are supported by links to online finding aids for the selected collections. CAIRNS supports static sub-sets of the available Z39.50 catalogues, known as "mini-clumps", defined by a variety of third-party services. A mini-clump is equivalent to an Entry landscape. The user can create a Survey landscape by manually removing or adding individual catalogues, before moving to the Discover and Obtain stages supported by the union catalogue. The two services are also integrated, so that static and dynamic landscapes from SCONE can be used to create a "dynamic clump" in CAIRNS, and general information about the collections described in selected CAIRNS catalogues can be accessed in SCONE from CAIRNS.

Collaborative resource acquisition is supported by the use of CAIRNS mini-clumps by inter-library loan services. An example is the document supply service of Napier University which is based in Edinburgh. A mini-clump containing its own catalogue and those of the other three universities in Edinburgh and the National Library of Scotland, also located in Edinburgh, was made accessible to end-users for checking the availability of a specific expression or manifestation in the local area before making an application for an inter-library loan. Library staff in many institutions can use SCONE to landscape online finding-aids and CAIRNS catalogues when searching for items to satisfy loan requests. Acquisition services staff can check for the availability of expensive resources in accessible collections held by other institutions before committing a purchase. The landscaping functions of CAIRNS, SCONE and their combination are a useful tool for any acquisition activity that requires checking the contents of multiple library and other collections.

Collaborative resource discovery is supported by the scalability of the CAIRNS service in numbers of catalogues and landscape generation. The CAIRNS service has grown from an initial 20 catalogues (Nicholson & others, 2001a) to around 50, extending its scope beyond higher education and research libraries to public, further education and special libraries (CAIRNS, 2007b). Mini-clumps are available to exclusively landscape the catalogues of members of the Scottish Confederation of University and Research Libraries (SCURL) or the catalogues of public libraries, and additional mini-clumps can be easily implemented, allowing the creation of multiple virtual union catalogues within the CAIRNS distributed union catalogue which match the scope of these different communities.

Collaborative resource access is also supported by CAIRNS mini-clumps, which can be used to encourage end-users in a reciprocal access community to exploit the improved accessibility to members' collections. SCONE landscapes for members' collections can also be used to display general access conditions such as opening hours, provision for wheelchair users, and a map of the location of a physical collection, as well as specific access arrangements for community members. The case study of Glasgow Academic Libraries Together (GALT) discussed below is an example. A special feature of a CAIRNS mini-clump or SCONE landscape is that it can be directly invoked using a parameterised URL, and can be displayed in the context of a specific community (GALT, 2007a, 2007b) or with standard CAIRNS and SCONE branding (CAIRNS, 2007a; SCONE, 2007a). This allows direct links to the CAIRNS and SCONE Entry landscapes; such links can have text or graphic labels appropriate and familiar to the community and its end-users.

Collaborative preservation and conservation activity can also be made more effective using an information environment. An example from Scotland is the Distributed National Burns Collection project (Hopes & Dunsire, 2005). One of the aims of the project was to identify resources owned by, created by, or about Robert Burns from archives, libraries and museums in Scotland, and to plan priorities for appropriate preservation and conservation. The project created an online catalogue of nearly 9000 items, with each record containing only two metadata elements for describing the item (National Burns Collection, 2004). The full display of each record contains a link to the SCONE description of the collection to which it belongs, allowing users to identify the location of the item and access conditions, and carry out further searches for more detailed metadata in the local collection catalogue, if available. In addition, the main search page contains links to a dynamic landscape in SCONE which identifies collections associated with Robert Burns, and a mini-clump of CAIRNS catalogues with significant holdings of Burns resources. The mini-clump in this instance is transparent to the end-user, who sees only the results of an automatic search of the mini-clump for items associated with Robert Burns.

Case study: UCABLIS

UCABLIS: Union catalogue of art books in libraries in Scotland was, until 2001, a physical union catalogue hosted by the National Library of Scotland, giving the holdings of resources with the subject focus of the visual arts in the libraries of members of the Scottish Visual Arts Group (SVAG). The catalogue supported the aims of the Group, which include maximising opportunities for co-operation in Scottish institutions, promoting collections and services, and linking related activities

between local and national level (SVAG, 2007). The catalogue records were aggregated by copying metadata from local catalogues and manual de-duplication. This resulted in high maintenance costs for the National Library of Scotland which not only hosted the catalogue service but was a major contributor to the holdings.

In 2001 the National Library indicated that it could no longer support the service as a physical union catalogue. No further records were to be added, but access to the existing catalogue would be maintained for at least two years while the Group sought alternative solutions to its information retrieval needs (Baptie & others, 2002).

One proposed solution was to use the distributed union catalogue architecture offered by CAIRNS to provide cross-searching of the Z39.50 catalogues of members of the Group, where available. This could provide an initial mini-clump or Entry landscape of catalogues registered in CAIRNS and belonging to members, with a Survey landscape chosen by the end-user from all of the registered catalogues of Scottish libraries. At the same time, a SCONE landscape of institutional-level collections could provide a wider Entry landscape covering all Group members, including those without Z39.50 catalogues or online public access catalogues. Preliminary investigation identified nine CAIRNS catalogues associated with the 30 members of the Group, including the National Library of Scotland and other large contributors, and SCONE records for 20 of the members. The proposal was eventually accepted by the Group, although it was recognised that this would significantly dilute the subject focus of the union catalogue as searches would be applied to the entire local institutional collection and not restricted to "art books".

The research and development work to implement a UCABLIS mini-clump and SVAG landscape was carried out as part of the Scottish Portals for Education, Information and Research (SPEIR) project, with pilot services made available in 2004 (Nicholson & others, 2004a). The project identified existing Z39.50 catalogues of group members which had not been registered in CAIRNS, including the 2001 version of the original UCABLIS physical union catalogue. These were registered and tested, and technical assistance was given to members to install and configure Z39.50 servers for their online catalogues. At the same time, records for all members were added or updated in SCONE. The original UCABLIS catalogue was removed from CAIRNS, and therefore the mini-clump, in 2006 because it was significantly out of date and those Group members with large collections but no Z39.50 catalogue had implemented policies to join CAIRNS.

The mini-clump and landscape continue to be maintained and used. There are currently 11 catalogues in the CAIRNS mini-clump (CAIRNS, 2007a), and 25 collections in the SCONE landscape (SCONE, 2007a). Some members of the Group do not own collections, while others are related by organisation hierarchy to other members, so their collections are in fact sub-collections already accounted for in the collection hierarchies. Maintenance costs of the new UCABLIS services are relatively low. CAIRNS maintenance is only required when a member library upgrades or replaces its Z39.50 server, or the server becomes unavailable. Most of the SCONE records for Group members are updated annually as a result of the maintenance of all Scottish library directory information carried out by the Scottish Library and Information Council (SLIC) for Scottish library and information resources online (SLIR, 2007).

Several technical developments have been identified to improve the UCABLIS service. One is the creation of subject-restricted Z39.50 indexes by each member library. This would involve the building of the standard CAIRNS keyword and control number indexes on a filtered subset of the records in the local catalogue, determined by the subject classification applied to each record; for example, the "art books" title keyword index could be built from those records with a Dewey Decimal Classification in the 700s. The CAIRNS Survey stage can accommodate this approach to improving the precision of UCABLIS searches, so barriers to implementation are more likely to arise as a result of limited functionality of the local library management system or the absence of suitable subject metadata in the catalogue. Another relevant development is the High-Level Thesaurus (HILT) project, which offers ways of improving the precision of subject-based searches in heterogeneous union catalogues by developing a service to translate between different same-language subject heading schemes (Nicholson & others, 2001b; 2004b). The project has also demonstrated methods of integrating subject-based collection landscaping functions within such a terminologies service in an information environment (Nicholson & others, 2004c).

Case study: GALT

GALT: Glasgow Academic Libraries Together is a consortium of libraries located in or near the city of Glasgow in Scotland. GALT aims to develop co-operation and knowledge-sharing between its members, to work together to improve access to resources for library users in Glasgow, and to ensure that the libraries of Glasgow speak with a single voice (GALT, 2006). The consortium created a website to provide information about its members and details of conditions of access to their collections. Many of the libraries belong to various reciprocal access schemes with scopes ranging from local to the United Kingdom and applying to various categories of user. The website also displayed the opening hours and location of each physical library, along with an indication of the main strengths of its collection.

The website was constructed with plain HTML, and any amendments required direct editing of the source file. There was no formal process for ensuring the information was kept current, and it had become necessary to transfer responsibility for keeping the website available from one member to another. As a result, the consortium realised in 2006 that the website had become badly out of date, and sought ways of improving its maintenance. Members noted that much of the content was already available in SCONE, and it was being updated at least once per year as part of the maintenance of SLIR. An approach was made to SCONE to discuss the possibility of incorporating the remaining GALT information in the relevant SCONE records, especially the detailed access conditions, and to ascertain if a SCONE-based website could be restricted to the consortium members.

Analysis of the GALT information on access scheme details showed that it could be easily accommodated within the existing SCONE record structure, along with all the other information required about member libraries. All the GALT libraries already had entries in SCONE, so a landscape could be quickly created. Furthermore, several of the members had Z39.50 catalogues registered in CAIRNS, allowing the creation of a GALT mini-clump. A pilot landscape was implemented to allow members to check the currency and completeness of the information in their SCONE records, and to feed back comment. The Scottish Library and Information Council offered to extend SCONE maintenance to include the consortium's requirements and provide a

web homepage as part of its strategy on encouraging shared services in Scotland. The consortium accepted the offer, the SCONE records were updated where required, and a new homepage created and published.

The homepage (GALT, 2006) describes the consortium and provides links to a SCONE landscape of eight institutional collections (GALT, 2007a) and a CAIRNS mini-clump of five catalogues (GALT, 2007b), both with customised interfaces. GALT members made a number of suggestions for making SCONE easier to use, including the ability to "brand" mini-clumps and landscapes to avoid abrupt changes to screen displays as users switched from local environments to CAIRNS or SCONE. These enhancements were judged to be useful for other users, and were incorporated in an upgrade of the services in March 2007.

A technical development that would improve the functionality of the GALT information on access schemes is a more refined structure for the relevant metadata in the SCONE database. This would allow specific information such as the name of the scheme, its homepage, and to which categories of user it applied, to be stored and processed as discrete elements. The ability to landscape CAIRNS by access schemes and conditions was identified in the original Co-operative Academic Information Retrieval Network for Scotland project which created the CAIRNS service (Nicholson, 2001a). There are several regional access schemes in use or under development in Scotland in addition to GALT, so any enhancement of SCONE would be of general benefit.

Regional and national information environments and landscapes

These examples and case studies show that general information environments can support collaborative library communities based on a variety of types of focus, including:

- Geographical location; for example, Glasgow Academic Libraries Together
- Subject topic; for example, Scottish Visual Arts Group
- Educational level; for example, Scottish Confederation of University and Research Libraries
- Resource format; for example, Scottish Distributed Digital Library, which is a landscape of collections of openly-accessible online digital resources

Structured collection-level metadata is an important requirement for environments which intend to support such a variety of landscapes. For example, the subject of a collection needs to be clearly distinguished from its location; while it is true that, for most local history and local studies collections, the location and the subject are the same thing, it is not always the case.

It is also important to relate collections, especially super- and sub-collections. The use of functional granularity to identify physically distributed super-collections with a common finding-aid such as a union catalogue has already been noted. Identifying sub-collections allows a more flexible approach to landscaping, for the sub-collection may be in scope while its parent collection is not. And modelling hierarchies can remove the need for significant duplication of location and access condition metadata

as, in general, a sub-collection of a physical collection will be located at the same address and general opening hours and other accessibility conditions will apply to all sub-collections at that location.

The use of controlled vocabularies for metadata elements which are the basis of community and user-generated dynamic landscapes has similar advantages to those identified for item-level description: ambiguity is reduced, consistency and coherency are improved, and the vocabulary can be presented as a pick-list to the user to help select the appropriate term. SCONE uses a number of controlled vocabularies (Dunsire, 2004b), covering:

- Collection types
- Countries (for important Scottish collections located outside of Scotland)
- Days of the week (for statements of opening hours)
- Educational levels
- Languages
- Names of persons and organizations
- Regions (local authority administrative areas)
- Subject classifications (Dewey Decimal Classification)
- Subject topics (Library of Congress Subject Headings; Conspectus)
- Times (for statements of opening hours)
- Town and village names

Information environments with a regional or national focus will find it particularly useful to identify or develop and maintain controlled vocabularies for place names and the names of persons and organizations prominent in the region or nation. The use of internationally recognized vocabularies for other attributes will improve interoperability between regional and national environments.

Extension of information environments to incorporate archive and museum collections

One of the datasets used to inform the initial development of SCONE was a directory of collections of local history and local studies aimed at genealogical researchers, Exploring Scottish history (Dunsire, 2002b). This included specific collections from archives and museums as well as libraries, so the need to extend the information environment to these other communities was evident from an early stage. Further evidence has emerged from the development of Scottish library and information resources online (SLIR, 2007). This was originally focussed exclusively on the library community in Scotland, but had to accommodate archival and museum collections held as part of a library service, so it proved difficult to confine the scope of the service to just libraries and library collections.

The development of metadata schema for collection-level description has assumed that they will cater for all types of collection, irrespective of how they are curated or administered. In fact, archives have traditionally used a form of collection-level description to describe and access their holdings, while museums are increasingly aware of the need to describe their collections for promotional reasons.

End-users are now used to retrieving online information from a wide variety of sources; it is probably fair to say that they are not interested in where the resource originates, just that it exists and is accessible. This has stimulated the idea of the "common information environment", which makes no assumptions about who uses it, why they use it, what their specific information needs are, or where the resources satisfying those needs are stored (Dunsire, 2006a).

A common information environment thus describes physical and digital resources collected by archives, libraries, museums and other organizations in a particular geographical area to satisfy the information discovery and access needs of all users located within that area or interested in that area.

Impact of new and emerging collection description standards

The Dublin Core collections application profile (Dublin Core Metadata Initiative, 2007) and NISO draft standard for collection description (National Information Standards Organization, 2005) focus on the Collection entity of collection-level description. Both are also based on the Dublin Core abstract model (Powell & others, 2007), allowing interoperability with similar metadata schemas for related Agent and Location entities.

The Dublin Core profile is directly compatible with all of landscape scopes discussed in this paper, with the exception of those based on the Location entity. There is sufficient information in the owner and collector Agent relationships to support landscapes focussed on a particular organization or person, but some form of structured metadata for the Location will be required to generate landscapes based on geographical scope. SCONE metadata for Locations shows that street names often contain town, region or country names, so relying on full-text keyword retrieval may result in false-drops which are particularly damaging to environments based on regions or nations.

The availability of standard metadata formats, schemas and vocabularies makes it easier to implement information environments to support communities, consortia, and collaborative activities, as well as improved end-user services for resource discovery and access. And the domain-neutrality of such standards must surely encourage the development of common information environments through the collective and co-operative activity of archives, libraries, and museums.

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