THE UNIVERSITY of York

Digital Library Project (SAFIR)

Requirements Specification

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Contents

Purpose and scope

The purpose of this document is threefold. Firstly it is a high-level reference model for the University of York digital library, offering both an overarching service framework and a technical infrastructure. Secondly, it offers a model for the set of functions, processes and information workflows that the digital library must support. Finally, through this it derives a set of specific technical, user and functional requirements for building and delivering a digital library service. The latter will be used as the basis for a software evaluation and recommendation. As a whole, the document will drive the digital library project and, as such, it is open to future revisions as changes in our environment demand changes to our services.

Methodology

This document is informed by desk research, discussion and analysis. These methods have been combined to provide data for the three purposes fulfilled by this document, as identified above. From a number of previous JISC projects, and other sources, there exists a considerable amount of documentation around user and other requirements gathering. This material cannot replace individual discussions with the user community, but it does offer supplementary data to back-up or refute findings. The intelligence gleaned from the literature review has been incorporated in the document. Details of literature reviewed can be found in the Bibliography (Appendix 1).

The second method was to interview representatives from a number of University Departments. The digital library project has already identified several Departments across the University with whom it will work closely in the initial three year phase of the project. Informal interviews with the following Departments have been held: Music, History of Art, Language & Linguistics, Theatre, Film & Television, Archaeology, Psychology and the Borthwick Institute for Archives. Details of interviews held can be found in Appendix 2.

Finally, through analysis of both the results of the literature review and the notes taken from interviews, information about resources types, collections and requirements have been elicited and used to form the backbone of the ensuing document.

A digital library for the University of York

The digital library Project

The SAFIR project is phase one of the University of York's digital library project. SAFIR is an 11-month start-up project funded by JISC with the aim of establishing a multimedia repository at the University. The next phase will take the project to the end of its third year and will give time to work with more Departments and varied collections. After that the digital library will be integrated into the Library & Archives core services. It plans to offer vital central storage and access to digital collections at the University and to act as a central point for funding activities and digital library technology developments. It will have a pivotal role in stimulating and supporting future activities and projects in digitization and digital resource creation and acquisition.

Scope of the digital library

The scope of the digital library, from the outset, has been defined and framed by the existing needs identified and the existing infrastructure and services available at the University of York. It is not the aim of the digital library to duplicate any service that exists or is planned or to deliver functionality that is not its core purpose and can be better served elsewhere. Integration with other services providing such functionality is an important aspect of the digital library project.

The need which the digital library is addressing is for a repository, or repositories, to manage, store and provide access to digital resources which are used as a source for research and teaching, or arise out of either activity. Digital resources from various disciplines and in a range of different formats have been identified. Initially, the focus is on resources within the following Departments of the University: Music, History of Art, Language & Linguistics, Theatre, Film & Television, Archaeology, Psychology and the Borthwick Institute for Archives, and covering materials which encompass audio, digitized manuscripts, film, video and images. Research and teaching at the University of York are closely allied, with each informing the other, so the boundary between what constitutes research material and what teaching is not clear. The digital library will work to deliver clear policy and guidance, engage users and communicate and integrate with systems such as the VLE.

In scope for the digital library are the following types of data:

- Images – 2D, 3D and 4D in a range of file formats and sizes
- Digital audio files, including musical performance and broadcast materials
- Digital video and film, including performance and broadcast material
- Transcriptions
- Digitized text and manuscripts
- Web resources
- Presentational resources
- Datasets, for example statistical, experimental or analysis data
- Collections and aggregations combining any of the above types

Some types of data and service which are considered out of the current scope for inclusion within the digital library are:

- Research publications or any similar materials falling within the remit of White Rose Research Online
- Course development and creation and/or storage of course materials or learning objects used exclusively for teaching – these fall within the remit of the Yorkshare VLE
- Current web pages hosted by YorkWeb and the forthcoming Web CMS
- Current information, rapidly changing information and time-limited information such as news

- Corporate and administrative records, or other management information dealt with by YIMS systems
- People information and identity management
- Mutable information, i.e. resources that are subject to regular update and revision such as office documents handled by traditional filestore (document versioning with change tracking and roll-back functionality is out of scope for the digital library)
- Large datasets and complex scientific data that are currently stored in alternative digital repositories or data archives (although cross-searching these would be within scope)
- Collaborative project working and collaboration tools such as wiki's are currently supported by the Yorkshare VLE and elsewhere.
- Mass digitization projects do not fall within the scope of the current digital library project, although the digital library will provide the infrastructure for storing and managing the outputs from such projects

Any of the above information-holding services are potential integration or interoperability targets. The digital library is committed to coordinated approaches for a number of reasons, including maximising the use and re-use of information, reducing duplication of effort in data creation and offering the optimum tool for different services.

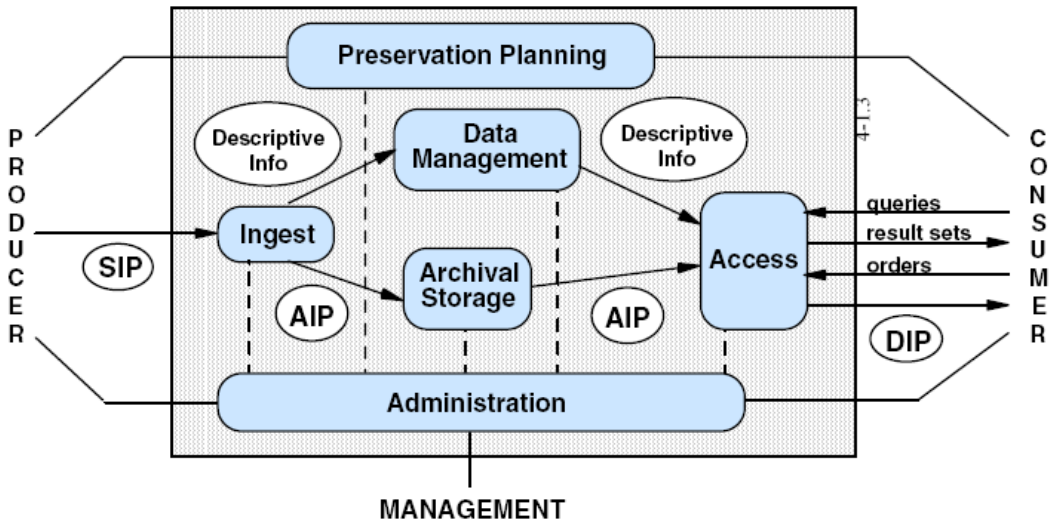
A model for the digital library

Flexibility is a key consideration in working across Departments and subject disciplines with different resource requirements. Because of this, the 'digital library' is not envisaged as a single repository or filestore, rather its aim is to offer a technical infrastructure and intellectual framework within which a range of "services" can be developed, tested and delivered.

Before coming up with a set of functions, practices and information flows, it is useful to look broadly at the overarching model. It is not the intention of this document to draw time and energy away from core project goals towards consideration of abstract models and lengthy standards documents. Having said that, a high-level model is crucial as it provides the framework and vision for our service.

There is already a well established model in the area – OAIS (Reference Model for an Open Archival Information System). This has had considerable uptake within the archival community as its primary focus is on long-term preservation. Planning for the long-term is something that the York digital library, in fact any digital repository, must do, alongside its more immediate goals of ingesting material and providing access. By choosing OAIS as a model for the digital library, it is our intention to draw us closer to a community already thinking along OAIS-lines and to allow us to better frame our requirements with a set of (relatively) neutral terminology and concepts. What we must ask ourselves when thinking about OAIS is whether it constrains or enables us? If treated as guidance rather than directive, OAIS is very useful as it allows us the flexibility to build a service within its framework that will support our user requirements and to define a 'long-term' that will suit our needs and community.

Briefly, the following diagram explains OAIS and is widely used. The OAIS environment is made up of the OAIS, i.e. the digital library system, the producers and consumers of its content and services, and the management and strategic input into the system. Within the OAIS are six main functions, listed in the following section. Information, which reflects both the data and its descriptive metadata, flows around the system.



To be OAIS-compliant, there are a set of mandatory responsibilities:

> *The OAIS must:*
> - *Negotiate for and accept appropriate information from information Producers.*
> - *Obtain sufficient control of the information provided to the level needed to ensure Long-Term Preservation.*
> - *Determine, either by itself or in conjunction with other parties, which communities should become the Designated Community and, therefore, should be able to understand the information provided.*
> - *Ensure that the information to be preserved is Independently Understandable to the Designated Community. In other words, the community should be able to understand the information without needing the assistance of the experts who produced the information.*
> - *Follow documented policies and procedures which ensure that the information is preserved against all reasonable contingencies, and which enable the information to be disseminated as authenticated copies of the original, or as traceable to the original.*
> - *Make the preserved information available to the Designated Community. (CCSDS 2002, p. 3-1)*

These responsibilities should be easily achieved. For the digital library, our interpretation of an OAIS is not as a single closed system, rather it is a network of interactions between different function-providers, including people, internal processes and external systems.

Designated community

In OAIS, this is "an identified group of potential Consumers who should be able to understand a particular set of information. The Designated Community may be composed of multiple user communities". For the digital library, our 'designated community' can be profiled in various ways.

User community

As Producers of content

- University of York
  - Staff or students (individuals or groups)
  - Content providers (machine-agents)
- External
  - Content providers (machine-agents)

The digital library does not anticipate deposit from external individuals or groups, unless through a collaboration or partnership with the University of York.

As Consumers of content

- University of York [principal community]

    - Individuals
        - Academic researchers and research students
        - Teaching academics and undergraduates
        - Distance learners *
        - Administrative and Support staff
    - Groups
        - Departments – Academic and Administrative/Support
        - Institutes, research centres and other groups
    - Services (machine-agents)
        - University systems
- External individual and group users
    - White Rose Consortium
    - Other partnerships and collaborations involving the University of York
    - Higher Education (UK)
    - Other educational sectors – Further Education, Schools, continuing professional development (UK)
    - Heritage and voluntary sector – museums, art galleries etc. (UK)
    - International subject communities
    - International educational, heritage and other communities
    - General public

The principal designated community for the digital library is the University of York. This is the only community to whom we will offer direct support, advice and guidance. Secondary to this is the UK HE Community as funded by JISC. Wherever possible the digital library will provide open access, particularly across the UK educational sector. Any advice and guidance documents will, where permissible, be made public.

* Distance Learners have been specifically included as an example of a group of users for whom digital access to resources can help provide an experience that is comparable to that of campus-based students. Distance Learners in this context include undergraduate and research students.

Disciplinary community
The University of York Departmental structure covers the following broad disciplines:

- Archaeology
- Biology
- Chemistry
- Computer Science
- Economics
- Education
- Electronics
- English Literature
- Environment
- Health Sciences
- History
- History of Art
- Medicine
- Language and Linguistic Science
- Law
- Management
- Mathematics
- Music
- Philosophy
- Physics
- Politics
- Psychology
- Social Policy and Social Work

- Sociology
- Theatre, Film and Television

It is clear that requirements differ across different subject disciplines and Departments. Findings from a study by the JISC StORe project found that "noticeable variations in the way that data are gathered, formatted, allocated metadata and subsequently shared (both between disciplines and within disciplines) were noted, and this needs to be taken into consideration when establishing a Source to Output repository interface." (Miller, 2006). As acknowledged, it is not only the types of resources that differ, for example images for History of Art and audio for Music are of primary relevance, but the ways in which these are used and managed. Even within the University of York, a digital library must acknowledge such differences and develop a service which can support variety whilst being cohesive and complementary. Working closely with Departments is essential and will continue through the life of the project and beyond, extending to other Departments within the University whose digital resources are candidates for ingest.

System/Service development community
The digital library is dependent upon those who support, manage and run it. These form a discreet community whose engagement, interest and expertise must be fostered:

- Internal
    - Library & Archives
    - ELearning - Yorkshare VLE managers and learning technologists
    - Computing Service
    - White Rose Research Online
    - Other University Systems
- External
    - Repository Developers and/or software vendors
    - External service providers/consumers, aggregators

Management
- Administrative and Support staff
- Repositories community in the UK
- International repositories community
- JISC Repositories and Preservation Programme
- Funding bodies, JISC and potential future funders
- University management bodies, for example Information Strategy Group, Strategic Information Projects Implementation Group

As this document as a whole takes a hybrid approach with a strategic high-level model and low-level requirements informing the future of the digital library, so should the document parts – engaging with management communities and sharing information on a management and strategy level is of significant benefit for the future of the digital library service.

Usability
The above analysis of the designated community focuses on different types of user and stakeholder. Within these broad groups will exist many layers of expertise, interest and engagement. It is important that the digital library recognises this and builds a system that is usable on a very simple level whilst scaling up to support advanced users.

Functional model
What is it that the digital library needs to 'do' in order to support this community? What are its functions?

OAIS specifies six over-arching functions, within which are a series of sub-functions. There is no requirement within OAIS to design a system according to this model, merely that these and the flow of information as identified through the OAIS diagrams be considered. These six

functions provide a useful framework and structure for considering our requirements. They will be explored further in the requirements section of this document.

Overview of OAIS functions:

Ingest [deposit, put]

- receive submission [SIP]
- generate AIP [Archival Information Package]
- quality assurance
- generate descriptive info
- co-ordinate updates

For the digital library *scanning and digitization* would form part of this process. The actual mechanism for creating deposits and generating metadata are not explored here but could include a variety of techniques, from a user logging into the digital library, to a desktop drag and drop facility that derives metadata from document properties. Getting material into repositories is the first step of the workflow. Providing guidance and support, offering mediated deposit and supporting flexible mechanisms are all crucial aspects of this function.

Archival Storage

- receive data
- manage storage hierarchy
- replace media
- provide data
- error checking
- disaster recovery

This function must provide the secure storage and back-up required for deposited items, or formats converted for storage. OAIS does not include functions or sub-functions relating to tracking the provenance of ingested items, nor does it make explicit connections between description information [Data Management] and information objects stored by the Archival Storage function. These functions would be necessary for the digital library, to enable the recording of audit trails.

Data Management

- generate report
- administer database
- receive database updates
- perform queries

This function stores descriptive and system information and must interact with various functions to ensure the smooth flow of information.

Administration

- physical access control
- establish standards and policies
- manage system configuration
- archival information update
- audit submission
- activate requests
- customer service
- negotiate submission agreement

This function would include *Collection Development* activities, including devising procedures and policies, and also a standards-watch function. This would likely be a very varied function composing a range of human tasks alongside systems tasks. A useful way to view this function might be to see it as orchestrating or choreographing the remaining functions – putting together the digital library building blocks.

Managing authentication and authorisation would be a task of this function, working with the Ingest and Access functions to facilitate access control.

Preservation Planning

- develop preservation strategies and standards
- develop packaging designs and migration plans
- monitor designated community
- monitor technology

The Preservation Planning function does not carry out actual preservation activities, rather it is responsible for carrying out a technology watch function, monitoring changes in community requirements, recommending changes and updates, designing the information packages and developing preservation policies.

Access

- coordinate access activities
- deliver response
- generate DIP

Access is the point at which the repository interfaces with its Consumers, receiving queries and requests, delivering responses and connecting with the Data Management and Archival Storage functions to generate the DIP. Users here can be local or remote and might include interactions with external systems such as OAI-harvesters or federated search services that rely on existing standards (for example OAI-PMH or SRU) and pre-defined metadata schemas (for example Dublin Core or IEEE LOM). In reality, it is likely that access will not be from a "single user interface" (CCSDS 2002, p. 4-15) rather, multiple access points with exist for different Consumers.

Information model

OAIS offers a conceptual model for information which includes the notion of an information package. There are three types of information package defined: that which is deposited (the submission information package or SIP), that which is stored (the archival information package or AIP) and the package(s) delivered to users accessing the service (the dissemination information package or DIP). Each package should contain the data object(s), descriptive information and information needed to access and use the resource.

For the digital library, the notion that a deposited package might be converted for storage and/or dissemination is very important, as is the need for multiple dissemination formats. There are various use cases which suggest that delivering the most appropriate format for the user will require the creation of multiple formats derived from an archival 'master' resource.

In a very simplistic form, the conceptual model from OAIS can be expressed thus:

Information Package
contains Content Information (0 or 1)
contains Data Object (Physical / Digital)
contains Representation Information
contains Structure Information
contains Semantic Information
contains Preservation Description Information
contains Reference Information
contains Provenance Information
contains Context Information
contains Fixity Information
identified/delimited by: Packaging Information (1)
described by: Package Description (0 or more)

In reality, the OAIS model is very flexible and the digital library project will extend this into a more concrete model in its metadata work package.

The information model and the information lifecycle

For the purposes of this section, data or data object refer to the primary digital resource types in the following list – items deposited into the digital library. Metadata provides additional information about these resources. Information encompasses both the data and metadata – both are of equal importance for the digital library.

Making a distinction between data and metadata isn't necessarily useful. In fact, OAIS doesn't use the term metadata, preferring 'information' to encompass both the data and the information that describes it. What are important is what information needs to be stored, what needs to be edited and updated, how information might change with usage or purpose and what information can be captured automatically.

Fixed content

Sun Microsystems define the notion of 'Fixed Content' thus: "Fixed Content shares the long-term storage requirement of archival data and yet requires fast and frequent accessibility. Fixed Content has the characteristics of (a) longevity, i.e. it is stored to long periods – years to decades, (b) immutability, i.e. it is unchanged after being written, (c) accessibility, i.e. fast random read access is required". This definition describes succinctly the notion of 'content' that the digital library intends to support.

Types of 'fixed content' identified for inclusion in the digital library:

- Images – 2D, 3D and 4D in a range of file formats and sizes
- Digital audio files, including musical performance and broadcast materials
- Digital video and film, including performance and broadcast material
- Transcriptions
- Digitized text and manuscripts
- Web resources
- Presentational resources
- Datasets, for example statistical, experimental or analysis data
- Collections and aggregations combining any of the above types

Collections and aggregations

In many cases, the resources held by the digital library will not be single atomic units, but aggregations of smaller resources. Identifying the smallest useful unit for re-use will be a key goal for the digital library information model. For example, a fragment from a longer video might be considered an individual resource if it needs to be referenced and re-used.

Structured collections of resources also fall within the remit of the digital library. These might include complex, hierarchical archival collections with different resources associated. The digital library must be able to support the description and navigation of such collections.

Relationships

Expressing relationships between resources is something that the digital library will want and need to do. It is no longer enough to have a single object, however richly described, without being able to make connections between it and other objects. This is a fundamental concept on the web (hyperlinking), but the Web lacks the ability to identify the type or nature of the link at present (x is the same as y, a is part of b, c is a different version of d, e is the same as f but in an alternative media type). The digital library will explore techniques and standards for expressing detailed relationships. Examples include establishing where multiple representations are of the same data object, such as a page of digitized text and a marked-up transcription of the same text.

Identification

The Web architecture identifies a resource as "Anything that might be identified by a URI". The digital library must leverage the Web as a dissemination mechanism and therefore must create URIs for every resource that it wants to make available. Ubiquitous use of the Web is a given - using the Web as our primary delivery mechanism for both public and access controlled dissemination is beyond question.

Workflow

Talking about functions and information can imply a static system. Introducing the notion of processes, of ***life***cycle and work***flow*** extends this and introduces the dynamics of an active system.

The way that content is ingested and accessed will vary for different users. From the stakeholder analysis we can elicit a number of user groups and types of people who need to input at various stakes of the metadata and information lifecycle, from creators, through editors, to people depositing on behalf of others. Depositors might include both people and machine agents depositing through interfaces. These varying points of deposit and different user needs require flexibility in the digital library infrastructure.

The Scenarios included in this document should help illustrate workflows and information lifecycles.

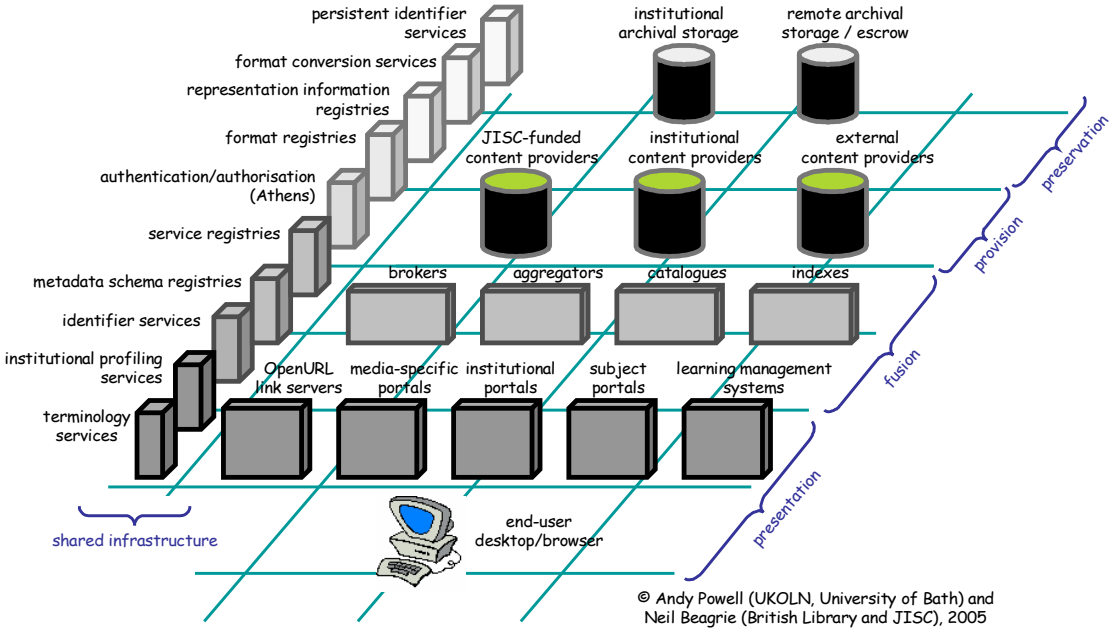
Interoperability and integration

For the purposes of this document, integration is taken to mean systems working together using web services or APIs; interoperability is sharing data and services using open standards. The two are closely allied. Within the University/White Rose the digital library will need to integrate with (at least) the following services:

- Yorkshare VLE
- Web Content Management Sysem
- White Rose Research Online
- Portal (proposed)
- Streaming service
- Access control, identity management and people information services
- YIMS

Beyond the University, interoperability with educational services such as the Intute repository search project, OAIster and BASE will be achieved through implementing interoperability standards. Closer to home the University of York is home to the Archaeology Data Service and to the CVMA collection, currently hosted by the Arts and Humanities Data Service. Both of these will be targets for interoperability. Standards such as ATOM/RSS and the Atom Publishing Protocol might be supported to allow not only additional interoperability on the wider Web with blogs for example, but dissemination and deposit within the University.

The following diagram has been widely used to provide a view of how the interoperability underpins the JISC Information Environment. Without looking at this in too much detail it is easy to see that the provision of various functions can be carried out by a suite of interconnecting services.



Technical architecture

It is too early to specify a detailed technical architecture, but as a minimum the digital library should explore modular or service-oriented approaches. Building a dynamic, flexible set of "services" will allow improvements and additions to be more seamlessly embedded. "Services" might more easily be described as "functional components" – elements of the digital library that support some kind of functionality, as identified through the ensuing requirements section. These are not necessarily technical components. Some examples of the types of "service" we ***may*** want to support are:

- video streaming
- audio streaming
- image rendering
- GIS rendering
- XML rendering

Usage scenarios

The following four scenarios reflect the current situation for a number of collections across the University. They are based on real practice, but in many cases combine information from a range of people to form a single, coherent description.

Scenario one : finding image materials

There are three main slide collections at the University of York, in the Departments of Archaeology and History of Art, and the King's Manor Library, plus a number of additional smaller collections in the King's Manor Library. Slide librarians work part time in both the King's Manor library and the History of Art Department where they can provide hands-on help with finding slides, but only some of the time. In King's Manor Library the staff are occasionally asked questions such as *'I am looking for slides of illustrated manuscripts showing images of...'* which can be difficult to answer without specialist knowledge of the slide collections. In History of Art the slide library is open for use by members of the Department, with slides being organised to an in-house classification scheme. Digitized images, of which there is a growing collection, are held on a PC in the slide library where they are organised into directories according to the member of staff who requested their digitization – these are not currently backed up to University filestore so are not available over any network. This can make intra-Department use of the images difficult if students are not aware of which member of staff has requested which images. Also, a single slide classification scheme provides a single 'access point' to slides and cannot reflect the fluidity of research interests. For both the physical slide collections and digital images, a personal visit is required – this is not always feasible for collections held at other sites. Inter-Departmental access is virtually impossible, other than for collections in the King's Manor library. In addition, image collections are held by individual academics and by other Departments and central services. Cross-disciplinary use of such collections is almost impossible. Other risks include damage, loss or misfiling of slides and duplication of effort in digitizing multiple images.

Scenario two : sharing resources, advice and guidance

An academic wants to scan some images into a digital format. She does not know what resolution at which to scan, what file format to use or how large to make her file. She wants to use the images and text in a powerpoint presentation. Where should she go for advice? What is the best practice? Is there any equipment that she could use? Once created, where could she store this image so others could make use of it? In the end, she finds an old scanner in a Departmental office and makes a best guess – it looks OK on screen.

Meanwhile, a member of support staff in the Web office is putting together a brochure about the University and needs some high quality images. He knows exactly the image resolution and file size required. The images above would be ideal, but, not only does he not know about the existence of these images, the academic scans them at a resolution that could not support print quality.

Scenario three : streaming

Access to music and video resources in the University are currently provided through a CD and DVD collection held either departmentally or within the Library & Archives. Neither solution is ideal since the former prevents wider access and the latter can result in materials not being available to those who need them. Purchasing multiple copies is one solution, but is not viable in the long term due to cost and space implications. Provision of dedicated listening or viewing resources, alongside analysis tools, or complementary resources such as music scores, transcripts or keyboards, is not available in the Library at present. Enabling restricted access to streamed audio and video from campus machines is one possible solution to these issues, although there are copyright implications.

Scenario four : archival collections

The University of York houses one of the largest archival collections of historical material in the country, in the Borthwick Institute for Archives. The Borthwick are able to allow access to physical archival materials and have made provision for their preservation and description. Digital access would be of direct benefit for preserving these materials into the future. Finding aids for archival collections are complex, hierarchical documents and making these available online, alongside digitized text and/or marked up transcriptions can provide unprecedented levels of access for a wide user community. Other Departments across the University also hold archival collections, including the Firthian archive in the Department of Language and Linguistics. As a modern archive, this collection is at risk from paper degradation and at present is largely inaccessible to users. Providing digital access to this material would allow it to be used not only by the Language and Linguistics Department, but also by other disciplines.

Scenario five : video materials

Students studying child language development often use video, audio and transcription data in their research. There is an existing corpus of material documenting research carried out around 20 years ago. This material is currently stored remotely and players for the film reels are difficult to find. Using this material is thus virtually impossible for students. Digital access could enable use of a collection that is otherwise inaccessible.

Requirements

Requirements overview

The digital library project must be able to support the following high-level goals.

1. Providing robust and sustainable online access for digital resources
2. Building a critical mass of high quality digital materials from the University's collections to serve research, scholarship, teaching, and learning by assisting scholars and students from the University and elsewhere in the pursuance of their work
3. Supporting multi-disciplinary variations in usage and requirements whilst promoting cross-disciplinary use and re-use
4. Providing long-term, sustainable and managed storage for digital resources
5. Facilitating and promoting the creation of digital content
6. Supporting funding activities for further digital resource creation and digitization
7. Developing and setting standards
8. Providing advice and consultancy services for projects, for example on copyright, resource creation, digitisation and scanning.

User, functional and technical requirements

Priority Key: H = High priority; M = Medium priority; L = Low priority; I = Request for Information (RFI)

No.	Requirement	Key	Description
OAIS			
1.	OAIS-compliance	M	Should support the mandatory aspects of OAIS.
Information Model			
Metadata, packaging and data objects			
2.	File formats	H	Must accept and store any multimedia and text-based file format for storage, including compressed and uncompressed formats such as TIFF and WAV. *RFI: Please outline any limitations.*
3.	Metadata standards	H	As a minimum, the system must be able to import and export simple Dublin Core records.
4.	Other metadata standards	M	The system should support additional metadata standards, for example Dublin Core application profiles, VRA, CDWA, PREMIS, PBCORE, LOM, MPEG-7 and other XML-based metadata formats. Should be extensible for new schemes.
5.	Complex metadata structures	M	Should support rich, complex, structured metadata, such as hierarchies) and multi-entity description sets.
6.	RDF metadata	M	Should support RDF-encoded metadata creation, e.g. for use by semantic Web applications, and storage, e.g. in an rdf triple store.
7.	XML metadata	M	Should support XML-encoded data, for metadata exchange.
8.	Custom metadata profiles	H	Must support the extension of metadata profiles with customised schemes both for internal use and for export and import.
9.	Custom metadata views	M	Should support the ability to provide multiple custom 'views' of metadata for different user roles and content types, both for deposit and access.
10.	Metadata types	M	Should support the capture of metadata for different purposes, such as administrative, preservation, technical, descriptive and rights metadata.
11.	Relationship typing	H	Must support an extensible set of relationship types between metadata resources/objects; examples might include part/whole, child/parent relationships or citations. These rela-

			tionships may be captured using RDF.
	External relationships	L	Should support relationships between internal and external resources; examples might include a citation between a resource in the digital library and a publication held in White Rose Research Online.
	Automatic relationship typing	L	May support automatic suggestions for related items both at deposit and access.
12.	Metadata versioning	M	Should capture audit trails for metadata creation, identifying the users involved in metadata creation by session rather than by edit, with roll-back functionality.
13.	Packaging standards	H	Must support METS as a packaging standard for deposit, export and content management.
14.	Multiple packaging standards	M	Should support other packaging standards, such as IMS CP and DIDL and provide extensibility for new standards such as ORE resource maps.
15.	Mapping	H	Must support customisable mapping of metadata and/or package structure to internal data stores to ensure metadata or packages can be ingested or extracted.
16.	OCR	M	Should support OCR conversion of text-based images.
	Legacy formats	L	In storing legacy formats, the system may offer support for accessing these formats, such as emulation, alongside format migration and other techniques.
17.	Expressions	M	Should store multiple expressions (i.e. revisions or versions) of the same work, capturing relationships between expressions.
18.	Manifestations	H	Must allow for storage of multiple manifestations (i.e. same content, different file format or file size) and capture relationships between manifestations. For example, multiple file sizes for an image.
19.	Multiple formats	I	Outline how the system manages and delivers multiple expressions or manifestations, including how it manages the relationships between entities.
20.	Large file sizes	H	Must be able to deliver large high-quality audio and video resources on-demand. *RFI: What is the largest file size the system will support?*
21.	Point identification	M	Should support identification and tagging of specific points within, for example, an audio or video file, a section of an image, including providing an identifier for that point.
22.	Creation of new data objects	M	Should support creation of new data objects through cropping, annotating and interpreting data objects, for example by extracting a frame or scene from a video object.
Collection building			
23.	Collections	H	Must support collections. It must be possible to include resources in multiple collections, by reference, rather than by duplication.
24.	Hierarchical collections	H	Must support management and navigation of hierarchical collections, for example archival collections.
25.	Collection building	H	Must support on-the-fly collection-building by users. Should allow such collections to be saved for individual use or sharing.
26.	Annotation	M	Should support annotation of collections and individual resources by users, including annotation of marked points or areas, e.g. a section of an image.
27.	Compound objects	H	Must manage multi-object aggregations as a single resource or collection, with a persistent, unique identifier.
28.	Aggregations of external resources	M	Should support the creation of collections or aggregations from resources within and outside the system, for example a collection of images on a theme, which references images from externally-managed sources.

Subject access and name authority			
29.	Subject taxonomies or classification schemes	H	Must support standard taxonomies or classification schemes, for example library of congress subject headings or other subject-specific schemes.
30.	Name authority	H	Must support internal name authority and selection of names from an internally-generated list.
	Externally-managed taxonomies	L	May support integration with externally-managed taxonomies or name authority lists, either through access to external web services or through integration into the digital library system. Examples might include a subject-taxonomy managed externally where users can pick terms for inclusion in digital library metadata, with dynamic update.
31.	Multiple taxonomies	H	Must support use of multiple taxonomies, either externally or internally defined.
32.	Taxonomies by user type	M	Should support access to different taxonomies for different user roles, for example subjects-specific taxonomies.
33.	Custom taxonomies	H	Must support custom hierarchical classification schemes, for example based on University Departmental structure.
34.	Controlled term lists	H	Must support controlled term lists for any data element.
35.	Mapping subject terms and keywords	M	Should create mappings between synonymous keywords and subject terms, and name acronyms or pseudonymns.
	Auto-classification	L	May support automatic subject classification or suggested classifications.
36.	Keywords and tagging	M	Should support user-defined keywords or tagging.
	User tagging	L	May support user of user-generated tagging to generate tag clouds or other lightweight mechanisms for browsing.
Identification			
37.	Unique identifiers	H	Must support the creation of unique identifiers (HTTP URIs)
38.	Resolvable identifiers	M	Identifiers should resolve to an appropriate representation of the resource identified. Example resource might include physical, digital and conceptual resources, e.g. metadata records, data files and people.
39.	Persistent identifiers	H	Identifiers must be persistent and should support the W3C guidance on Cool URIs (http://www.w3.org/Provider/Style/URI). Mechanisms must be in place for dealing with changes of location and deletions. For example a logical human-readable explanation should be returned for a deleted resource, rather than a HTTP error code.
40.	Human-readable locators	M	Should support the use of human-readable locators. These may exist alongside the unique identifier for the resource; may resolve to the same resource, but they do not have to persist in the same way as the identifiers.
41.	Identifier schemes	M	Should support a standard identifier scheme such as handle or doi.
42.	Other identifier schemes	M	Should support the use (and resolution) of other identifiers that may have been assigned to resources previously, for example doi, info.
	Identifier equivalence	L	May support the use of relationships to identify equivalent identifiers/locators/resources, for example owl:sameas.
43.	Deep linking	M	Should support deep linking from Blackboard VLE (including the reading list module and CMS) and from the Web.
Text mark-up			
44.	XML	M	Should support XML-encoded data formats. In particular, should support XML-based mark-up languages used for tagging text resources, for example TEI or EAD.

Functional Model			
Ingest			
45.	User deposit	H	Must support user deposit and metadata creation.
46.	Web deposit	H	Must support deposit through a Web-based user interface.
47.	Machine-agents as depositors	M	Should support machine-agents acting as depositors, for example through APIs.
48.	Deposit mechanisms	M	Should support standard interfaces for accepting deposit from remote tools and different mechanisms for deposit, for example emailed attachments, desktop drag and drop, web-based clients managed by other systems. Should support ATOM Publishing Protocol (SWORD profile) and/or WebDav.
	Multiple locations	L	May support deposit to multiple locations from a single deposit point, for example for deposit into the digital library and into a funding council's required repository, or deposit of a specific file type to the digital library and another to WRRO.
49.	Automatic metadata generation	M	Should support automatic generation of some metadata; examples might include deriving author name from University systems or document properties, capture of metadata from embedded image data, ID3 audio tags or use of remote metadata creation web services.
50.	Duplicate metadata	M	Should support duplicating metadata records for deposit of multiple similar objects.
	Spell checking	L	Should support customisable spell-checking of metadata, e.g. for certain metadata elements only, or should integrate with external tools.
51.	Duplicate checking	M	Should support duplicate or equivalence checking for resources already within the digital library.
52.	Bulk import	H	Must support bulk import of object and/or metadata; for example migrating a collection from another system.
53.	Deposit by-value	H	Must support deposit of binary data files.
	Deposit by-reference	L	May support deposit by-reference, i.e. ingest or obtain a file and/or package by supplying a URI. This may be extended to support ORE resource maps.
	Web archiving	L	May support Web archiving, for example grabbing a web page and associated files and depositing into the repository.
54.	Metadata only deposit	M	Should support deposit of metadata only, with references to externally-held data objects if available.
55.	OAI-PMH	M	Should support OAI-PMH for metadata harvesting. Should allow metadata format support beyond oai_dc.
56.	Integrity of deposit	M	Should support storage of the deposit package, as is and retrieval of this original package.
57.	Format checking	H	Must determine file format on deposit.
58.	File conversion	M	Should be able to perform automatic conversion of deposited files to storage formats, if desired.
59.	File re-sizing.	H	Must support customisable re-sizing, e.g. of images.
60.	File compression.	M	Should support customisable compression of audio/video.
61.	Validation	M	Should perform file and metadata validation on deposits, e.g. with checksums.
62.	CRUD	H	Must support Create, Retrieve, Update and Delete actions on deposits.
63.	Deletion and archiving	M	Should support deletion and archiving, both purging for permanent deletion (with support for dealing with orphaned URIs), and dark archiving (no further access).
64.	Rights clearance	M	Should support rights clearance tasks on deposit by offering integrated checking of licence repositories, Sherpa Romeo or similar.
Workflow			
65.	Workflow	H	Must support the specification of multiple workflows for metadata creation and deposit, based on user role. For ex-

			ample a deposit might go through a number of metadata creation stages with different users supplying different metadata, including quality control and buffer stages before items enter the live digital library.
66.	Mediated workflows	M	Should support mediated actions, for example deposit and creation of metadata by somebody working on behalf of the 'true' depositor, such as a Departmental secretary for an academic.
67.	Parallel workflows	M	Should support parallel workflows whereby a resource may be 'complete' in terms of its primary workflow but other users may add additional metadata streams, e.g. additional subject metadata or classification, additional of preservation metadata.
Access			
68.	Web accessible	H	Must be accessed via a Web-based user interface.
69.	HTTP download	H	Must support HTTP download of resources.
70.	Other delivery mechanisms.	M	Should support extensible delivery modes, including streaming and FTP.
71.	Image previews	H	Must be able to preview images for download, for example with thumbnails.
72.	Media previews	M	Should be able to preview multimedia files, for example with short video or audio clips, or still images.
73.	Access formats	M	Should support delivery of multiple dissemination formats derived from archival 'master' formats.
74.	Controlling formats	M	Should support control of format delivery by user role or user choice.
	Custom formats	L	Should support user customisation of default formats.
75.	Embedded metadata	M	Should support use of embedded metadata associated with data objects, for example by generating HTML link tags, ID3 tags or document properties.
	E-commerce	L	Should support sale of digital resources and access restriction to high quality versions reserved for sale.
76.	Bulk migration	H	Must support bulk migration of a customisable set of resources, including scheduled migration for example to a preservation service.
77.	Export	H	Must support the export of search results in XHTML.
78.	Customised exports	M	Should support user-defined exports in XHTML and other formats (RDF, XML, bibliographic citation formats, Dublin Core) for use in other applications, for example XHTML fragments for inclusion in a personal web site or CV.
79.	Syndication	H	Must support ATOM or RSS syndication. Feeds should be customisable, for example for popular records, user-defined saved searches, search results.
80.	Image tools	M	Should support tools for accessing images, to support the following features: image viewing, pan and zoom, scrolling, multiple image selection and sorting, image comparison, scaling and measurement.
81.	Presentation tools	M	Should support tools for building presentations or online exhibits from heterogeneous digital library contents, including addition of annotation and contextualisation. Should support output of presentations to standard formats such as Microsoft Powerpoint.
	Query by example	L	May support interactive tools for querying and sampling different formats, for example audio analysis tools for finding instruments or sections of a piece of music.
82.	Ease of use	H	Must offer intuitive and easy to use interfaces for access. *RFI: Provide evidence to support this.*
83.	Personalisation	M	Should support personalisation of interfaces for authenticated users, including saved searches and collections, stored de-

			faults, e.g. for formats, search alerts (via ATOM or RSS) and export functions.
84.	Public interfaces	H	Must support a public user interface.
85.	Alternate formats for user roles	H	Must support the delivery of different formats depending on access controls and user roles, for example streamed content and downloadable content.
Search			
86.	Collection search	H	Must support search across all collections, selected collections and individual collections.
87.	Fielded and advanced search	H	Must support advanced search features. Advanced search must be customisable to any combination of metadata elements, e.g. artist, author, subject, keywords, dates etc.
88.	Search filtering and sorting	H	Must support filtering of search results, e.g. by resource type or date. Should support user customisation or personalisation of search results display, e.g. by date or relevance.
	Custom search	L	Should support custom advanced search features for different collections.
89.	Search operators	M	Should support use of standard search operators, such as boolean, truncation, phrases and proximity.
90.	Search methodology	I	*RFI: Outline how your search facility functions, including how search results are ranked and displayed, whether there is de-duplication, highlighting of search terms etc.*
91.	Cross-search	H	Must support cross-search of external collections, using a recognised search standard such as Z39.50, SRW/U or SPARQL.
	Spell checking	L	Should support spell checking of search terms, if desired.
92.	Synonym suggestions	M	Should support synonym suggestions for search terms.
93.	Alternative searches	M	Should provide suggestions for alternative searches where both zero or large results sets are returned.
94.	Browsing	H	Must support browsing by taxonomy or specific metadata elements, for example resource type.
95.	Browse and search	M	Should support a combination of browse and search, e.g. search within a sub-section, browse by specific metadata elements in search results.
Accessibility			
96.	Accessible interfaces	H	Interfaces and access tools must adhere to SENDA legislation and to accessibility legislation.
97.	Accessible formats	H	Must support the delivery of accessible formats, for example for visually impaired users.
98.	Role-based accessible formats	M	Should support the delivery of accessible formats based on stored user information, e.g. by making a transcription available automatically to a visually-impaired user.
Administration			
Access control			
99.	Access control by role and group	H	Must support access control based on a customisable set of user roles (student, staff, administrator etc.) and groups (course, Department, research group, Institution).
100.	Access control by time/date	M	Should support access control based on date/time, for example for embargoed materials, but also for video clips where restrictions on use might specify that they are only accessible for a period of time to a specific role/group.
101.	Access control by object or collection	H	Must support access control based on individual object, object type or system-selected collection.
102.	Access control by machine agent	M	Should support sharing of access control and user role data between systems. For example, with the Yorkshare VLE.
Other administrative functions			
103.	Administrative	H	Must support administrator roles for enhanced access to ad-

	roles		ministrative functions.
104.	Delegated administration	H	Must support delegation of administrative rights to users within specified domains or collections, including delegation of administrative responsibility to a Departmental representative or digitisation project manager.
105.	Policy creation	M	Should support policy creation and any relevant mark-up languages for policy encoding.
106.	Policy administration	M	Should support policy administration and applying policies to deposit and access processes.
107.	Statistics	H	Must generate statistics for usage, deposit, access, download and a range of other aspects.
108.	Rights management	H	Must support repository licences and rights metadata and support use of creative commons licences for materials.
109.	Web-based interface for admin	H	Must provide web-based access for performing routine systems and administrative tasks.
110.	Customisation of administrative functions	M	Should support web-based customisation of administrative interfaces and functions
111.	Global editing	M	Should support bulk editing of system data, by administrators.
Training and support			
112.	Training	M	The supplier should be able to provide comprehensive initial training for all key role-holders within the system e.g. administrators, template designers, authors. *RFI: Describe the training available.*
113.	Documentation	H	Comprehensive documentation must be supplied for all relevant aspects of the system and for all key role-holders within the system e.g. administrators, template designers, authors. *RFI: List the documentation delivered with the system.*
114.	Documentation re-use	M	The University should be able to re-use the vendor's documentation in locally developed materials at no extra cost.
115.	Online help facilities	H	The system must provide online help facilities.
116.	Context-sensitive help	M	The online help facilities should be context-sensitive.
	Customisable help	L	The online help content should be customisable.
117.	Product support	H	Comprehensive product support must be available.
118.	Support during working hours	M	Responsive help desk support should be available during normal UK working hours.
119.	Online fault-logging system	M	The supplier should provide an online system for problem/fault/query logging and tracking.
120.	Support model	I	*RFI: Describe your support model.*
121.	Customer user groups	M	Customers should have access to active user groups and forums for the higher education/public sector, which influence product development and enhancement. *RFI: Provide a list of the user groups and forums.*
Preservation Planning			
122.	Preservation planning	I	*RFI: Provide information about the strategy with regards digital preservation.*
123.	Preservation tasks	M	Should support preservation actions on deposited packages, for example format migration. This may be performed by integration with existing tools or services.
	Scheduled preservation	L	May support scheduled preservation actions, for example format migration.

124.	Preservation alerts	M	Should support automated preservation warnings.
Data Management			
125.	Real-time indexing and updating	H	Must support real-time indexing and updating of the database, including immediate access to 'live' records.
126.	Full-text indexing	M	Should support full-text indexing of text resources.
127.	Provenance and auditing	H	Must retain provenance information and audit trails for deposited objects and metadata.
128.	Logging search queries	H	Must provide detailed statistics for searches, including searches returning no results, searches specific numbers of results, popular search terms etc.
Technical			
Infrastructure			
129.	Future proofing	M	Should support a flexible data model to enable future integration and development.
130.	Open standards	H	System must have an open standards based architecture.
131.	Application architecture	I	*Describe the software architecture, identifying key components and their inter-relationship. Indicate which components are core and which are optional. What programming language(s) is the system developed in?*
132.	Supported platforms	H	The system must run under one of the following operating systems: a) Solaris 10 or later (SPARC or x86) b) Windows Server 2003R2 or later *RFI: Provide a list of the platforms and operating environments that are supported by the system, giving full release details (e.g. Solaris 10 11/06). Indicate any significant differentiation in functionality of the system across supported platforms/environments.*
133.	Virtualisation support	M	The system should be supported when running on virtualised hardware, such as VMWare or Solaris Zones. *RFI: Give details of your support for machine virtualisation. Indicate any differences in support between virtualised and non-virtualised hardware.*
134.	Content storage	I	*Describe how the system stores content. E.g. in a file system, in an object database, a relational database or some hybrid?*
135.	Supported databases	H	The system must support one or more of the following for core database functionality (if required): a) Oracle 10g or later (preferred) b) SQL Server 2000 or later c) MySQL 4 or later *RFI: Provide a list of the databases that are supported by the system, giving full release details (e.g. Oracle 10g R2).*
136.	Networked filestore support	H	Any filestore-based content must be stored using networked filestore. The system must support this technology.
137.	NFS/CIFS file access support	H	Filestore-based content must be accessible directly using NFS and/or CIFS
138.	Clustering	H	The system must support clustering (for load balancing and failover) at the application, database and filestore layers. (eg if the system supports Oracle then it must support Oracle RAC). *RFI: Describe the system's support for clustering.*

139.	Load-balancing support	M	The University uses F5 load-balancing technology. The system's clustering features should integrate with this technology.
140.	Availability during upgrades	M	Most routine systems maintenance operations, including upgrades, should be able to be carried out without disrupting the service to users. *RFI: Describe how system availability is maintained during scheduled maintenance e.g. application of patches and installation of upgrades.*
141.	System monitoring	H	The system must provide facilities to monitor its overall health and thereby predict or detect failures. *RFI: Describe the system monitoring capabilities.*
142.	High performance/availability	I	*Describe any other high performance/availability features of the system*.
143.	Scalability	H	The system must be incrementally scalable to meet changing processing load and content storage demands.
144.	Configurations	I	*Provide the recommended hardware and software configurations for the following profiles:* *10,000 content items* *100 Gb total content (raw - not incl. metadata/system)* *10 simultaneous active depositors/depositing agents* *200 simultaneous active consumers* *high availability* *1 million content items* *10 Tb total content (raw - not incl. metadata/system)* *50 simultaneous active depositors/depositing agents* *1000 simultaneous active consumers* *high availability* *On both cases indicate expected response times to typical user activities*
145.	Backup and recovery	I	*State the recommended approach to backup and recovery, including the impact on performance and application availability.*
146.	Authentication	H	The system must be able to authenticate users against the University's Sun iPlanet LDAP service. *RFI: Describe how the system authenticates users.*
147.	SSO Integration	M	The system should be configurable to work with single sign on technologies such as CAS (http://www.ja-sig.org/products/cas/).
148.	Federated access control	M	The system should be configurable to work with Shibboleth federated access control technology (http://shibboleth.internet2.edu/).
149.	Data security (SSL)	H	SSL must be configurable for all security-critical data exchanges into and out of the system (including file upload and LDAP).
150.	Password security	H	Copies of user passwords must not be stored on the persistence layer of the system.
151.	Clustered session management	H	The system must support session management in a clustered environment. *RFI: Describe how the system supports session management, including what and how session details are held on the client. State how this is handled in a clustered*

			environment.
	Failover session management	L	The system should be able to maintain user sessions under application server failure. This requires that session data is accessible from multiple servers in the cluster.
152.	Browser support	H	All of the system's built-in web pages (including the interfaces for administration and authoring) must be browser-independent and must be fully usable in at least the following browsers, with no loss of functionality: Internet Explorer 6.0 or greater Firefox 1.5 or greater Safari 2.0 or greater Opera 8.5 or greater Where suitable browser releases are available, it must be possible to use these on at least Windows 2000/XP, UNIX/Linux and Mac OS X. *RFI: State your browser support policy.* *Give details of your current browser/platform support matrix. This must include version information.* *Highlight any differences in functionality across the platform combinations in respect of administration, publishing and general viewing.* *List any dependencies on plugins, helper applications, etc.*
Integration and Customisation			
153.	External role data	H	The system must be able to read and use role data from the University's corporate systems in the assignment of privileges to users. This role data encapsulates information such as who is a student, who is staff in a particular department. The information is stored in a variety of relational databases and LDAP directories. *RFI: State how the system would integrate with such sources, including how it would keep track of external changes to source data.*
154.	Data from external datasources	H	The system must provide facilities to integrate data from external sources, e.g. relational databases, into system-managed content. *RFI: Describe any built-in capabilities (e.g. scripting languages) to facilitate this.*
155.	SMTP and IMAP integration	H	E-mail integration with the University's central SMTP service is required for workflow notifications etc. If for any reason it is necessary to poll mailboxes, the system must also be able to integrate with the University's central IMAP service. *RFI: Describe the system's e-mail functionality covering the above points. List any reliance on specific mail technologies external to the system.*
156.	Anti-virus integration	H	The system must integrate with or incorporate antivirus software to protect against viruses being uploaded in content.

			RFI: Describe how the system meets this requirement and how updates to the virus database are handled.
157.	Application Programming Interface (API)	H	The system must provide fully documented and fully supported APIs to allow integration with external systems. These must allow access to content datastreams and metadata stored within the Digital Library and control of workflow. *RFI: Provide details of the supported API(s), indicating in each case whether the access is read-only. Also describe the technology in which the API may be implemented (e.g. web services or Java), and the security context for the use of the APIs.*
158.	OKI Repository OSID support	M	The system should support the Open Knowledge Initiative (OKI) Open Service Interface Definition (OSID) for a Repository. http://plectrudis.mit.edu/okicommunity/filemgmt_data/files/OSID_Repository_rel_2_0.pdf. This defines an open standard API for accessing content stored within a repository.
159.	VLE integration	M	The system should integrate with the Blackboard VLE. *RFI: Please outline how this system could integrate with Blackboard Academic Suite 7*
160.	OpenURL integration	M	The system should integrate with OpenURL link servers. *RFI: Please outline how this system could integrate with Ex Libris SFX*
161.	Metasearch integration	M	The system should integrate metasearch tools. *RFI: Please outline how this system could integrate with Ex Libris MetaLib*
162.	Software licensing	H	The University of York requires a software licence supporting all users of the system engaged in: The administrative, learning, teaching, research and community service functions of the University Collaborative projects such as research with other bodies (e.g. universities, medical schools, teaching hospitals and government agencies)
163.	Licensing model	I	*Describe the licensing model for the system and, in broad terms the way this is implemented.*
164.	Third-party licenses	I	*Itemise any third party licenses that would be required for the system in the York University environment. Only those licenses directly related to the base-level operating system may be excluded from this list.*
165.	Separate testing/training/development systems	H	The licensing model must support the use of separate test systems for trying out new materials and software releases. *RFI: Describe how this is supported.*
166.	Failover hardware	I	*Identify any licensing implications should it be desired to run the software on alternate hardware in the event of a server failure.*
167.	Overall product development	I	*RFI: Describe the product development path for the system, identifying the primary development platform(s) and describing the procedure for porting to other supported platforms. Any delays to the release for platform ports must be detailed. The supplier should demonstrate a well managed product development and enhancement environment that is accredited*

			to industry quality standards.
168.	Maintenance and enhancement	H	The supplier must meet the following requirements: Regular product maintenance, development and enhancement. Provision of comprehensive advance information and training on new and changed features appearing in upgrades. Enhanced supplier support during and after upgrades. Automatic notification of patches and fixes. Advance product lifecycle warning notices, e.g. withdrawal of support for a particular database version. *RFI: Detail any differentiation in support levels for the different platforms, e.g. Windows vs. Unix.*
169.	System and application housekeeping	I	*RFI: Detail the facilities provided for routine system administrative housekeeping, including* *The roles involved* *When the tasks must be performed* *The degree of automation available* *Identify any activities by administrators that would require direct access to any underlying database and or operating system.*
170.	Skill set	I	*RFI: Describe the skill set required for the key management roles within the system, e.g. administrators, template developers.*
171.	Implementation support	M	Suppliers should demonstrate that they have a well developed and tested implementation support programme: Preferably with experience of implementing their system within the higher education or public sector; With support facilities provided for the period before, during and following installation. *RFI: Describe the implementation process and give details of typical implementation support and timescales.*
172.	JISC and Community projects	I	*RFI: Pleases describe any involvement in JISC development projects. Also outline involvement in other externally-funded or community-led projects.*

Appendices

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