

JISC DEVELOPMENT PROGRAMMES

Project Document Cover Sheet

JISC IEMSR PROJECT PLAN

Project

Project Acronym	IEMSR	Project ID	
Project Title	JISC IE Metadata Schema Registry		
Start Date	2004-01-01	End Date	2005-06-30
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Contributing Institutions	CETIS Becta		
Project Web URL	http://www.ukoln.ac.uk/projects/iemsr/		
Programme Name (and number)	JISC IE Shared Services		
Programme Manager	Helen Hockx		

Document

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Document History

Version	Date	Comments
V01	2004-01-01	Initial draft
V02	2004-03-29	Revised draft

2. Background

This is a proposal to build a JISC IE Metadata Schema Registry as a shared service within the JISC Information Environment (JISC IE). The Schema Registry will act as the primary source for authoritative information about metadata schemas recommended by the JISC IE Standards framework. The Registry will be targeted at the spectrum of education communities, aiming to provide a service sufficiently generic to handle schema based on both the Dublin Core and IEEE LOM

Metadata within the JISC IE is based largely on two key standards - Dublin Core (DC) and the IEEE Learning Object Metadata (IEEE LOM). The MEG Registry project, funded by JISC and Becta in 2002, developed RDF-based registry and schema creation tools. These tools were readily usable with Dublin Core but less so with the more hierarchical model of IEEE LOM. The JISC IE Metadata Schema Registry will re-engineer the MEG software to accommodate the IEEE LOM format, supporting ongoing cooperation between the Dublin Core and IEEE LOM standardisation communities.

The Registry will provide the JISC IE with a single point of referral for recommended schemas. It will allow various initiatives within the JISC IE to publish application profiles in a common registry, making them available to others. This provides a concrete way of encouraging sensible uniformity alongside necessary divergence. It helps avoid unnecessary duplication of effort, and supports sharing of common approaches.

The JISC IE Metadata Schema Registry will build on previous work in the DESIRE, MEG and CORES projects which have explored provision of information about metadata at the level of data elements, element sets or application profiles. The emergence of Semantic Web and Web Services technologies has encouraged the structured representation of element sets as machine-readable schemas that can be manipulated by software tools.

3. Aims and Objectives

The overall aim of metadata schema registries is to provide users, human or software, with the means to navigate and access schemas. A managed schema registry becomes an authoritative source for information about metadata, and an access point to schemas for re-use. Establishing a pilot Metadata Schema Registry will leverage previous work by project partners in this area, and will progress setting up a shared infrastructure for the JISC IE. The benefits of metadata schema registries are in summary:

- Promotion of existing metadata schema solutions
- Increased interoperability between schemas as a result of re-use across applications
- Less duplication of effort amongst implementers
- Managed evolution of schemas
- Encouragement of harmonisation between 'competing' standards

The project will deliver Web based tools that will allow people to browse existing schemas and application profiles based on DC and IEEE LOM, and to create new applications profiles.

The registry will also provide interfaces to allow software applications to query the registry, including the capacity to discover XML Schemas and/or RDF schemas associated with application profiles.

4. Overall Approach

4.1. Strategy

The Schema Registry will build on the MEG Registry work but significantly develop and enhance the software and user interface to accommodate the IEEE LOM model. This work will be carried out with a view to accommodating other metadata schemas in future, if this proves feasible.

4.2. Methodology

Initial development will be based on recommendations emerging from evaluation of the MEG registry. These included enhancements to the data model and improved usability. Further work will be required to gather user requirements. This will be done in collaboration with CETIS and Becta who will facilitate access to learning and education communities, and with selected JISC projects and services. The project will achieve its objectives by undertaking work

- To gather user requirements from the education and digital library communities, with support of user organisations (Becta, CETIS, identified JISC services).
- To refine the DC/RDF data model underlying the registry and schema creation tool, with a view to supporting the IEEE LOM hierarchical model, taking into account user requirements.
- To specify enhancements to the registry and schema creation tool software according to the new data model.
- To specify improvements to the usability and presentation of the CORES schema creation tool and registry based on user requirements.
- To collaborate with applications within digital library and education communities to demonstrate m2m use of registry, with support of user organisations (Becta, CETIS, identified JISC projects and services).
- To collaborate with other schema registry and ontology activities to explore common approaches, solutions and to track developments.
- To draw up a policy framework for the registry addressing quality assurance, persistence and content.
- To organise a workshop targeted at potential users of the registry, exploring the role of schema registries, connections with other registry and directory activity.

4.3. Issues to be addressed

Various issues emerged from previous work within the MEG project which will need to be addressed by the JISC IEMSR project. Firstly, the ***need for descriptive information about schemas and application profiles***. Users require basic information about domain areas in which a schema or application is used, details of deployment, links to documentation, available versions etc.

More significantly it emerged there were ***difficulties in accommodating DC and IEEE LOM metadata formats in one registry due to differences in their underlying models***. The constraints of the MEG registry data model and RDF binding meant that much of the hierarchical aspects of the IEEE LOM element set were stripped away and represented within the MEG registry by a 'flattened' model. The JISC IE Metadata Schema Registry is intended to provide users with human readable Web pages about both DC and IEEE LOM schemas and application profiles, with links to appropriate XML schemas. This means the registry will need to be sufficiently expressive to reflect the structure of both IEEE LOM and DC schemas.

There is a ***requirement to point from application profiles to existing external XML schemas***. Many applications are based on XML, and IEEE LOM metadata applications in the JISC IE typically use an XML binding. Although a registry based on RDF can provide required semantics, applications may require a link or pointer to an XML schema.

There is a ***need to enhance the schema creation tool***. Within the initial DESIRE project, UKOLN staff created entries themselves for schemas in the registry. This is not a scaleable solution in the longer term. The MEG project developed a schema creation tool to be used in an interactive way with the MEG Registry. Initial evaluation of this tool indicated that usability could be improved, and that schema creators require support in the form of documentation and workshops.

4.4. Scope and boundaries of work

The project is not intended to include comprehensive registration of 'controlled vocabularies' and subject schemes, the focus will be on describing controlled vocabularies associated with registered application profiles. Experience of establishing a Metadata Schema Registry should inform any future plans for registering controlled vocabularies and subject schemes, and should contribute to forward thinking regarding a JISC IE registry for terminology services.

4.5. Critical success factors

Set achievable scope to project ambitions.

Ensure user expectations are realistic.

Establish good communication with potential users to achieve effective requirements gathering.

Prioritise functional requirements to ensure realistic software development schedule.

Work towards establishing a sustainable service.

Adopt standards-based approach.

5. Project Outputs

The deliverables as outlined in the proposal are:

5.1. Enhanced data model

Based on the MEG data model, the project will produce an enhanced data model to incorporate the more hierarchical structure of IEEE LOM. The data model will include 'schema' as an entity and a pointer from application profiles to relevant XML schema

5.2. Metadata Schema Registry

A schema creation and registration tool will be developed by ILRT according to the functional specification produced by UKOLN. The tool will enable distributed creation of schemas for DC and IEEE LOM element sets and application profiles either in a standalone fashion or in interactive mode with the MEG registry. The registry will provide information about schemas and application profiles as well as indexing the schemas and application profiles.

5.3. Schema creation facility

The usability and presentation of the schema registration tool as a desktop application will be considered. The existing Java based MEG schema creation tool may not be suitable for creation of IEEE LOM Application profiles.

5.4. Demonstrate m2m usage of registry

A Registry API will enhance the use and re-use of information stored in the registry and provides easy programmatic access to the information at a software level. It will enable applications within the JISC IE to query the registry, locate and download schemas. Provision of a registry API also means that the registry and creation tool can be weakly coupled, so that either the client or server can be replaced or improved independently.

5.5. Validation service case study

The potential of a validation service will be explored, with a view to implementation at a later phase of development. This service would allow users of the registry to upload an application profile of their own creation, and have it checked and validated according to other registered schemas.

5.6. Registry policy framework

In order to encourage confidence in the registry policies are required regarding persistence of the registry service and schema content, collection scope and quality assurance

While acknowledging that a number of policy issues are more relevant to a 'production' registry, concerns about persistence are particularly significant even at the pilot stage. Schema creators and system developers do not feel able to commit any significant efforts to creating and registering schemas unless they have confidence in continuance of the registry. In order to commit time to gaining familiarity with the tools they need some assurance regarding future maintenance of the registry service, and future management of the content of the registry.

5.7. Guidance materials

Schema creators will need training and guidance materials to express their information models in a common form. The project will support users with guidance materials.

5.8. Evaluation report

An interim evaluation report will be produced by an external consultant mid-project.

5.9. Open source software maintenance

Software will be managed by ILRT in a centralised open source software environment such as SourceForge. SourceForge provides support management tools (Tracker) and release management using a Web-based file release system. Software will be made available using an appropriate licence.

6. Project Outcomes

List the outcomes you envisage, including their impact on the teaching, learning, or research communities, and what change they will stimulate or enable.

Within the context of the JISC IE, an effective infrastructure for management of metadata is vital for cost effective delivery of services. A registry service is a basic 'middleware' component for metadata management and it is important that the major funding bodies take a lead in the development of such a service.

The intention is that the less tangible outcomes of the project will be

- DC and IEEE LOM communities working more closely together
- Less duplication of effort amongst implementers
- Promotion of existing metadata schema solutions
- More clarity regarding the Application Profile model
- Support for implementers to construct 'well-structured' Application Profiles

Development of the JISC IE Metadata Schema Registry will be of interest to other organisations that are establishing schema registry as a means to enable re-use and interoperability between schemas. The project will be pro-active in collaboration with other registry activities such as

- DCMI distributed registry (Rachel Heery, UKOLN, co-chairs this activity and there are existing implementations at OCLC; University of Goettingen, Germany; ULIS, Tsukuba, Japan; UKOLN)
- OAI registry (Jeff Young, OCLC)
- SIMILE project (Andy Seaborne, HP Labs Bristol)

Both CETIS and UKOLN have been involved in European workshops supported by CEN/ISSS (European Committee for Standardisation - Information Society Standardization System). Rachel Heery at UKOLN has co-authored a CEN Working Agreement 'DCMI Application Profile Guidelines'¹ which will inform data modelling work within the Registry.

7. Stakeholder Analysis

List key stakeholder groups and individuals that will be interested in your project outcomes, will be affected by them, or whose support/approval is essential, both within your institution and in the community, and assess their importance (low/medium/high).

Stakeholder	Interest / stake	Importance
JISC IE Shared service programme	Effective development of infrastructure services	High

¹ Baker, Thomas *et al.* Dublin Core Application Profile Guidelines.Final draft CWA September 2003
<<ftp://ftp.cenorm.be/public/ws-mm-dc/mm-dc076.zip>>

CETIS	Disseminate information about IEEE LOM standard, IEEE LOM UK Core and derived application profiles	High
DCMI UK Affiliate (proposed)	Disseminate information about Dublin Core terms, and DC application profiles Interest in relation between IEMSR and DCMI Registry	High
Becta	Interest in role of registries to facilitate effective re-use of schemas, interest in role of registries for quality assurance	High
Metadata schema creators and maintainers within JISC projects and services using (application profiles of) the DC and IEEE LOM standards	Requirement for easy access to information about existing schemas and application profiles	5 High
Commercial suppliers of software products and services to JISC IE projects and services.	Requirement for access to machine readable schemas and application profiles deployed within JISC IE	High
Potential users of 'JISC IE shared infrastructure services' within JISC projects and services	Requirement for access to machine readable schemas and application profiles deployed within JISC IE Requirement to 'publish' machine readable schemas and application profiles used within implementations	High
Wider DC community	Interest in functionality of schema registries	Medium
Wider IEEE LOM community	Interest in functionality of schema registries	Medium
Other registry activity	Interest in collaboration	Medium

8. Risk Analysis

List factors that could pose a risk to the project's success, assess their likelihood and severity, and how you will prevent them from happening (or manage them if they if they occur). Cover the types of risks listed and any others that apply.

Risk	Probability (1-5)	Severity (1-5)	Score (P x S)	Action to Prevent/Manage Risk
Staffing (recruitment and turnover)	3	4	12	Flexibility regarding schedule, alert programme manager early
Complexity of finding common data model to fulfil requirements across DCAPs and IEEE LOM APs	5	4	20	Set realistic scope, prioritise requirements to ensure useful deliverable within timescale of project
Lack of consensus on models for DCAPs and LOM APs	4	4	16	Set realistic scope
Unable to offer solution acceptable to IEEE LOM implementors	3	4	12	Negotiate with CETIS
Complexity of software development required	3	4	12	Review and monitor progress

9. Standards

References to standards the project will be using can be found alongside references to additional background documentation on the project web pages see

<http://www.ukoln.ac.uk/projects/iemsr/background/>

Specifications that will be used to inform description of schemas and application profiles include:

RDF Vocabulary Description Language 1.0: RDF Schema (W3C Recommendation)

<http://www.w3.org/TR/2004/REC-rdf-schema-20040210/>

RDF Concepts and Abstract Syntax (W3C Recommendation)

<http://www.w3.org/TR/2004/REC-rdf-concepts-20040210/>

RDF/XML Syntax Specification (Revised) (W3C Recommendation)

<http://www.w3.org/TR/2004/REC-rdf-syntax-grammar-20040210/>

RDF Semantics (W3C Recommendation)

<http://www.w3.org/TR/2004/REC-rdf-mt-20040210/>

OWL see WebOnt Tech Reports

<http://www.w3.org/2001/sw/WebOnt/>

XML Schema

The scope of the IEMSR will be the two standards for resource description recommended by the JISC and application profiles associated with those standards that are deployed within the JISC and wider education community:

Dublin Core Metadata Element Set, Version 1.1: Reference Description

<http://dublincore.org/documents/dces/>

DCMI Metadata Terms

<http://dublincore.org/documents/dcmi-terms/>

Expressing Simple Dublin Core in RDF/XML. (DCMI Recommendation)

<http://dublincore.org/documents/dcmes-xml/>

Expressing Qualified Dublin Core in RDF/XML. (DCMI Proposed Recommendation)

<http://dublincore.org/documents/dcq-rdf-xml/>

Guidelines for implementing Dublin Core in XML. (DCMI Recommendation)

<http://dublincore.org/documents/dc-xml-guidelines/>

IEEE Standard for Learning Object Metadata (Approved Publication of IEEE)

<http://ltsc.ieee.org/wg12/par1484-12-1.html>

Standard for XML binding for Learning Object Metadata data model (Modified Revision Project)

<http://ltsc.ieee.org/wg12/par1484-12-3.html>

Standard for Resource Description Framework (RDF) binding for Learning Object Metadata data model (New Standard Project)

<http://ltsc.ieee.org/wg12/par1484-12-4.html>

UK Learning Object Metadata Core

<http://www.cetis.ac.uk/profiles/uklomcore>

RDN/LTSN LOM application profile

<http://www.rdn.ac.uk/publications/rdn-ltsn/ap/>

UK Common Metadata Framework Draft X4L Application Profile

http://www.cetis.ac.uk/profiles/uklomcore/ukcmf_x4l_v0p2p2.doc

TOIA-COLA Assessment Metadata Application Profile v1.2

http://www.cetis.ac.uk/profiles/uklomcore/toia cola_metadata_v1p2.doc

The project will strive to follow good practice regarding accessibility standards and guidelines, for example by following HTML W3C html 4.01 (<http://www.w3.org/TR/1999/REC-html401-19991224/>) and using W3C WAI guidelines to double A conformance (<http://www.w3.org/WAI/WCAG1AA-Conformance>).

9. Technical Development

The technical development will follow the open source development model, using existing software from the MEG and CORES projects along with appropriate third party open source code. The development will be done in the open with public access to the source code and project information. This work will be done using the SourceForge project services, via the project already registered in 2003 for open source RDF schema registry and client software development. SourceForge provides CVS access, mailing lists, bug and issue tracking and other services for developing software under open source licenses.

The development will follow the standard practice of gathering user requirements leading to a specification of functional and non-functional requirements. These will be used to derive technical requirements that will drive the choice of software and use of other open source materials. The development will proceed with the partners having equal access to the CVS area and use the bug and issue tracking to deal with problems. After the releases, these trackers can be used to review the issues arising and update the software for later releases.

10. Intellectual Property Rights

IPR in any software delivered by the project will be assigned according to the Consortium Agreement. All software delivered by the project will be covered by an OpenSource Licence. IPR in the content of the registry (schemas, application profiles, annotations) will remain with the creators. No additional IPR issues are envisaged.

11. Project Partners

Core Partners

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Consortium agreement in preparation, schedule to be signed by end-March 2004.

12. Project Management

The JISC IE Metadata Schema Registry will be project managed by Rachel Heery at UKOLN. Project administration will be carried out with the assistance of Jenny Taylor working as a Project Assistant. Project management will be based on the JISC development programme guidelines. UKOLN will be responsible for monitoring activities to ensure proper execution of the work programme to schedule and budget. Project management techniques will be of a relatively modest level of complexity, in keeping with the scale of the work involved,

Communication: email, phone conferences, private web pages
Project meetings: regular meetings
Schedule: Gantt chart
Budget: interim reports

13. Programme Support

The IESMR is positioned within the JISC IE Shared Service programme. It would be helpful for the JISC programme manager to ensure there is good communication between projects within this programme, and between this programme and the wider JISC project community. Cross programme meetings will be useful means to achieve this. As the IEMSR will potentially offer 'infrastructure services' it would be useful for the programme manager also to encourage communication between IEMSR and appropriate JISC services. Perhaps use of project outputs by services might be the topic of a themed meeting.

14. Budget

Use the budget template and attach the project budget as Appendix A. Explain any changes from the budget in the agreed project proposal.

15. Workpackages

Use the workpackages template to plan the detailed project work and attach as Appendix B. Clearly indicate project deliverables and reports (in **bold**), when they are due, phasing of workpackages, and explain any dependencies. You may also attach a Gantt chart, diagram, or flowchart to illustrate phasing.

See Appendix B

The project will run from beginning of January 2004 to end June 2005.

WP1 Project management

(Partners: UKOLN lead)

Project management and partner co-ordination will be provided by UKOLN and will be achieved by an initial project start-up face-to-face meeting with all partners, followed by quarterly project meetings. Communication between partners will be supported by a dedicated project discussion list and informal methods. Financial reports will be supplied by the UKOLN Resources Co-ordinator. Established project management procedures as recommended by JISC will be followed to ensure timely completion of deliverables and an effective outcome. Staff supervision will be provided by Rachel Heery at UKOLN, and Dave Beckett at ILRT.

WP2 Modelling and Usability

(Partners: UKOLN lead, CETIS, Becta)

UKOLN will lead requirements gathering in collaboration with CETIS, Becta and JISC projects and services. The focus will be to

- Define use cases for registry and schema creation
- Enhance Registry data model to accommodate IEEE LOM
- Specify RDF language for describing metadata schemas including IEEE LOM and DC Application Profiles
- Specify Web Interface requirements
- Specify m2m requirements

Early requirements will be gathered and fed into WP3, this will allow the technical development to proceed at an early stage in the project. There will be an iterative process which will inform development of an initial prototype which will be available in 3Q 2004 for a workshop of practitioners in the JISC/Becta/CETIS communities to be held in 1Q 2005. The workshop will inform any changes that are needed to the functional specification. A finalised functional specification will be delivered in month 2Q 2005.

WP3 Registry tools development

(Partners: ILRT lead, UKOLN)

WP3 will develop a complementary schema registry and schema creation facility that will support sharing and publishing of DC and IEEE LOM schemas and application profiles within the JISC IE. ILRT will build a Schema Registry Web Interface which will allow human users to create new schemas and Application Profiles and to browse and search existing application profiles

This functionality will be presented from a single user interface, although differences in underlying DC and IEEE LOM models will require different constraints in creating an IEEE LOM or DC application profile. The various options for software design may integrate the back-end database to a greater or lesser extent.

ILRT will develop m2m access to XML schemas associated with application profiles and to RDF schemas associated with application profiles where appropriate. The Registry machine interface will be developed to provide a Web Service API interface to the registry model for remote operation via standard mechanisms such as the Web REST architectural model and/or SOAP.

The technical work will also consider emerging Web developments in describing vocabularies with RDF and Web Ontologies such as the W3C Web Ontology Language (OWL) and how that effects enhancing the existing DC/RDF based registry. Existing software and standards will be used as far as possible and appropriate.

WP4 Demonstration of m2m usage

(Partners: ILRT lead, UKOLN, Becta)

The project will identify and collaborate with applications within the JISC IE digital library and education communities to demonstrate m2m use of registry. This activity will be carried out with support of CETIS and Becta. (Becta, CETIS, identified JISC services).

WP5 Case study

(Partners: UKOLN lead, Becta)

A case study will be developed to consider the potential of an added-value validation service. This will take Becta requirements for validation and explore them by means of scenarios and use cases.

WP6 Policy and Guidance

(Partners: UKOLN lead, CETIS)

Policies will be drawn up regarding persistence of the registry service, collection scope and quality assurance.

Guidance materials will be created for metadata schema and application profile designers on how to build their schemas, how to create and register schemas in the Registry. The material will be in the form of guided instruction, online tutorials and a 'sand-box' implementation of the Registry environment.

WP6 will meet the requirements of *schema creators* by providing materials explaining the data model and the encoding of profiles in plain, accessible language, as well as online help related to the use of the tools offered around the Registry. WP6 will meet the requirements of *systems developers* by providing materials defining and documenting the Application Program Interface that can be used in their applications to access and download (fragments of) the schemas contained in the Registry

WP7 Evaluation

(Lead: UKOLN, all partners)

Project partners will identify appropriate performance indicators. Evaluation will be carried out by an external consultant. If practical, the external evaluation will be planned in conjunction with the workshop targeted at representatives from user groups. Final summative evaluation will be carried out by project partners and included in the final project report.

16. Evaluation Plan

Early within the development process project partners will identify the key benefits intended to result from the registry development, and will consider appropriate performance indicators. Budget has been set aside for evaluation to be carried out by an external consultant. The project will gain most from this formative evaluation if it can be carried out in stages or at least at mid-term, in order to inform further work. The external evaluation might usefully be done in conjunction with the workshop targeted at representatives from user groups. Final summative evaluation will be carried out by project partners and included in the final project report.

A more formal evaluation plan will be drawn up in collaboration with external evaluators.

17. Quality Assurance Plan

Explain the quality assurance procedures you will put in place to ensure that project outputs comply with JISC technical standards and best practice, and what will constitute evidence of compliance.

Timing	Compliance With	QA Method(s)	Evidence of Compliance
1Q 2005	Fitness for purpose, usability	Workshop	Feedback from users
Throughout	Best practice for processes	Follow JISC project management guidelines	Checklist
Throughout	Adherence to standards	Follow JISC IE standards guidelines	Cross check
Throughout	Accessibility legislation	Follow JISC IE Standards guidelines	Checklist
3Q 2004	Sound architectural design	Peer review	Identify reviewers as part of evaluation process
3Q 2004	High quality product	User testing (alpha and beta testing)	User testing report Track bug fixes

18. Dissemination Plan

Explain how the project will share outcomes and learning with stakeholders and the community. List important dissemination activities planned throughout the project, indicating purpose, target audience, timing, and key message.

Timing	Dissemination Activity	Audience	Purpose	Key Message
2Q 2004 onwards	News articles/ mailing lists	Practitioners, developers and information management specialists	Awareness raising	Overview, intended benefits of registry to community

1Q 2004 onwards	CETIS Metadata and Digital repository SIGs MEG meetings	Practitioners, developers and information management specialists within elearning communities	Awareness raising, identify potential Registry depositors and users	More detailed outline of Registry architecture and functionality. Benefits of registry to audience
3Q 2004	Workshop			
2Q 2004 3Q 2004 1Q2005	JISC All Project meetings		Awareness raising, identify potential Registry depositors and users	More detailed outline of Registry architecture and functionality. Benefits of registry to audience
1-2Q 2005	Conference paper	Research community	Awareness raising, future collaboration	Exploration of lessons learnt

19. Exit/Sustainability Plan

Explain what will happen to project outputs at the end of the project (including knowledge and learning). Focus on the work needed to ensure they are taken up by the community and any work needed for project closedown, e.g. preservation, maintenance, documentation.

Project Outputs	Action for Take-up & Embedding	Action for Exit
Project web pages	Publicise	Retain on UKOLN web site for 5 years
Knowledge and learning	Document on project web site and through dissemination channels	Ensure web site is up to date at project end
Registry service		
Registry policy documents		

List any project outputs that may have potential to live on after the project ends, why, how they might be taken forward, and any issues involved in making them sustainable in the long term.

Project Outputs	Why Sustainable	Scenarios for Taking Forward	Issues to Address
Software		Maintain on SourceForge	'Release manager' (with some effort) will be required to ensure coherent future management of the software
Registry service		Take forward within JISC IE framework	Ensure functionality is adequately developed, users will need to trust in continuation of service before they commit time to building well structured application profiles to be deposited in registry

9.1. Appendixes

Appendix A. Project Budget

Appendix B. Workpackages